

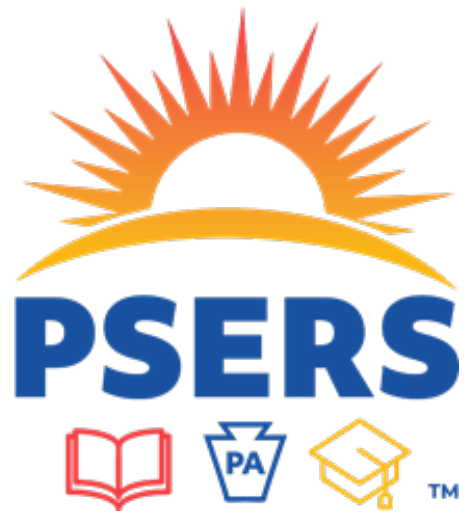
PSERS Budget Report

Fiscal Year 2020 - 2021



SECTION 3 - INVESTMENT INFORMATION

Investment Risk Management and Capital Market Assumptions.....	Tab 8
Asset Exposure and Investment Program Summary.....	Tab 9
Performance	Tab 10
Managing Investment Expenses and Investment Fees by Manager.....	Tab 11
Commitment to Pennsylvania-Based Investments	Tab 12



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Section 3 - Investment Information

Investment Risk Management

Risk management is essential to the entire investment process. The goal of investment risk management is to find the appropriate balance between expected returns and the risks taken to generate those returns. An entirely risk-free investment portfolio that has a high probability of meeting all investment goals does not exist. Therefore, PSERS does not attempt to eliminate all risk but instead seeks to limit the possibility of permanent loss. Risk itself is neither good nor bad, but it is necessary that the System expose itself to some appropriate level of risk if it is to generate the long-term investment returns required to maintain stable and cost-effective contribution rates.

The future is difficult to forecast with any accuracy or certainty, particularly changes in the economic and market environment but PSERS can understand the future as a range of probabilities, some desirable and some not, and can position its current investments to guard against undesirable outcomes and to make desirable outcomes more likely. In positioning

for future developments, PSERS cannot know with complete certainty how markets or particular investment strategies will perform. The strategic asset allocation mix, more than implementation or any other factor or decision, largely determines the portfolio's overall risk and return.

Given its long-term investment horizon, PSERS accepts prudent investment risk in exchange for acceptable levels of additional incremental return. PSERS' Board sets long-term asset allocation and risk parameters. The Investment Office implements investment policies within these approved guidelines. The Investment Office works closely with PSERS' Board to establish, monitor, and report its various risk metrics and has the required authority to efficiently and effectively implement associated actions.

The Policies of the Board can be found on the Investment page on PSERS website.

Section 3 - Investment Information

Capital Market Assumptions

Capital Market Assumptions (CMAs) are estimates of expected returns and risks for a given set of asset classes, and expectations of the relationship (correlations) between these asset classes over long periods of time. They are issued periodically by investment consultants, asset managers, and investment banks. Inflation, real short-term interest rates, and economic data frequently provide the foundation used by CMAs for expected returns across global asset classes. These are the primary building blocks for developing equity and fixed income returns expectations, which in turn are used in setting expectations for alternative asset class returns. PSERS collects and evaluates this information when considering its long-term actuarial rates of return assumptions and in setting its Asset Allocation Policy.

Compared to 2018, 2019 survey results under the 20-year forecast indicate a slight decrease in return assumptions across most asset classes. CMAs are forecasting slower growth and lower asset returns over the coming decade than has been experienced in past decades. The 2019 survey newly introduced assumptions for Private Debt. Select asset classes are detailed in Table 8.1.

Table 8.1 summarizes the average expected capital market geometric return assumptions of 20 - 30 surveyed independent investment advisors in 2015, 2016, 2017, 2018 and 2019:

Table 8.1					
PSERS Capital Market Assumptions (CMA's)					
Average Expected Geometric Returns (2015 - 2019)					
Asset Class	2015 Survey	2016 Survey	2017 Survey	2018 Survey	2019 Survey
U.S. Equity - Large Cap	7.1%	7.9%	7.8%	7.4%	7.1%
U.S. Equity - Small Cap	7.3%	8.2%	8.4%	8.2%	7.5%
Non-U.S. Equity - Developed	7.5%	8.0%	7.6%	7.7%	7.7%
Non-U.S. Equity - Emerging	8.7%	9.1%	8.7%	8.8%	8.7%
U.S. Fixed Income - Core	3.7%	4.6%	4.4%	4.5%	4.3%
U.S. Fixed Income - Long Duration Corp.	4.0%	4.9%	4.8%	4.4%	4.4%
U.S. Fixed Income - High Yield	6.0%	6.8%	6.2%	5.8%	5.8%
Non-U.S. Fixed Income - Emerging	2.7%	3.7%	3.5%	3.2%	3.4%
Non-U.S. Fixed Income - Developed	6.0%	6.4%	6.2%	6.1%	6.1%
Treasuries (Cash Equivalents)	2.4%	3.2%	3.2%	3.1%	3.0%
TIPS (Inflation-Protected)	3.1%	3.9%	4.0%	4.0%	3.5%
Real Estate	6.3%	6.8%	6.7%	6.7%	6.8%
Hedge Funds	5.8%	6.2%	6.0%	6.2%	6.2%
Commodities	4.4%	4.8%	5.0%	4.9%	4.7%
Infrastructure	7.1%	7.1%	7.1%	7.1%	7.2%
Private Equity	9.5%	10.3%	10.1%	9.5%	10.1%
Private Debt	N/A	N/A	N/A	N/A	7.8%
Inflation	2.2%	2.3%	2.4%	2.5%	2.3%

Fixed Income

Nominal government bond returns are a function of long-term expectations for inflation and government yields. Corporate bond returns are a function of expected inflation, government yields and expectations for credit spreads, defaults and downgrades. The majority of the decrease in corporate bond return assumptions from 2016 – 2018 can be explained by falling yields and the flattening of yield curves. This trend continued into 2019 as the yield curve inverted and flattened.

Equities

Equity return assumptions are driven by market valuations, earnings growth expectations and assumed dividend payouts:

- Global Equity returns expectations have declined relative to 2018, driven by slowing growth, political uncertainty and trade wars.

Equity market returns over the past three years have been driven by rising valuations and to a lesser extent, an increase in profits from tax cuts. In the past year, volatility has increased and participants concern over slowing growth has driven future expected returns lower.

Section 3 - Investment Information

Capital Market Assumptions

(continued)

Real Estate

Expected returns across the global real estate markets remained in line with 2017 assumptions, slightly higher than 2014 assumptions.

- Slightly higher initial yields are offset by expected price declines.

Hedge Funds

Hedge Fund assumptions reflect changes in the underlying equity, fixed income and cash capital market assumptions. Slight increases in the hedge fund assumptions from 2017 - 2018 reflected rising expectations for cash. Expectations as of 2019 remain unchanged.

An alternative approach to asset allocation that is sometimes suggested to pension plans is to establish a stereotypical 60% equity/40% fixed income policy that remains static

over time. Tables 8.1 and 8.2 illustrate one reason why such an approach would not be prudent. Because PSERS can select from a broad array of asset allocation alternatives, we can analyze alternative allocation strategies using asset classes with varying expected returns and expected risk in order to formulate an optimal asset allocation policy most likely to achieve the investment return and investment risk goals established by the Board. In recent years, lower risk projections have afforded PSERS valuable flexibility in identifying different combinations of asset allocations that can achieve our current long-term goal of 7.25% at acceptable levels of risk even as return assumptions have fallen. Furthermore, PSERS applies leverage opportunistically in implementing its asset allocation policy, providing an additional mechanism to increase expected volatility in order to target higher expected return when warranted. A stereotypical 60%/40% strategy would have precluded such flexibility and exposed the system to artificial and harmful limits on our ability to manage the Fund.

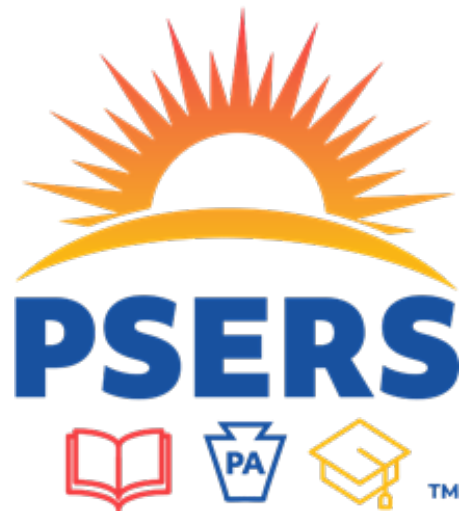
The CMA surveys also included forecasts for 20 year average expected risk (Table 8.2). The numbers below reflect the expected standard deviation in % around the expected return.

Table 8.2

PSERS Capital Market Assumptions (CMA's)

Average Expected Risk (2015 - 2019)

<u>Asset Class</u>	<u>2015 Survey</u>	<u>2016 Survey</u>	<u>2017 Survey</u>	<u>2018 Survey</u>	<u>2019 Survey</u>
U.S. Equity - Large Cap	17.1%	16.9%	16.6%	16.4%	16.2%
U.S. Equity - Small Cap	21.0%	21.0%	20.2%	20.2%	20.2%
Non-U.S. Equity - Developed	19.6%	19.5%	18.9%	18.7%	18.2%
Non-U.S. Equity - Emerging	26.6%	26.4%	25.4%	24.9%	24.7%
U.S. Fixed Income - Core	5.6%	6.0%	5.5%	5.7%	5.5%
U.S. Fixed Income - Long Duration Corp.	10.8%	10.5%	10.4%	10.8%	10.5%
U.S. Fixed Income - High Yield	11.2%	11.0%	10.6%	10.2%	10.1%
Non-U.S. Fixed Income - Emerging	7.4%	7.6%	7.4%	6.9%	7.6%
Non-U.S. Fixed Income - Developed	11.7%	11.6%	11.8%	11.4%	11.3%
Treasuries (Cash Equivalents)	2.8%	2.8%	3.0%	2.7%	2.3%
TIPS (Inflation-Protected)	6.3%	6.5%	6.3%	6.3%	6.1%
Real Estate	13.6%	14.7%	14.5%	13.9%	15.0%
Hedge Funds	8.3%	8.4%	8.0%	7.9%	8.4%
Commodities	18.0%	18.5%	17.9%	17.6%	17.7%
Infrastructure	13.1%	13.8%	14.6%	14.7%	14.0%
Private Equity	23.6%	23.1%	22.0%	22.2%	22.0%
Private Debt	N/A	N/A	N/A	N/A	11.6%
Inflation	1.8%	1.8%	1.7%	1.8%	1.7%



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Section 3 - Investment Information

Asset Exposure

(as of June 30, 2019)

While the Board can choose to modify its asset allocation at any time it determines that changes are warranted (for example, due to changing liquidity circumstances or opportunities in the marketplace), the Board maintains a disciplined and thorough process to establish a new asset allocation policy annually. This process begins following the Board's review and acceptance of the actuary's

annual report, as described in Tab 5. PSERS' investment professionals and general investment consultant collaborate to analyze potential asset allocations (using actuarial as well as capital market return assumptions) in order to identify those potential asset allocations that meet the long-term return and risk objectives of the Fund. The Board is then presented with alternative asset allocations with detailed analysis of probable long-term return and risk characteristics from which it will select a new Asset Allocation Policy for further implementation by staff.

Table 9.1 represents PSERS' asset exposure and target allocation plan that became effective October 1, 2018, and was in effect on June 30, 2019:

Asset Class	Market Value (in millions)	Percentage of Gross Asset Exposure	Percentage of Net Asset Exposure	Target Allocation %	Target Allocation Range
Global Public Market Equity:					
U.S. Equity	\$ 2,646.8	4.1%	4.6%	4.8	
Non-U.S. Equity	6,532.9	10.1%	11.4%	10.2	
Total Global Public Market Equity	\$ 9,179.7	14.1%	16.0%	15.0	
Private Markets	8,310.9	12.9%	14.5%	15.0	
Total Equity	\$ 17,490.6	27.2%	30.6%	30.0	± 10
Fixed Income*	\$ 22,535.7	35.0%	39.4%	36.0	± 10
Commodities*	4,357.6	6.8%	7.6%	8.0	± 4
Infrastructure*	3,838.6	6.0%	6.7%	6.0	
Real Estate*	5,516.7	8.6%	9.6%	10.0	
Total Real Asset Exposure	\$ 13,712.9	21.4%	23.9%	24.0	± 10
Risk Parity*	\$ 4,717.6	7.3%	8.2%	8.0	± 5
Absolute Return	\$ 5,964.8	9.3%	10.4%	10.0	± 5
Gross Asset Exposure	\$ 64,421.5	100.0%	112.5%	108.0	
Financing*	(7,215.9)		-12.5%	-8.0	+24/-14
Net Asset Exposure	\$ 57,205.6		100.0%	100.0	

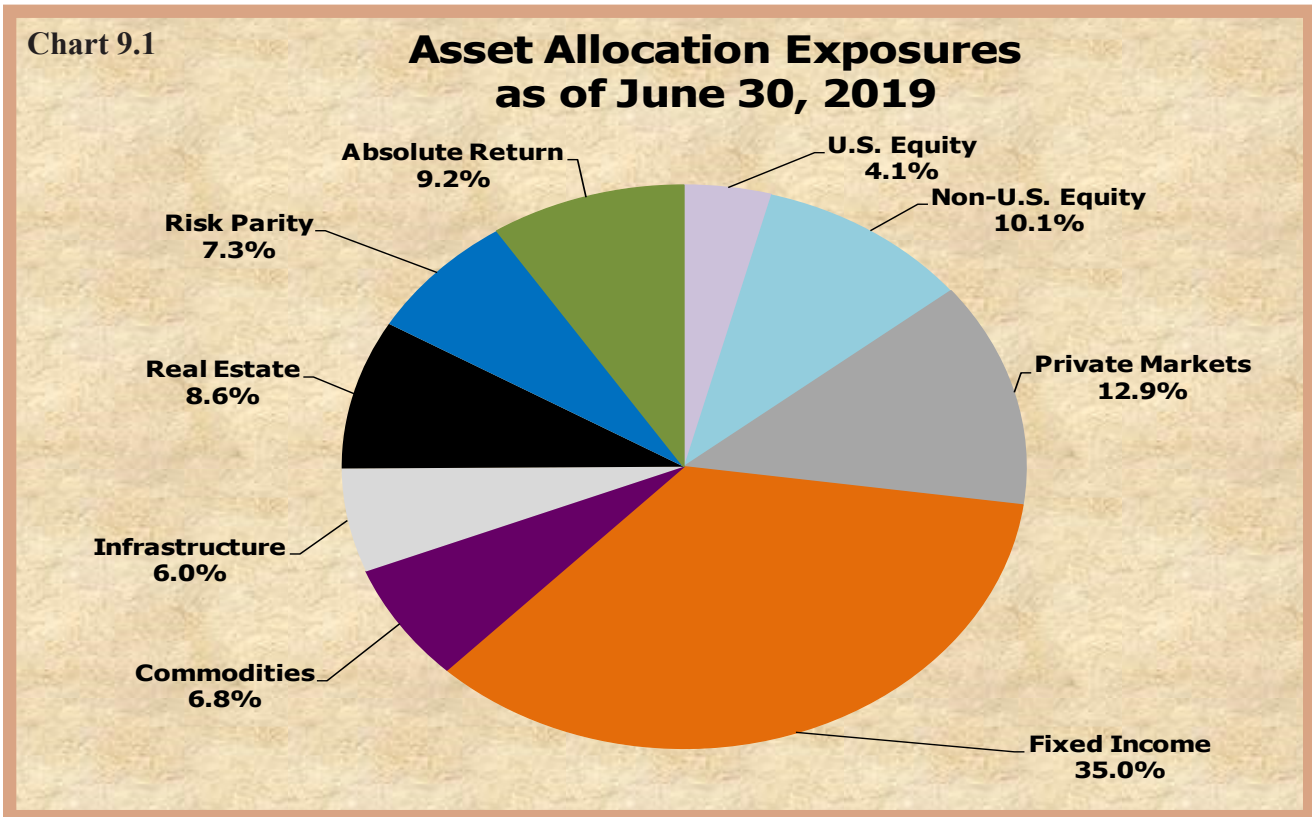
*PSERS uses financing to achieve increased economic exposure to diversifying asset classes to manage the overall portfolio risk while maintaining an allocation designed to achieve the long-term return goals of the System. Increased economic exposure is generally achieved through the use of either derivative positions or higher volatility funds. As of June 30, 2019, PSERS had total increased economic exposure of \$7.2 billion related to the following asset classes: Fixed Income (\$3.6 billion); Risk Parity (\$0.5 billion); Infrastructure (\$0.6 billion); Real Estate (\$0.2 billion) and Commodities (\$2.3 billion). An allocation of 6% to Cash is included in the Target Allocation.

Note: PSERS' asset allocation was updated October 1, 2019 and is available for review at <http://www.psers.pa.gov>.

Section 3 - Investment Information

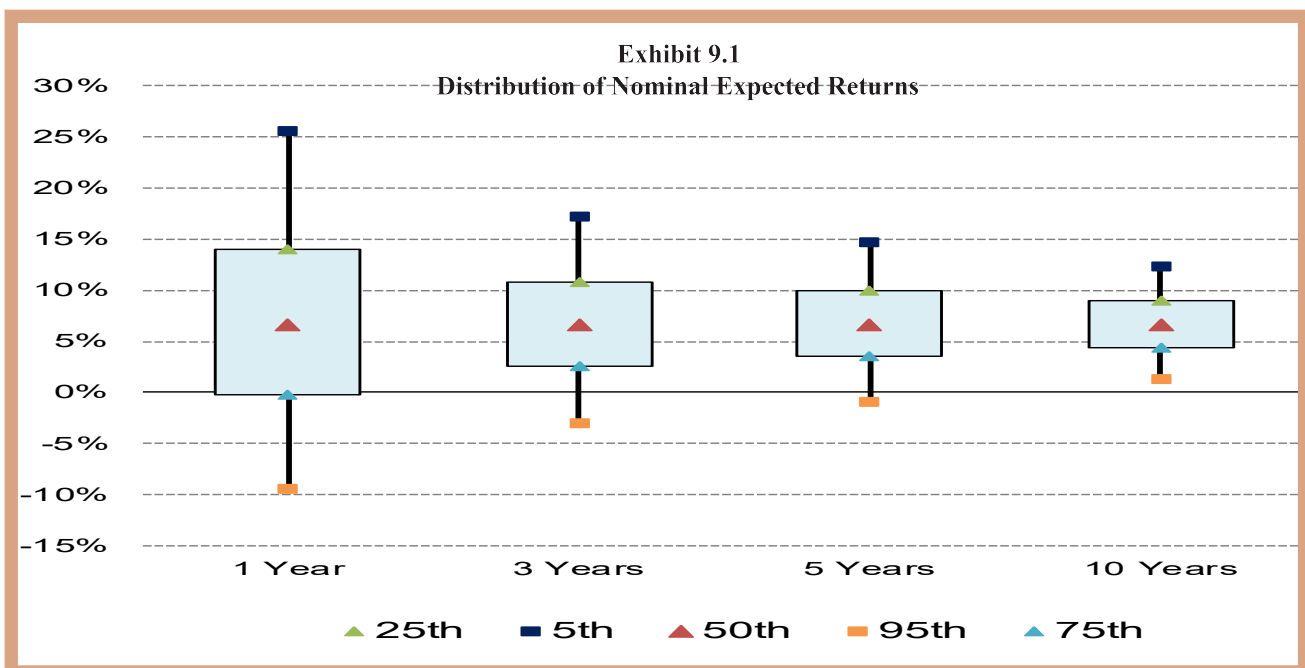
Asset Exposure (continued)

Chart 9.1 illustrates PSERS' asset allocation exposure as of June 30, 2019:



Note: Financing represents a negative 12.5% allocation and is not reflected in Chart 9.1.

The purpose of the asset allocation is to meet the long-term investment objectives of the System. PSERS considers the expected range of returns for 1, 3, 5, and 10 year periods of various alternative asset allocations (as seen in Exhibit 9.1) to select the optimal asset allocation annually. While the range of returns can be high for any single year, volatility will decrease and converge around a median return over time. This is demonstrated in Exhibit 9.1 below, which depicts expected future returns for PSERS' current asset allocation:



Section 3 - Investment Information

Range of Returns				
Percentiles	1 Year	3 Years	5 Years	10 Years
5%	27.2%	18.4%	15.8%	13.3%
25%	15.1%	11.8%	10.7%	9.7%
50%	7.4%	7.4%	7.4%	7.4%
75%	0.1%	3.1%	4.1%	5.0%
95%	-9.4%	-2.7%	-0.5%	1.7%

Source: Aon Hewitt's 30-year capital market assumptions as of June 30, 2019.

Public Market Global Equity Investments

Public Market Global Equity includes both U.S. Equity and Non-U.S. Equity investments. PSERS' investment plan diversifies equity investments and balances equity management styles. Equities are utilized by the Fund primarily because their expected large return premiums versus inflation will, if realized, help preserve and enhance the real value of the Fund over long periods of time. Equities tend to perform well when economic growth is stronger than expected or inflation is lower than expected. The Public Market Global Equity Exposure asset class is managed on a total return basis.

Equity investments consist almost entirely of publicly-traded securities listed on major worldwide stock exchanges or derivatives such as swaps or listed futures that replicate the performance of equity indexes such as the S&P 500 Index. Swaps and futures are employed by PSERS to equitize cash.

PSERS' Asset Allocation targets a current allocation of 15.0% of assets to Global Public Market Equity. PSERS contracts with external investment managers and also uses internal portfolio managers to manage Public Market Equity portfolios.

Private Market Investments

Private Market investments provide the opportunity to negotiate and set a price between the owner of a business and the buyer/investor in a private fashion. There exists a very large private economy of companies with various needs (for example, operating expertise, capital to grow their businesses, an exit out of family businesses, etc.). In public equity markets, thousands of buyers and sellers set prices of securities issued by companies every day, however no such mechanism exists in the private markets. Thus, private markets provide fertile grounds for investing.

For the Private Markets investment program, PSERS' long-term investment objective is to achieve a risk-adjusted total return, net of fees, that exceeds market returns for similar investments. The primary vehicle used to invest funds in this asset class is the limited partnership. Individual management groups selected by PSERS form these partnerships for the purpose of investing in and managing private equity and unlisted-subordinated debt positions on behalf of PSERS and other limited partners. PSERS' Asset Allocation currently targets an allocation of 15.0% to Private Market investments.

Section 3 - Investment Information

Private Market Investments (continued)

Private Equity involves investments in private companies which normally do not have technology risk associated with traditional venture capital investments. It has evolved to include the financing of more mature, profitable companies that do not have access to, or qualify for, public equity and debt funding.

Venture Capital is considered the financing of young, relatively small, rapidly growing companies. In traditional venture capital investments, companies have a 5-10 year investment horizon and develop technology for a particular market, such as pharmaceuticals, software, medical products, etc.

Private Debt involves investments in the secured and/or unsecured debt obligations of private and/or public companies. This debt is typically acquired through directly negotiated or competitively bid transactions. Owners of these debt instruments typically take either an active or passive role in the management of the firm.

PSERS Private Market Internal Co-Investment Program consists of co-investments made alongside of General Partners with whom PSERS has a strong relationship. These relationships aid in the generation of deal flow for investments and also serve as additional due diligence for the evaluation of General Partners. The investments have the potential for higher returns as they have low or no fees and no profit sharing. This program also provides PSERS with the ability to buy secondary interests in funds from other Limited Partners usually at a discount to net asset value.

Fixed Income Investments

Fixed Income investments include a wide variety of bonds and similar securities which allow PSERS to diversify Fixed Income investments and balance Fixed Income

management styles. PSERS contracts with external investment managers and also uses internal portfolio managers to manage Fixed Income portfolios.

Fixed Income securities are used for a variety of purposes as follows:

Nominal bonds are used for their ability to serve as a hedge against disinflation and/or deflation, their general ability to produce current income in the form of periodic interest payments, and their ability to provide sufficient liquidity to meet the Fund's obligations to pay member benefits and support other investment commitments. Nominal bonds tend to do well when growth is weaker than expected or when inflation is lower than expected;

Inflation-linked bonds are used for their ability to serve as a hedge against inflation, their general ability to produce current income in the form of periodic interest payments, and their ability to provide sufficient liquidity to meet the Fund's obligations to pay member benefits and support other investment commitments. Inflation-linked bonds tend to do well when growth is weaker than expected or when inflation is higher than expected; and

High yield securities and emerging market bonds are used for their ability to generate high current income in the form of periodic interest payments as well as offering greater total return opportunities than high grade debt. High yield securities and emerging market bonds tend to do well when growth is stronger than expected.

PSERS' Asset Allocation targets a current allocation of 42.0% of assets to Fixed Income, 10.0% of which is designated to Investment Grade, 11.0% of which is designated to Credit-Related, 15.0% of which is designated to TIPS strategies, and a 6.0% allocation to Cash is included in the (8)% allocation to Financing.

Section 3 - Investment Information

Commodity Investments

Commodity investments such as gold, oil, and wheat are utilized by the Fund for diversification within the portfolio and to act as a hedge against unanticipated inflation. The prices of commodities are determined primarily by near-term events in global supply and demand conditions and are positively related with both the level of inflation and the changes in the rate of inflation. However, stock and bond valuations are based on longer-term expectations and react negatively to inflation. Therefore, commodity returns have had a historically negative correlation to stock and bond returns since commodities tend to do very well in periods of rising inflation. As such, commodities, when combined with stocks and bonds, lower the risk of a portfolio. PSERS contracts with external investment managers and also uses internal portfolio managers to manage Commodity portfolios.

PSERS' Asset Allocation currently targets an allocation of 8.0% of assets to Commodity investments which includes a 5.0% target allocation to a Diversified Commodity Basket and a 3.0% asset allocation to Gold. Gold is particularly useful as a contra-currency to provide protection against the debasement of fiat currencies in periods of monetary inflation.

Infrastructure Investments

Infrastructure investments target stable, defensive investments primarily within the energy, power, water, and transportation sectors. The program plays a strategic role within the System by providing steady returns and cash yields, defensive growth, inflation protection, capital preservation and diversification benefits. Historically, Infrastructure investments have performed better in environments of falling growth and falling inflation. PSERS contracts with external investment managers and also uses internal portfolio managers to manage Infrastructure portfolios.

Master Limited Partnership (MLP) securities, which are publicly traded on a securities exchange, avoid federal and state income taxes by meeting specific qualifications of the IRS related to the production, processing or transportation of oil, natural gas, and coal. MLP securities are utilized by the System due to their low correlation to stock and bond returns, attractive growth characteristics, and their ability to produce current income in the form of periodic distributions. MLP securities tend to do well when economic growth is stronger than expected and when inflation is higher than expected. PSERS contracts with external investment managers and also uses internal portfolio managers to manage MLP portfolios.

PSERS' Asset Allocation currently targets an allocation of 6.0% of assets in Infrastructure investments, inclusive of the 4.0% target for MLP investments.

Real Estate Investments

Real Estate investments provide PSERS exposure to real property directly or indirectly through global publicly-traded real estate securities (PTRES), direct investments, commingled fund investments, limited partnerships, and direct private placements. This is done in a prudent manner to create a diversified real estate portfolio of high quality investments which will enhance PSERS' overall long-term investment performance, diversify the asset base, and reduce the volatility of the total investment portfolio returns. Real Estate investments tend to perform well in periods of stronger than expected growth and lower than expected inflation.

The real estate program is designed to create the highest possible risk-adjusted returns in a controlled, coordinated, and comprehensive manner. Recognizing that real estate market conditions and PSERS' objectives for real estate may change over time, the program is reviewed periodically and updated as needed. The existing

Section 3 - Investment Information

Real Estate Investments (continued)

target allocation is 10.0% of total assets, of which 9.0% is designated for Private Real Estate and 1.0% for PTRES.

PSERS seeks to diversify its real estate portfolio by investing in a mix of Opportunistic (30%), Value Added (50%) and Core (20%) real estate investments.

Opportunistic real estate investing is the financing, acquisition or investment in real estate assets, real estate companies, portfolios of real estate assets, and private and public Real Estate Investment Trusts (REIT's) that do not have access to traditional public equity or debt financing. Opportunistic real estate consists of investment strategies that seek to exploit market inefficiencies with an emphasis on total return. Opportunistic investments require specialized expertise and the flexibility to respond quickly to market imbalances or changing market conditions. Investments may include non-traditional property types and/or assets that involve development, re-development, or leasing risks.

Value Added real estate investing typically focuses on both income growth and appreciation potential, where opportunities created by dislocations and inefficiencies between and within segments of the real estate capital markets are capitalized upon to enhance returns. Investments can include high-yield equity and debt investments and undervalued or impaired properties in need of repositioning, re-development, or leasing.

Core real estate investing is the financing, acquisition or investment in real estate assets, real estate companies, portfolios of real estate assets, and private REITs that are broadly diversified by property type and location, focused primarily on completed, well-leased properties with modest levels of leasing risk, using relatively low leverage, and investing mainly in institutional

property types and qualities allowing for relative ease of resale.

PSERS Real Estate Internal Co-Investment Program consists of co-investments made alongside of General Partners with whom PSERS has a strong relationship. These relationships aid in the generation of deal flow for investments and also serve as additional due diligence for the evaluation of General Partners. The investments have the potential for higher returns as they have low or no fees and profit sharing. This program also provides PSERS with the ability to buy secondary interests in funds from other Limited Partners usually at a discount to net asset value.

Risk Parity Investments

Risk Parity investments are designed to generate investment returns through a more diversified allocation by endeavoring to balance market risk factor exposures as opposed to capital exposures. PSERS' Risk Parity investment managers each have proprietary methods to define and measure the risk factors upon which they manage their portfolios. Inclusion of this asset class is expected to reduce the portfolio's overall risk exposure over long-term horizons because it is designed to be more resistant to market downturns than traditional investment strategies, and further enhances the System's diversification due to the risk-balancing portfolio construction. Risk Parity portfolios are designed to perform consistently well in periods of rising or falling growth or inflation. PSERS contracts with external investment managers and also uses internal portfolio managers to manage Risk Parity portfolios.

PSERS' Asset Allocation currently targets an allocation of 8.0% of assets to Risk Parity investments. The Risk Parity investments are targeted to be 100% actively managed.

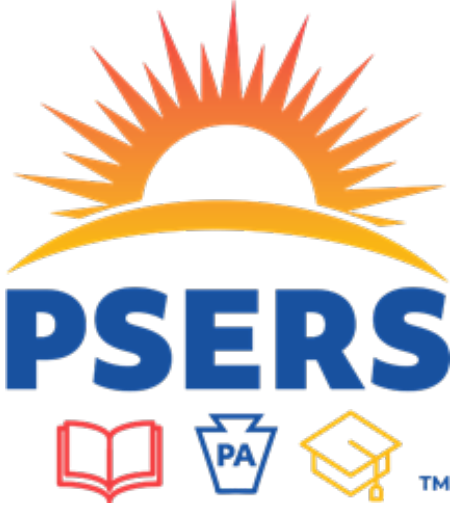
Absolute Return Investments

Absolute Return investments, sometimes referred to as hedge funds, are used by the Fund primarily to generate returns that are uncorrelated to the equities, fixed income, and commodities asset classes and to diversify the overall Fund. As such, returns are driven more by manager skill than changes in economic growth and inflation which affects other financial assets. PSERS contracts with external investment

managers to manage Absolute Return portfolios.

Absolute Return investments are made in a variety of unique, non-directional investment strategies, including global macro, relative value, event driven, capital structure arbitrage, reinsurance, volatility and other opportunistic strategies. The Fund diversifies this program by manager and style.

PSERS' Asset Allocation currently targets an allocation of 10.0% of assets in Absolute Return investments.



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Section 3 - Investment Information

Performance

PSERS' general investment consultant calculates the total investment return of the System as well as the performance of each external investment management firm and each internal investment manager retained by the Board to invest the System's assets. Performance is calculated using a time-weighted return methodology. For the one-year period ended June 30, 2019, the System

generated a total net of fee return of 6.68%. This return was below the Total Fund Policy Index return of 7.68% by 100 basis points. Annualized total net of fee returns for the three-, five-, and ten-year periods ended June 30, 2019 were 8.71%, 6.04%, and 9.02%, respectively. The three-year and ten-year returns ended June 30, 2019, exceeded the Total Fund Policy Index returns by 62 and 59 basis points, while the five-year return trailed by 2 basis points.

Table 10.1 provides the System's total time-weighted investment returns for each major asset class and the total portfolio, including, where applicable and available, respective benchmark indexes used by asset class and median performance by asset class:

Table 10.1	Annualized Total Returns (%)					
	Net of Fees					
	Ended June 30, 2019					
	1 Year	3 Years	5 Years	10 Years	15 Years	20 Years
PSERS Total Portfolio	6.68	8.71	6.04	9.02	6.87	6.11
Total Fund Policy Index	7.68	8.09	6.06	8.43	6.43	5.41
Median Public Defined Benefit Plan (DBP) Fund Universe (Aon Hewitt Database)	5.98	8.53	5.61	8.77	6.37	5.68
60% Global Equity / 40% Barclays U.S. Aggregate Bond Index	7.01	8.00	5.02	7.89	6.29	5.30
PSERS U.S. Equity Portfolios	7.84	13.63	10.16	14.95	8.71	N/A
U.S. Equity Policy Index (1)	8.96	14.04	10.24	14.60	8.91	N/A
PSERS Non-U.S. Equity Portfolios	2.84	11.72	6.94	9.58	8.43	N/A
Non-U.S. Equity Policy Index (2)	2.15	10.67	5.47	8.34	7.28	N/A
PSERS Fixed Income Portfolios (10)	7.89	6.55	5.59	8.12	6.83	6.94
Fixed Income Policy Index (3)	8.38	4.52	3.70	5.75	5.56	5.90
PSERS Commodity Portfolios (10)	0.19	0.63	-3.85	0.08	N/A	N/A
Commodity Policy Index (4)	0.17	-0.63	-5.22	-1.84	N/A	N/A
PSERS Absolute Return Portfolios	2.42	5.38	3.35	6.08	N/A	N/A
Absolute Return Policy Index (5)	6.16	5.34	4.76	6.22	N/A	N/A
PSERS Risk Parity Portfolios (11)	8.16	7.37	4.18	N/A	N/A	N/A
Risk Parity Policy Index (6)	9.41	7.10	5.08	N/A	N/A	N/A
PSERS Master Limited Partnership (MLP) Portfolios	1.55	1.99	-4.98	12.42	N/A	N/A
Standard & Poor's MLP Index	3.23	1.54	-6.65	8.88	N/A	N/A
PSERS Infrastructure Portfolios	5.55	5.86	N/A	N/A	N/A	N/A
Infrastructure Policy Index*	7.56	6.34	N/A	N/A	N/A	N/A
PSERS Real Estate (7) (10)	7.59	9.83	10.44	9.16	7.50	8.35
Blended Real Estate Index (8)	5.99	8.49	10.14	8.73	8.96	9.04
PSERS Alternative Investments (7)	11.21	13.93	9.44	12.14	12.26	10.50
Burgiss Median Return, Vintage Year Weighted (9)	9.67	13.26	10.88	13.37	9.27	6.64

*FTSE Developed Core Infrastructure 50/50 (Hedged to USD) Index (Net) effective October 1, 2015.

This represents a blend of three broad sectors: 50% Utilities, 30% Transportation (with rails capped at 7.5%) and 20% mix of other sectors including pipelines, satellites, and communication towers.

Other Footnotes to the Total Portfolio are available on page 92 of PSERS Comprehensive Annual Financial Report.

Section 3 - Investment Information

Performance (continued)

The past fiscal year was a positive year for the System with a net of fee return of 6.68%, however the return trailed the Policy Index by 1.00% for the fiscal year. The following asset classes were additive to returns this past fiscal year:

- Public Infrastructure, as represented by FTSE Developed Core Infrastructure 50/50 Index (Net) (Hedged), was up 16.1%.
- U.S. Long Treasuries, as represented by the Bloomberg Barclays U.S. Long Treasury Index, were up 12.3%. Returns in long-term treasuries were driven by falling interest rates.
- Gold, as represented by the Bloomberg Gold Subindex Total Return, was up 12.1%. Many investors flocked to Gold as a safe haven from turbulent global stock markets.
- Private Equity, as represented by Burgiss All Private Markets ex Real Estate (1Q Lag), was up 9.67%.
- Emerging Markets Debt, as represented by Bloomberg Barclays Emerging Market 10% Country Capped Index, gained 8.7%. US dollar-denominated EMD returns were aided by a strong rally within US treasuries, coupled with relatively stable credit spreads.

Significant detractors from performance this past fiscal year included:

- Commodities, as represented by the Bloomberg Commodity Index Total Return, were down -6.8%. Negative absolute returns were largely driven by slowing global growth concerns, which was a drag on crude oil prices.
- Emerging Markets equities, as represented by the MSCI Emerging Markets IMI Index (net), returned +0.5%. While this return was positive on an absolute basis, the asset class detracted relative to other markets, including U.S. and developed Non-U.S. equities.

As noted, one of the best performing asset classes this past fiscal year was Public Infrastructure, which was up over 16%, while one of the worst performers was Commodities returning -6.8% for FY 2019, a big change from its strong performance in FY 2018, returning +7.3%. This illustrates the importance of diversification. Many investment professionals discuss diversification using terms such as standard deviation, correlation, and co-variance. However, at its most basic level, diversification is insurance against

bad outcomes. The System diversifies simply because it doesn't know how actual events in the future will transpire relative to what is priced into the market. Diversification is a very humble approach to investing. If an investor knew with certainty which asset class would perform best the next month, quarter, or year, the investor would simply invest in that one asset class. However, without such perfect foresight, the downside risk of such a strategy could be devastating. PSERS employs diversification across a wide variety of public and private markets. Exposure to private equity and private real estate provided return enhancement and diversification benefits in FY 2019. Diversification into asset classes such as absolute return, TIPS, and high yield resulted in a drag on overall performance during this past fiscal year.

In analyzing performance, PSERS' Board, general investment consultant and staff pay particular attention to the Sharpe ratio, which tells an investor what portion of a portfolio's performance is associated with risk taking. The Sharpe ratio measures a portfolio's added value relative to its total risk; the higher a portfolio's Sharpe ratio, the better its risk-adjusted return. PSERS' Sharpe ratio, as calculated by the general investment consultant, was 1.17 for the 5-year period ending June 30, 2019, a top 4th percentile score among public pension plans with assets above \$1B.

The fiscal year continued a recent trend of strong performance but with increased volatility in the markets, with the VIX reaching a peak in December 2018. Global Equities closed the fiscal year higher after recovering from sharp losses in Q4 driven by concerns of slowing global growth and trade wars. Prospects of looser monetary policy by central banks, and a more positive outlook on US-China trade negotiations drove performance higher toward the end of the fiscal year.

Volatility in US equities over the year was driven by concerns around the slowing US economy and uncertainties around political risks and the future economic outlook. December in particular brought about huge losses across all sectors due to worse than expected earnings growth. Equities ended the fiscal year strong with returns largely driven by the prospect of monetary easing by the Fed and, at the time, a more positive outlook on the US – China trade wars.

Prospects of looser monetary policy were touted by major central banks at the end of June 2019. Over the year the US nominal yield curve inverted and shifted downwards as yields fell across all maturities. In the UK, Brexit uncertainties continued as UK Prime Minister Theresa May resigned in Q2 2019. However, increased expectations of further monetary stimulus from the European Central Bank combined with a strengthening of the euro against the U.S. dollar resulted in the European equities ending Q2 higher.

Section 3 - Investment Information

Performance (continued)

Emerging market equities, especially those with greater linkages to China, came under pressure over the fiscal year due to uncertainties around ongoing trade dispute.

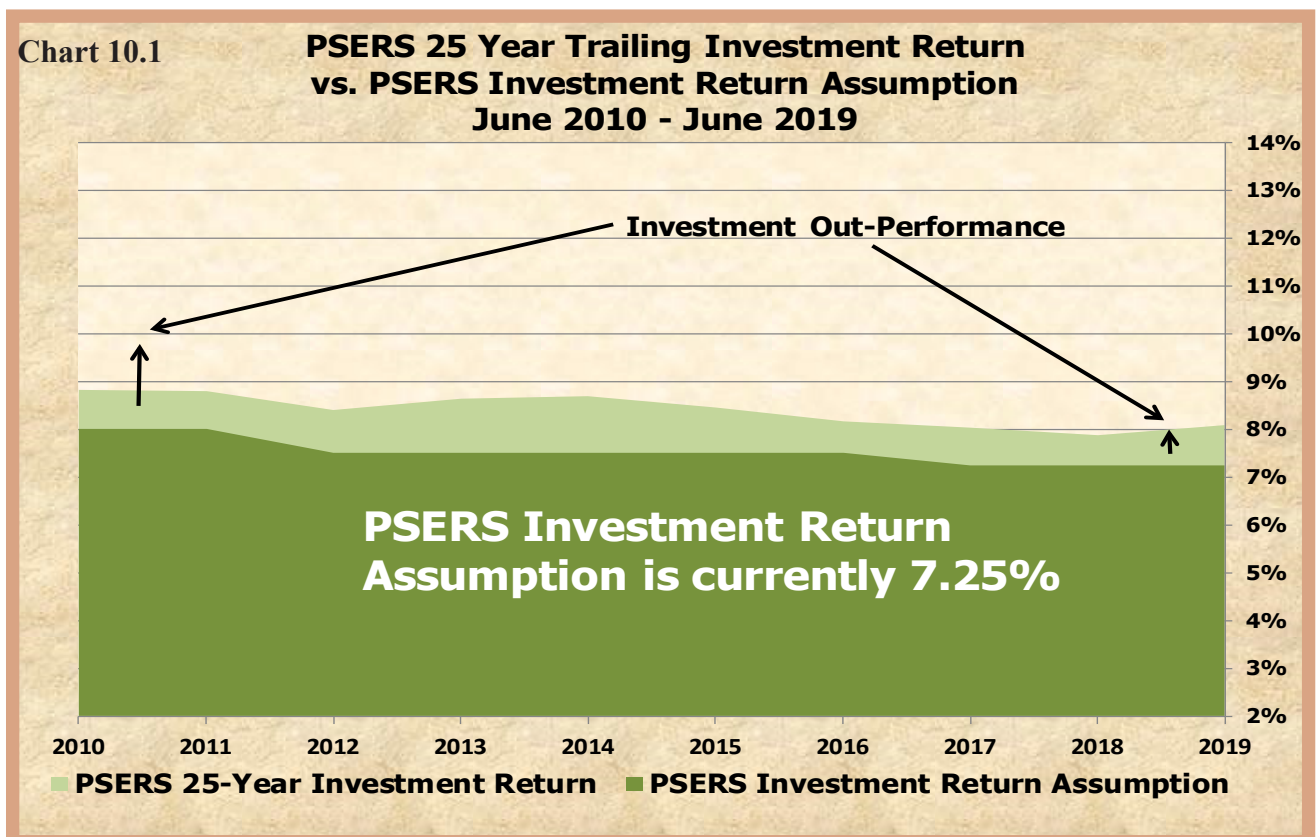
Commodity prices were negative over the 12 months ended June 30, 2019, driven by concerns of slowing growth. Oil prices got some support from rising tensions in Middle East as the U.S. re-imposed sanctions on Iran. However, a sharp rise in U.S. crude inventories and, more significantly, signs of slowing global growth put pressure on energy prices. The price of WTI crude oil decreased by ~22% over the past 12 months to US\$58/bbl. While it has been a challenging return environment as evidenced by the System's one-, and five-year annualized returns, since the first quarter after the Great Recession (10-years), PSERS' annualized net of fee return has been 9.06%, comfortably above the actuarial assumed rate of return of 7.25%. With cash rates around 2.25%, the System needs to take prudent risks to achieve

its long-term goal of a 7.25% return. An important concept to remember from the last sentence is "long-term." The System has built a diversified allocation to allow it to collect risk premiums over the long-term. In the short-term, no one knows what will happen and the System can go through periods of time of sub-7.25% annual returns. The System continues to believe the best way to achieve its long-term objectives is to maintain a very diversified portfolio which includes all asset classes available to it, such as equities, fixed income, real assets, risk parity and absolute return. In any given year, the System expects some assets to perform well, such as Infrastructure and U.S. Long Treasuries did this past fiscal year, and expects some to not do as well, such as Commodities this past fiscal year. However, over the long run, the System expects each of its asset classes to generate a positive return commensurate with the risks taken. The future is uncertain, but PSERS believes it is well positioned to accomplish its objectives.

Long Term Investment Performance Consistently Outperforms

The assets of the System are invested to maximize the returns for the level of risk taken. Chart 10.1 shows PSERS' 25 Year Trailing Investment Return for each of the past 10 fiscal years and Chart 10.2 depicts PSERS' Fiscal Year Investment Return versus PSERS' Investment Return Assumption for the past 10 fiscal years.

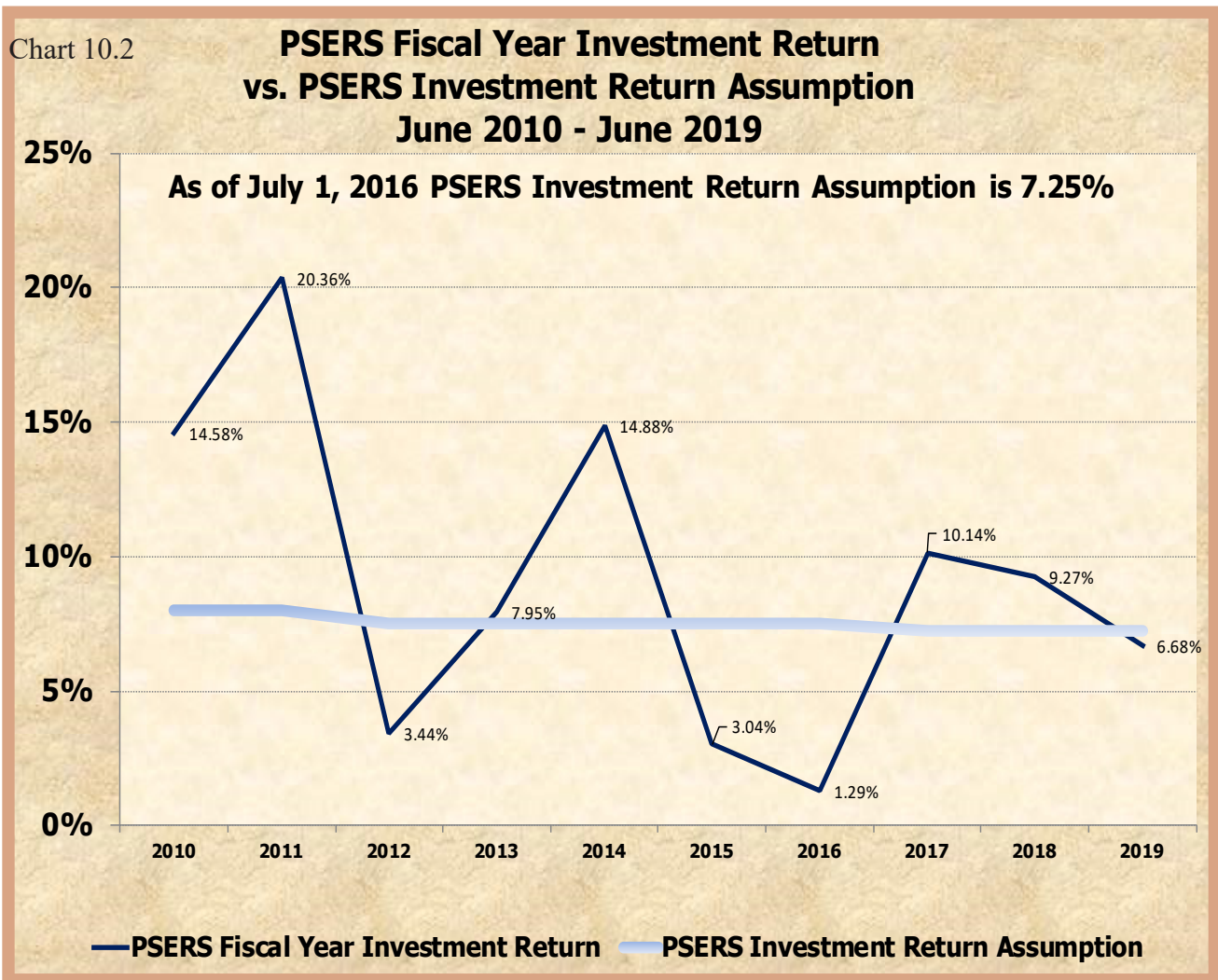
As shown in Chart 10.1, the 25 year trailing investment return has exceeded the investment return assumption over the last ten years including the Great Recession.



Section 3 - Investment Information

Performance (continued)

As depicted in chart 10.2, PSERS' one-year investment return was below the investment return assumption for fiscal year 2019. Six of the past ten fiscal years, it performed above the assumption.



Section 3 - Investment Information

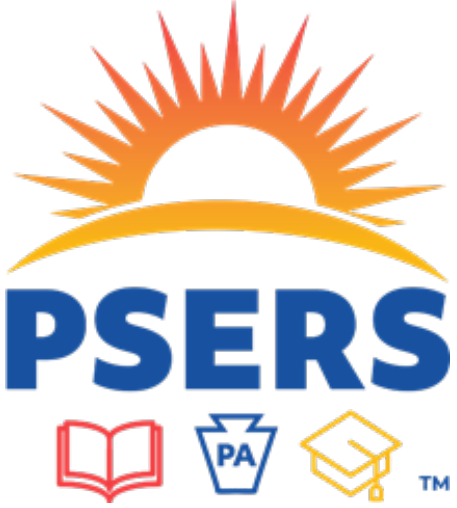
Performance (continued)

Table 10.2 demonstrates that over the past 20 fiscal years, on average, every dollar PSERS has spent in investment fees and expenses has resulted in investment earnings of \$2.06 above the Policy Benchmark's dollar returns.

Table 10.2 PSERS' Investment Earnings over Policy Benchmark
Fiscal Years Ended June 30
(Dollar Amounts in Millions)

<i><u>Fiscal Year</u></i>	<i><u>Total Investment Expenses *</u></i>	<i><u>PSERS' Net Return over Policy Benchmark (AFTER Payment of all Expenses)</u></i>	<i><u>PSERS' Investment Earnings over Policy Benchmark Net of Total Investment Expenses *</u></i>	<i><u>\$'s of Gross Alpha for every \$1 of Investment Expenses</u></i>
2019	\$450	-1.00%	(\$631)	(0.40)
2018	468	1.32%	661	2.41
2017	474	1.75%	800	2.69
2016	416	-1.78%	(853)	(1.05)
2015	455	-0.04%	(31)	0.93
2014	482	0.55%	240	1.50
2013	558	1.28%	590	2.06
2012	481	1.10%	521	2.08
2011	515	1.02%	416	1.81
2010	522	2.20%	1,754	4.36
2009	478	-5.22%	(3,131)	(5.55)
2008	399	-0.98%	(618)	(0.55)
2007	314	4.36%	2,360	8.52
2006	211	2.36%	1,635	8.75
2005	193	2.36%	1,090	6.65
2004	191	3.51%	1,388	8.27
2003	179	-0.43%	(141)	(0.21)
2002	163	0.57%	319	2.96
2001	144	2.13%	1,200	9.33
2000	<u>125</u>	1.85%	<u>934</u>	8.47
Total	<u>\$7,218</u>		<u>\$8,503</u>	<u>\$2.06</u>

*Dollar amounts in millions.



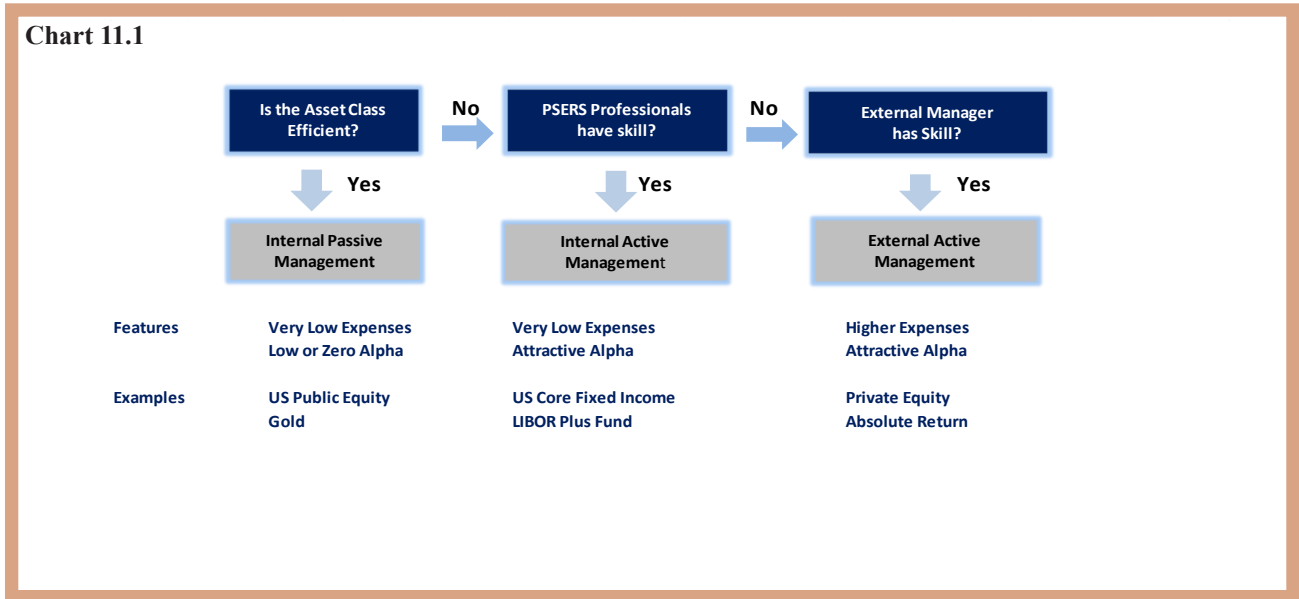
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Section 3 - Investment Information

Managing Investment Fees and Expenses

PSERS' investment professionals annually formulate an Asset Allocation Policy (as more fully described in Tab 9) with input from the general investment consultant, and works on an ongoing basis to implement the Policy through identification of attractive investment strategies and well-qualified investment managers. The

Board reviews and approves the long-term asset allocation targets of the System annually. A fundamental part of this implementation process is making key decisions with regard to use of active or passive strategies implemented by internal professionals or external investment managers, as depicted in Chart 11.1.



Management of investment fees and expenses is integrated into the process of making these key decisions, so analysis of these costs must also occur within this context. If one assumes that, under PSERS' Asset Allocation Policy, all of PSERS' investments could be made in a passive manner resulting in negligible fees and expenses while earning investment returns equal to the Policy Benchmark, then one can also assume that all of PSERS' actual investment fees and expenses are incurred with the goal of earning investment returns that exceed the Policy Benchmark (of course, as the prudent investor realizes, not all investments can be made in passive strategies,

not all passive strategies have low fees, and not all passive strategies deliver the market returns targeted). These assumptions allow PSERS to analyze how much excess investment return above the Policy Benchmark the System has been able to generate over time for the level of fees and expenses actually paid.

PSERS' ability to select a prudent combination of both internal and external managers, and both active and passive strategies, has generated and continues to generate significant excess risk-adjusted, net of fee returns relative to the Policy Benchmarks.

Section 3 - Investment Information

Managing Investment Fees and Expenses (continued)

Chart 11.2 below demonstrates that over the past 20 fiscal years, PSERS has earned \$7.6 billion in additional investment returns above the Board-approved Policy Index, net of fees.

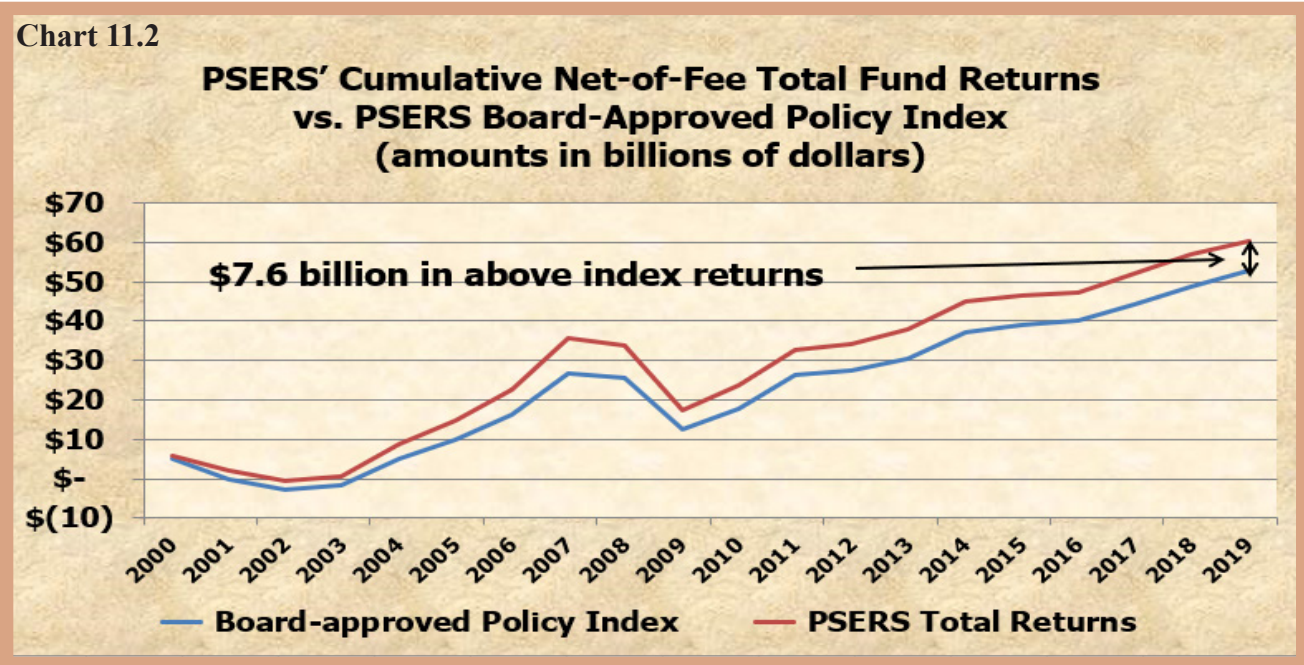
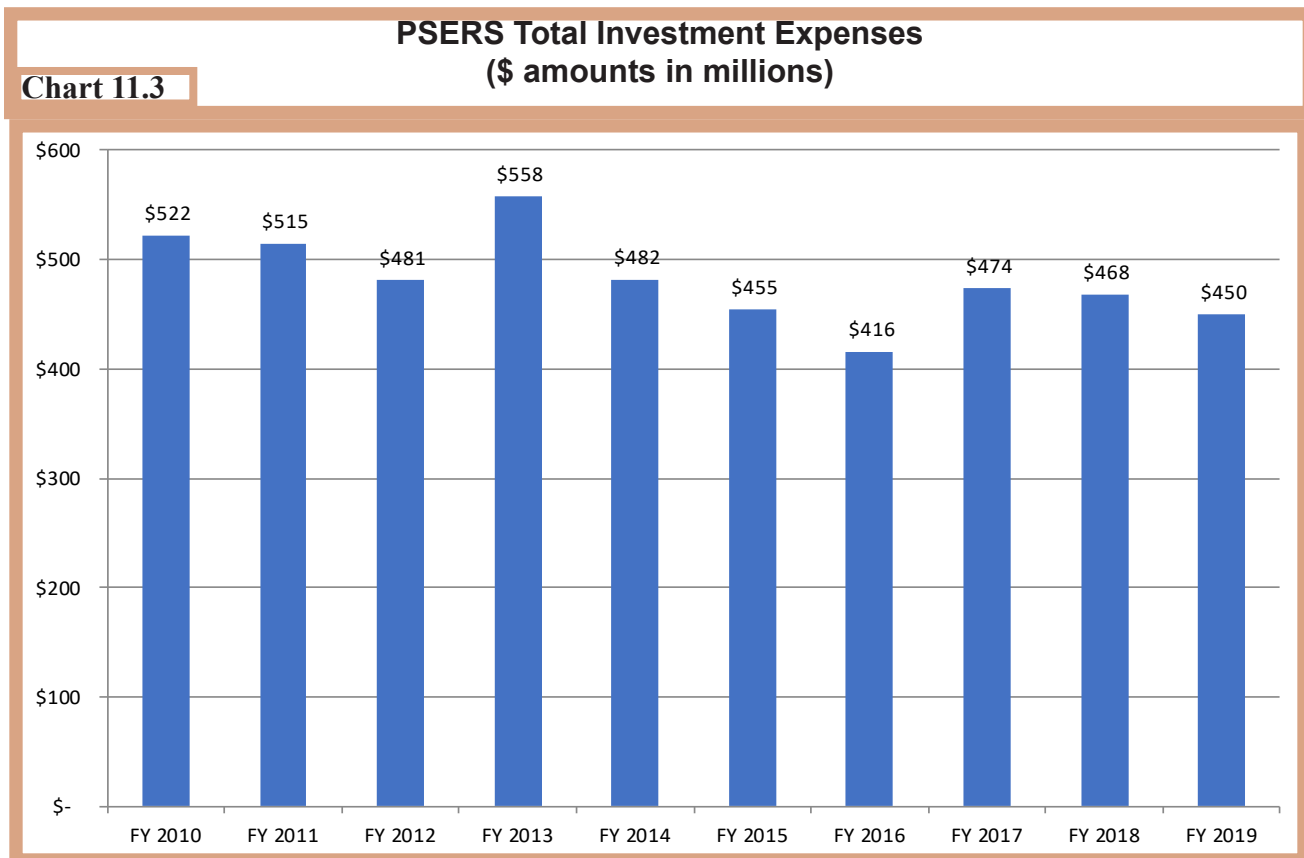


Chart 11.3 shows PSERS Total Investment Expenses over the past ten fiscal years.



Section 3 - Investment Information

Key Decision: Internal vs. External Investment Management

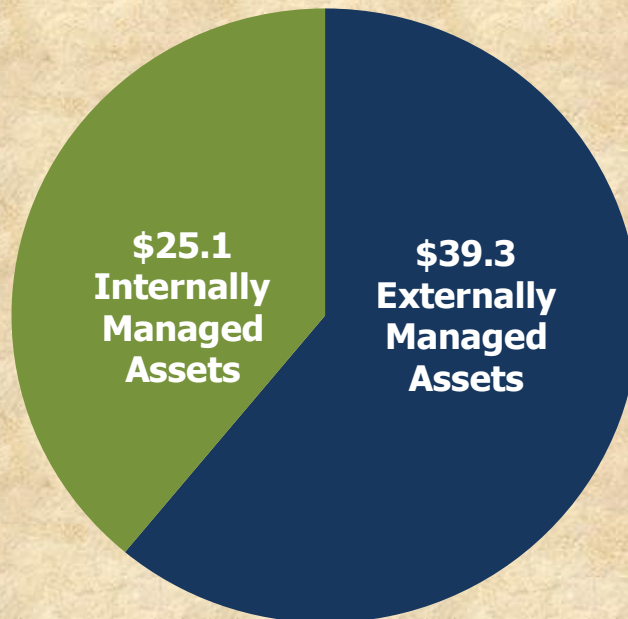
PSERS generally prefers to assign investment management responsibilities to internal professionals rather than to external investment management companies when certain conditions are present (see Chart 11.1). For example, it must be clear that internal professionals can achieve risk-adjusted returns that are at least equal to what might be earned by external investment managers in equivalent strategies, and PSERS' investment professionals must simultaneously have the operational capacity to take on the additional work. When assets are assigned to PSERS' professionals, the total costs (e.g., salary and benefits, computers and office supplies) are much lower than using even the largest "very low

fee" index mutual fund companies charge, giving PSERS a significant advantage.

When PSERS does select external investment managers, the decision is based in part on the fees the System has negotiated and in part on the likelihood the manager will meet or exceed the performance expected. Fee negotiations begin with the expectation that the contract with the investment manager will have a "Most Favored Nations" clause guaranteeing that PSERS' fees will be at least as low as other clients with a similar investment amount, and the System then negotiates fees lower from that point wherever possible.

Chart 11.4 displays the distribution of PSERS managed assets as of June 30, 2019.

Chart 11.4 **PSERS' Asset Exposures under Management as of June 30, 2019 (\$ Billions)**



Note: Financing represents a negative \$7.2 billion allocation exposure and is not reflected in Chart 11.4.

Section 3 - Investment Information

Key Decision: Internal vs. External Investment Management (continued)

PSERS' investment staff managed 21 portfolios internally, with a total estimated net asset value of over \$25 billion on June 30, 2019, resulting in significant fee savings. For the entire fiscal year, PSERS incurred costs of approximately \$18 million to manage these portfolios internally, as well as oversee all of the external managers, manage the asset allocation, oversee risk, and perform other tasks in managing the overall investment program.

As shown in Table 11.1 below, managing these assets externally would have cost PSERS over \$48 million in additional fees:

Table 11.1

<u>Account</u>	<u>Asset Class</u>	<u>Market Value as of 6/30/19*</u> <u>(,000)</u>	<u>Estimated Annual Fee</u> <u>%</u>	<u>Estimated Cost to Manage Externally</u> <u>(,000)</u>
PSERS - S&P 500 Index	U.S. Equities	\$2,036,956	0.01%	\$204
PSERS - S&P 400 Index	U.S. Equities	317,259	0.03%	95
PSERS - S&P 600 Index	U.S. Equities	291,498	0.04%	117
Misc. PSERS Equity Accounts	U.S. Equities	1,084	0.00%	-
	U.S. Equities Total	2,646,797		\$416
PSERS ACWI ex. U.S. Index	Non U.S. Equities	2,497,669	0.08%	1,998
	Non U.S. Equities Total	2,497,669		1,998
Private Markets Co-Investments	Private Markets	687,284	1.38%	6,873
PA Inv. Fund - Private Equity	Private Markets	2,715	1.38%	27
	Private Markets Total	689,999		6,900
Special Situations Internal	Fixed Income	111,717	1.00%	1117
PSERS Active Aggregate	Fixed Income	1,344,716	0.21%	2,824
PSERS TIPS Portfolio	Fixed Income	3,463,763	0.13%	4,503
PSERS Long Treasuries	Fixed Income	3,492,479	0.18%	6,286
	Fixed Income Total	8,412,675		14,730
PSERS Infrastructure Index	Infrastructure	1,172,970	0.50%	5,865
Infrastructure Internal	Infrastructure	38,437	0.50%	192
	Infrastructure Total	1,211,407		6,057
PSERS Commodity Beta	Commodities	1,608,042	0.15%	2,412
PSERS Gold Fund	Commodities	1,867,652	0.15%	2,801
Private Commodities Internal	Commodities	8,132	0.15%	12
	Commodities Total	3,483,826		5,225
PSERS S&P MLP Index	MLP	370,149	0.50%	1,851
	MLP Total	370,149		1,851
PSERS REIT Index	Real Estate	494,050	0.08%	395
Real Estate Co-Investments	Real Estate	107,841	0.49%	523
	Real Estate Total	601,891		918
PSERS Risk Parity	Risk Parity	2,508,599	0.30%	7,526
	Risk Parity Total	2,508,599		7,526
PSERS Cash Management	Cash Management	2,694,996	0.10%	2,695
	Cash Mgt Total	2,694,996		2,695
	Grand Total	<u>\$25,118,008</u>		<u>\$48,316</u>

*Market values include cash and derivatives exposure

Section 3 - Investment Information

Key Decision: Active vs. Passive Investment Management

Passive investment strategies form the basis that the Fund uses to attain market exposure in many public market asset classes. The advantage of passive strategies, such as indexing, is that they are generally very inexpensive to implement. If solely using passive strategies, however, performance will be limited to general market performance with little or no potential for excess earnings.

PSERS evaluates and selects active managers on a case by case basis with strong emphasis on understanding the manager's sustainable investment edge. If PSERS' investment professionals and consultants have conviction that the manager's process will generate attractive and potentially uncorrelated risk-adjusted net of fee returns in excess of the most competitive passive benchmarks, the active manager will be considered. Active strategies are also used by PSERS in asset classes where passive strategies are not available, such as Private Equity.

In selecting active managers, PSERS strives to hire managers that meet the following criteria:

- have a unique insight or process;
- have the ability to add long-term excess returns above passive alternatives, net of fees;
- have adequate capacity to execute the strategy;
- add diversification to PSERS' existing investment structure;
- do not exhibit style drift; and
- exhibit a high level of ethical behavior.

The advantage of active strategies is that they endeavor to generate net of fee returns in excess of the passive alternatives, if available, and/or provide diversification benefits which help manage total portfolio risk. The disadvantages of active strategies include being more expensive to implement than passive strategies and the risk that they may underperform passive strategies.

PSERS regularly measures the performance of active strategies relative to alternative passive strategies. In cases where PSERS is not receiving investment earnings from its active strategies in excess of alternative passive strategies, when all investment fees are taken into account, capital is redeployed either to other active strategies or to passive strategies. If PSERS determines that the active managers are not meeting expectations as a group, the Fund would endeavor to exit active strategies altogether and move to a purely passive implementation.

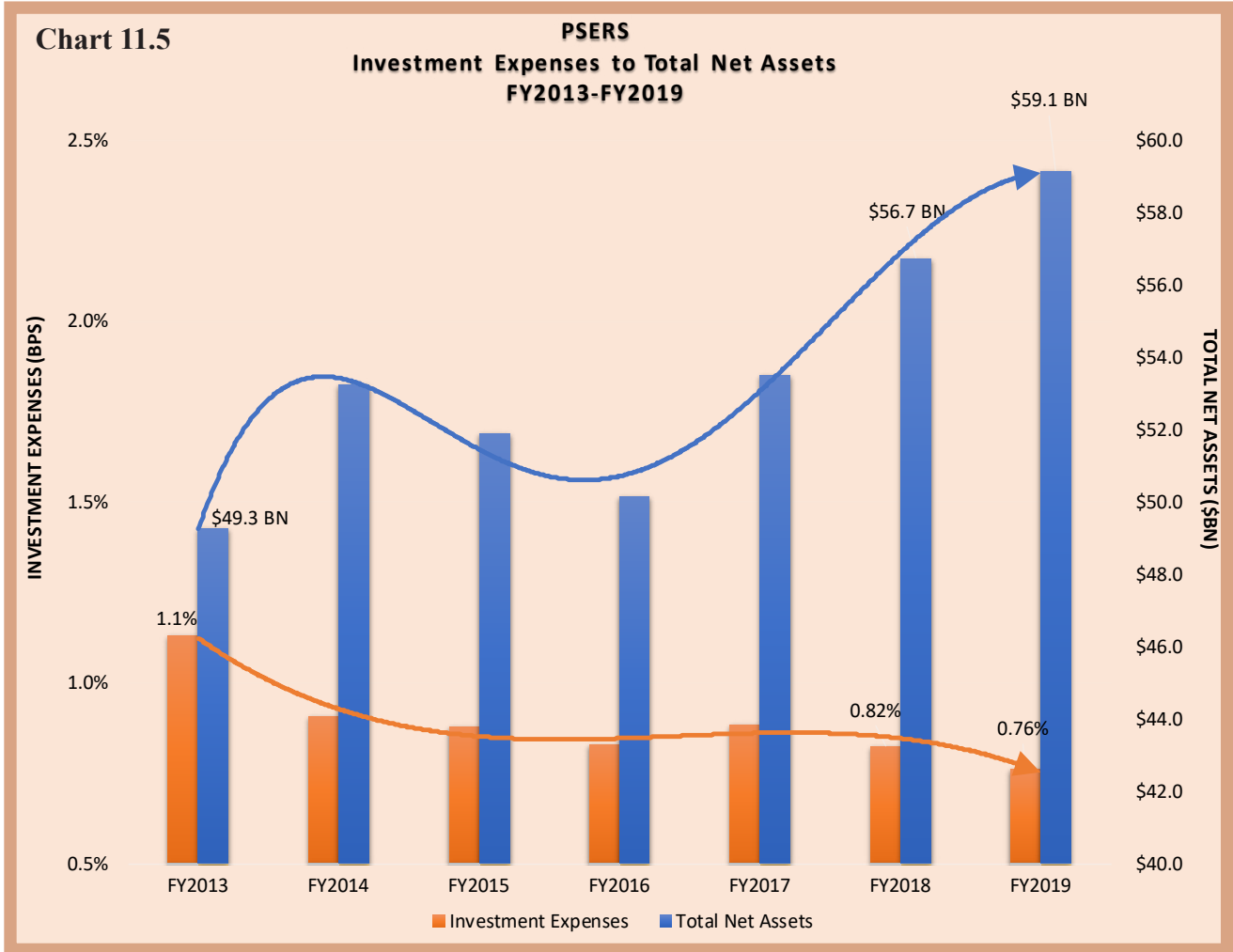
Section 3 - Investment Information

Table 11.2 summarizes total investment expenses for the fiscal year ended June 30, 2019. “Total External Management” includes all fees paid to external investment managers as either a base fee or a share of profits earned (performance fee). “Total Internal Management” includes all staff salaries related to PSERS’ Investment Office as well as costs needed to support their work (e.g., vendor services, hardware and software, office supplies). “Total Other Expenses” include fees paid to the custodian bank, consultants, and legal services providers.

Table 11.2 Summary of Investment Advisory Fees				
Fiscal Year Ended June 30, 2019				
(Dollar Amounts in Thousands)				
	<u>Base Fees</u>	<u>Performance Fees</u>	<u>Total Fees</u>	<u>Basis Points</u>
External Management				
U.S. Equity	\$1,527	\$1,561	\$3,088	86
Non - U.S. Equity	20,220	20,014	40,234	113
Fixed Income	100,007	1,414	101,421	84
Real Estate	47,702	-	47,702	100
Alternative Investments	96,060	-	96,060	130
Absolute Return	87,410	16,623	104,033	178
Commodities	4,998	-	4,998	59
Master Limited Partnerships	8,145	-	8,145	41
Infrastructure	2,478	-	2,478	105
Risk Parity	16,414	780	17,194	78
Total External Management	\$384,961	\$40,392	\$425,353	107
Total Internal Management			17,602	8
Total Investment Management			\$442,955	71
Custodian Fees			\$2,518	
Consultant and Legal Fees			4,351	
Total Other Expenses			\$6,869	
Total Investment Expenses			\$449,824	72

Section 3 - Investment Information

Increasing the number and size of portfolios managed internally has been a core initiative in reducing PSERS' Total Investment Expenses in recent years. As Chart 11.5 illustrates, Total External Management fees have decreased from \$558 million in Fiscal Year 2013 to \$450 million in Fiscal Year 2019, while Total Net Assets have increased from \$49.3 billion to \$59.1 billion. It is worth noting that these decreases have occurred while Total Internal Management and Total Other Expenses have remained flat.



Section 3 - Investment Information

External management fees are treated as a reduction of the investment revenue of the Fund rather than as a budgeted administrative expense.

Table 11.3

Investment Fees by Manager Fiscal Year ended June 30, 2019 (Dollar amounts in Thousands)

<u>Manager</u>	<u>Total Fees</u>
<u>U.S. Equity</u>	
Radcliffe Capital Management LP	\$3,088
Total - U.S. Equity	3,088
<u>Non - U.S. Equity</u>	
Acadian Asset Management, LLC	1,074
Baillie Gifford Overseas Ltd.	3,156
BlackRock Financial Management, Inc.	(280)
BlackRock Institutional Trust Company, N.A.	1,359
Cederberg Greater China EQ FD	1,414
ECM Feeder Fund 2 LP	4,067
Insight Investment International Limited	644
Marathon Asset Management Limited	3,175
Oberweis Asset Management, Inc.	1,718
QS Batterymarch Financial Management, Inc.	672
Steadview Capital Partners LP	2,147
The Children's Investment Fund LP	14,479
Wasatch Advisors, Inc.	6,609
Total - Non - U.S. Equity	40,234
<u>Fixed Income</u>	
AllianceBernstein L.P.	110
Apollo European Principal Finance Fund II (Dollar A), L.P.	697
Apollo European Principal Finance Fund III (Dollar A), L.P.	2,164
Avenue Energy Opportunities Fund, L.P.	1,900
Avenue Energy Opportunities Fund II, L.P.	652
Avenue Europe Special Situations Fund III (U.S.), L.P.	1,801
Bain Capital Credit Managed Account (PSERS), L.P.	1,870
Bain Capital Distressed and Special Situations 2013 (A), L.P.	2,151
Bain Capital Distressed and Special Situations 2016 (A), L.P.	2,503
Bain Capital Middle Market Credit 2010, L.P.	213
Bain Capital Middle Market Credit 2014, LP	1,183
BlackRock Financial Management, Inc.	4,263
Bridgewater Associates, LP	24,963
Brigade Capital Management, LLC	4,038

() Represents reversal of amount accrued in prior fiscal year.

Section 3 - Investment Information

Investment Fees by Manager Fiscal Year ended June 30, 2019 (Dollar amounts in Thousands)

<u>Manager</u>	<u>Total Fees</u>
Fixed Income (continued)	
Capula Investment Management, LP	730
Carlyle Energy Mezzanine Opportunities Fund II, L.P.	3,104
Carlyle Energy Mezzanine Opportunities Fund-Q, L.P.	1,315
Cerberus Levered Loan Opportunities Fund II, L.P.	1,084
Cerberus PSERS Levered Loan Opportunities Fund, L.P.	7,475
Galton Onshore Mortgage Recovery Fund III, L.P.	203
Galton Onshore Mortgage Recovery Fund IV, L.P.	683
Garda Capital Partners, LP	3,791
Hayfin SOF II USD Co-Invest, L.P.	72
Hayfin SOF II USD, L.P.	1,737
Hayfin Special Opportunities Credit Fund (Parallel), L.P.	841
ICG Europe Fund V, L.P.	953
ICG Europe Fund VI, L.P.	1,486
ICG Europe Fund VII Feeder SCSp	1,727
Insight Investment International Limited	84
International Infrastructure Finance Company, L.P.	904
Latitude Management Real Estate Capital IV, Inc.	738
LBC Credit Partners II, L.P.	199
LBC Credit Partners III, L.P.	1,788
LBC-P Credit Fund, L.P.	4,375
Mariner Investment Group, LLC	1,682
Pacific Investment Management Company (PIMCO)	1,368
Park Square - PSERS Credit Opportunities Fund, L.P.	2,123
Penn Mutual Asset Management, LLC	196
PIMCO BRAVO Fund III Onshore Feeder, LP	1,280
Pugh Capital Management, Inc.	203
PSERS TAO Partners Parallel Fund, L.P.	3,085
Radcliffe Capital Management, L.P.	1,431
Sankaty Credit Opportunities IV, L.P.	962
SEI Investments Company	763
Templeton Investment Counsel, LLC	1,839
TOP NPL (A), L.P.	33
TPG Opportunities Partners II (A), L.P.	155
TPG Opportunities Partners III (A), L.P.	1,604
TSSP Opportunities Partners IV (A), L.P.	1,110
Varde Scratch and Dent Feeder I-A, L.P., The	863
Varde Scratch and Dent Fund, L.P., The	927
Total - Fixed Income	101,421

Section 3 - Investment Information

Investment Fees by Manager Fiscal Year ended June 30, 2019 (Dollar amounts in Thousands)

<u>Manager</u>	<u>Total Fees</u>
<u>Real Estate-Direct Ownership</u>	
Bell Partners Inc.	2,062
Charter Oak Advisors, Inc.	1,159
GF Management, Inc.	131
L & B Realty Advisors, L.L.P.	108
Subtotal - Real Estate-Direct Ownership	3,460
<u>Real Estate-Partnerships/Funds (continued)</u>	
AG Core Plus Realty Fund III, L.P.	223
AG Core Plus Realty Fund IV, L.P.	1,025
AG Europe Realty Fund II, L.P.	998
AG Realty Value Fund X, L.P.	205
Almanac Realty Securities V, L.P.	97
Almanac Realty Securities VI, L.P.	271
Almanac Realty Securities VII, L.P.	884
Almanac Realty Securities VIII, L.P.	1,455
Apollo Real Estate Finance Corp	86
Ares European Real Estate Fund IV, L.P.	1,014
Ares U.S. Real Estate Fund VII, L.P.	25
Ares U.S. Real Estate Fund VIII, L.P.	796
Ares U.S. Real Estate Fund IX, L.P.	649
Avenue Real Estate Fund (Parallel) L.P.	826
Bell Institutional Fund IV, LLC	44
Bell Institutional Fund V, L.P.	862
Bell Institutional Fund VI, L.P.	616
BlackRock Asia Property Fund III, L.P.	0.2
Blackstone Real Estate Debt Strategies II, L.P.	110
Blackstone Real Estate Debt Strategies III, L.P.	1,188
Blackstone Real Estate Partners Europe III, L.P.	681
Blackstone Real Estate Partners Europe IV, L.P.	606
Blackstone Real Estate Partners VI, L.P.	174
Blackstone Real Estate Partners VII, L.P.	1,845
Blackstone Real Estate Partners VIII, L.P.	1,943
Brookfield Strategic Real Estate Partners, L.P.	1,139
Brookfield Strategic Real Estate Partners II, L.P.	2,345
Brookfield Strategic Real Estate Partners III-A, L.P.	603
Cabot Industrial Core Fund, L.P.	1,357
Cabot Industrial Value Fund IV, L.P.	184

Section 3 - Investment Information

Investment Fees by Manager Fiscal Year ended June 30, 2019 (Dollar amounts in Thousands)

<u>Manager</u>	<u>Total Fees</u>
<u>Real Estate-Partnerships/Funds (continued)</u>	
Cabot Industrial Value Fund V, L.P.	1,500
Carlyle Realty Partners IV, L.P.	15
Carlyle Realty Partners V, L.P.	369
Carlyle Realty Partners VI, L.P.	209
Carlyle Realty Partners VII, L.P.	653
Carlyle Realty Partners VIII, L.P.	1,606
DRA Growth and Income Fund IX, LLC	1,359
DRA Growth and Income Fund VI, L.P.	58
DRA Growth and Income Fund VII, L.P.	993
DRA Growth and Income Fund VIII, LLC	1,588
Exeter Core Industrial Club Fund II, L.P.	494
Exeter Industrial Value Fund II, L.P.	7
Exeter Industrial Value Fund III, L.P.	252
Exeter Industrial Value Fund IV, L.P.	1,150
Fortress Investment Fund V (Fund A) L.P.	213
Insight Investment International Limited	43
Latitude Management Real Estate Capital III, Inc.	876
LEM Multifamily Senior Equity Fund IV, L.P.	844
LEM RE High Yield Debt & Preferred Equity Fund III, L.P.	194
LEM Real Estate Mezzanine Fund II, L.P.	24
Paramount Group Real Estate Fund VII, L.P.	36
Pramerica Real Estate Capital VI, L.P.	548
RCG Longview Debt Fund V, L.P.	287
RCG Longview Debt Fund VI, L.P.	1,155
RCG Longview Equity Fund, L.P.	58
Security Capital Preferred Growth (Public)	1,371
Senior Housing Partnership Fund IV, L.P.	530
Senior Housing Partnership Fund V, L.P.	551
Stockbridge Real Estate Fund II, LP	189
Stockbridge Real Estate Fund III, LP	298
Stockbridge Real Estate Fund, L.P.	2,974
Strategic Partners Fund IV RE, L.P.	84
UBS (US) Trumbull Property Fund, L.P.	<u>570</u>
Subtotal - Real Estate-Partnerships/Funds	43,353

Section 3 - Investment Information

Investment Fees by Manager Fiscal Year ended June 30, 2019 (Dollar amounts in Thousands)

<u>Manager</u>	<u>Total Fees</u>
<u>Real Estate-Farmland</u>	
Prudential Agricultural Group	889
Subtotal - Real Estate-Farmland	889
Total Real Estate	47,702
<u>Private Equity</u>	
Actis Emerging Markets 3, L.P.	449
Actis Global 4 L.P.	1,259
Apax Digital, L.P.	1,705
Bain Capital Asia Fund II, L.P.	742
Bain Capital Asia Fund III, L.P.	2,600
Bain Capital XI, L.P.	898
Bain Capital XII, L.P.	1,875
Baring Asia Private Equity Fund III, L.P.	49
Baring Asia Private Equity Fund IV, L.P.	637
Baring Asia Private Equity Fund V, L.P.	3,021
Baring Asia Private Equity Fund VI, L.P.	833
Blue Point Capital Partners II (B), L.P.	19
Blue Point Capital Partners III (B), L.P.	437
Blue Point Capital Partners IV, L.P.	744
Bridgepoint Development Capital III, L.P.	1,265
Bridgepoint Europe IV, L.P.	1,470
Bridgepoint Europe V, L.P.	1,206
Bridgepoint Europe VI, L.P.	250
Capital International Private Equity Fund V, L.P.	377
Capital International Private Equity Fund VI, L.P.	512
Catterton Growth Partners II, L.P.	1,201
Catterton Growth Partners III, L.P.	1,334
Catterton Growth Partners, L.P.	593
Catterton Partners VI, L.P.	734
Catterton Partners VII, L.P.	1,561
Catterton VIII, L.P., L	1,862
Cinven Fund (Fifth), L.P.	707
Cinven Fund (Sixth), L.P.	1,128
Coller International Partners VI, L.P.	865
Coller International Partners VII, L.P.	1,469
Crestview Partners II, L.P.	1,054

Section 3 - Investment Information

Investment Fees by Manager Fiscal Year ended June 30, 2019 (Dollar amounts in Thousands)

<u>Manager</u>	<u>Total Fees</u>
<u>Private Equity (continued)</u>	
Crestview Partners III, L.P.	605
Crestview Partners, L.P.	265
CVC Capital Partners Asia Pacific III, L.P.	156
CVC European Equity Partners V (A), L.P.	39
DCPF VI Oil and Gas Co-Investment Fund, L.P.	131
Denham Commodity Partners Fund VI, L.P.	687
Energy & Mineral Group Fund III, L.P.	1,262
Equistone Partners Europe Fund V E, L.P.	949
Equistone Partners Europe Fund VI E, SCSp	1,498
Evergreen Pacific Partners II, L.P.	121
First Reserve Fund XII, L.P.	308
GoldPoint Partners Co-Investment V, L.P.	387
HgCapital 7 A, L.P.	888
HgCapital 8 D, L.P.	1,659
HGGC Fund II, L.P.	1,186
HGGC Fund III, L.P.	314
Incline Equity Partners IV, L.P.	1,280
Irving Place Capital Partners III SPV, L.P.	733
K4 Private Investors, L.P.	1,213
Landmark Equity Partners XIII, L.P.	237
Landmark Equity Partners XIV, L.P.	405
Milestone Partners III, L.P.	292
Milestone Partners IV, L.P.	257
New Mountain Partners IV, L.P.	260
New Mountain Partners V, L.P.	2,191
New York Life Capital Partners IV-A. L.P.	84
NGP Natural Resources X, L.P.	786
NGP Natural Resources XI, L.P.	1,368
North Haven PE Asia Fund IV, L.P. (Morgan Stanley)	1,219
Odyssey Investment Partners Fund V, L.P.	1,998
Orchid Asia V, L.P.	163
Orchid Asia VI, L.P.	1,176
Orchid Asia VII, L.P.	1,250
PAI Europe V, L.P.	205
PAI Europe VI, L.P.	380
Palladium Equity Partners IV, L.P.	578
Partners Group Secondary 2008, L.P.	617

Section 3 - Investment Information

Investment Fees by Manager Fiscal Year ended June 30, 2019 (Dollar amounts in Thousands)

<u>Manager</u>	<u>Total Fees</u>
<u>Private Equity (continued)</u>	
Partners Group Secondary 2011, L.P.	1,069
Partners Group Secondary 2015 (USD) A, L.P.	1,235
Portfolio Advisors Secondary Fund III, L.P.	884
StepStone International Investors III L.P.	509
Strategic Partners Fund IV, L.P.	113
Strategic Partners Fund V, L.P.	337
Strategic Partners Fund VI, L.P.	708
Strategic Partners Fund VII, L.P.	1,250
Trilantic Capital Partners IV L.P.	68
Trilantic Capital Partners V (North America), L.P.	614
Trilantic Capital Partners VI (North America), L.P.	1,728
Webster Capital IV, L.P.	502
Subtotal - Private Equity	69,021
<u>Special Situations</u>	
Apollo Investment Fund IX, L.P.	887
Apollo Investment Fund VIII, L.P.	865
Cerberus Institutional Partners V, L.P.	777
Cerberus Institutional Partners VI, L.P.	2,600
Clearlake Capital Partners IV, L.P.	591
Clearlake Capital Partners V, L.P.	647
Gold Hill Venture Lending 03-A, L.P.	35
NYLIM Mezzanine Partners Parallel Fund II, L.P.	1
OCM Opportunities Fund VII-B L.P.	146
Searchlight Capital II, L.P.	1,450
Venor Special Situations Fund II, L.P.	804
Versa Capital Fund II, L.P.	1,976
Versa Capital Fund III, L.P.	570
Subtotal - Special Situations	11,350
<u>Venture Capital</u>	
Aisling Capital III, L.P.	69
Aisling Capital IV, L.P.	934
Co-Investment Fund II, L.P.	306
Insight Investment International Limited	36
Insight Venture Partners X, L.P.	1,575
LLR Equity Partners III, L.P.	858

Section 3 - Investment Information

Investment Fees by Manager Fiscal Year ended June 30, 2019 (Dollar amounts in Thousands)

<u>Manager</u>	<u>Total Fees</u>
<u>Venture Capital (continued)</u>	
LLR Equity Partners IV, L.P.	2,297
LLR Equity Partners V, L.P.	3,491
Psilos Group Partners III-C, L.P.	57
Quaker BioVentures II, L.P.	541
SCP Private Equity Partners II, L.P.	377
Starvest Partners II (Parallel), L.P.	316
Strategic Partners Fund IV VC, L.P.	137
Summit Partners Growth Equity Fund VIII, L.P.	1,401
Tenaya Capital VI, L.P.	788
Tenaya Capital VII, L.P.	2,000
Tenaya Capital V-P, L.P.	508
Subtotal - Venture Capital	15,689
Total Alternative Investments	96,060
<u>Absolute Return</u>	
Aeolus Capital Management Ltd.	7,958
AKAZ Offshore Fund LTD	1,357
BlackRock Financial Management, Inc.	2,278
Bridgewater Associates, Inc.	24,695
Brigade Capital Management	2,168
Capula Investment Management, LLP	19,417
Caspian Capital, LP	4,000
Garda Capital Partners, LP	10,009
HS Group Sponsor Fund II Ltd.	651
Independence Reinsurance Partners GP, LLC	2,324
Nephila Capital Ltd.	2,703
Nimbus Weather Fund	1,790
Oceanwood Opportunities Fund	3,415
OWS Credit Opportunity Offshore Fund III, Ltd.	7,264
Pacific Investment Management Company (PIMCO)	7,269
Perry Partners, L.P.	201
Sciens Aviation Special Opportunities Investment Fund II, L.P.	53
Sciens Aviation Special Opportunities Investment Fund III, L.P.	1,895
Sciens Aviation Special Opportunities Investment Fund IV, L.P.	1,670
Two Sigma Risk Premia Enhanced Fund	2,755
Venor Capital Offshore	162
Total - Absolute Return	104,033

Section 3 - Investment Information

Investment Fees by Manager Fiscal Year ended June 30, 2019 (Dollar amounts in Thousands)

<u>Manager</u>	<u>Total Fees</u>
<u>Commodities</u>	
Denham Mining Fund, L.P.	1,016
Gresham Investment Management, LLC	985
NGP Natural Resources XII, L.P.	1,926
Wellington Management Company, LLP	1,071
Total - Commodities	4,998
<u>Master Limited Partnerships</u>	
Harvest Fund Advisors, LLC	3,754
Salient Capital Advisors, LLC	2,961
Stein Roe Investment Counsel D/B/A Atlantic Trust	1,430
Subtotal - Master Limited Partnerships	8,145
<u>Diversified Infrastructure</u>	
Insight Investment International Limited	96
International Infrastructure Finance Company II, LP	547
GCM Grosvenor Customized Infrastructure Strategies II, LP	1,185
Strategic Partners Real Assets II, L.P.	650
Subtotal - Diversified Infrastructure	2,478
Total Infrastructure	10,623
<u>Risk Parity</u>	
BlackRock Institutional Trust Company, N.A.	2,053
Bridgewater Associates, LP	9,536
D.E. Shaw Investment Management, L.L.C.	5,605
Total - Risk Parity	17,194
Total External Management	425,353
Total Internal Management	17,602 *
Total Investment Management	\$442,955

*Internal Management expenses include salaries and fringe benefits of \$12,441 and operating expenses of \$5,161.

Section 3 - Investment Information

Investment Fees and Expenses Initiatives

PSERS continues to pursue several avenues intended to maintain a reasonable cost structure. These initiatives include:

- For external managers making traditional investments, reduce base fees and create better alignment of interests by moving to a lower base fee coupled with a profit share.
- For external managers making traditional and absolute return investments, enter into arrangements for netting of profit shares for managers with multiple PSERS mandates.
- For external managers making non-traditional investments, continue to grow co-investments (which have lower fees and profit shares).
- For external managers making non-traditional investments, move away from paying on committed capital and towards paying on invested capital whenever possible.
- For external managers, re-underwriting all fee arrangements to ensure that the fee arrangements are fair and equitable.
- Research firms specializing in investment management fee negotiations, considering their credentials, references, past performance in reducing investment management fees for clients, and probable cost effectiveness for PSERS, for possible retention.



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Section 3 - Investment Information

Commitment to Pennsylvania Financial Services Firms (as of June 30, 2019)

The members of the Board and Professional Staff are fiduciaries and must act in the interests of the members of the System and for the exclusive benefit of the System's members. In creating the investment program, the Board hires both external and internal investment managers. The Board has determined that it is in the best interest of the System to manage assets internally when (1) the System's investment professionals have the proven ability and capacity to manage portfolios internally at least as well as the external investment managers, and (2) the cost of investing those assets is no greater than the cost that would have been incurred to have those assets externally managed. The Board will also consider the diversification benefits that may be achieved by allocating assets to external portfolio managers even when conditions (1) and (2) are met.

The Board evaluates external managers based on a variety of factors, including: (1) a unique insight or process; (2) the ability to add long-term excess returns above passive alternatives, net of fees; (3) adequate capacity to execute the strategy; (4) adding diversification to our existing investment structure; (5) not exhibiting style drift, and; (6) exhibiting a high level of ethical behavior. In selecting external managers, PSERS will show preference to Pennsylvania-based potential managers that demonstrate similar strengths to alternative managers without a Pennsylvania nexus.

PSERS has shown a strong commitment to Pennsylvania's financial services industry by having assets managed by firms based in Pennsylvania or by firms with offices in Pennsylvania. In FY 2019, investment management fees paid to external firms managing PSERS' assets from offices located in Pennsylvania amounted to \$ 32.4 million, or 7.6% of the total external investment manager fees.

Table 12.1 lists the asset exposures managed internally by PSERS, as of June 30, 2019.

Table 12.1		
Pennsylvania-Based Asset Exposures Managed Internally		
(as of June 30, 2019)		
<u>Asset Class</u>	<u>Market Value (in millions)</u>	<u>% of Total</u>
U.S. Equity	\$2,646.8	10.5%
Non-U.S. Equity	2,497.7	9.9%
Private Markets	690.0	2.7%
Fixed Income	8,412.7	33.5%
Master Limited Partnerships	370.1	1.5%
Commodities	3,483.8	13.9%
Infrastructure	1,211.4	4.8%
Real Estate	601.9	2.4%
Risk Parity	2,508.6	10.0%
Cash Management	2,695.0	10.7%
Totals	<u>\$25,118.0</u>	<u>100%</u>

Section 3 - Investment Information

Commitment to Pennsylvania Financial Services Firms (continued)

Chart 12.1 displays the distribution of exposures managed internally as of June 30, 2019.

Table 12.2 is a list of assets managed by external managers with headquarters or offices located in Pennsylvania, as of June 30, 2019.

Chart 12.1 PA-Based Asset Exposures Managed Internally as of June 30, 2019

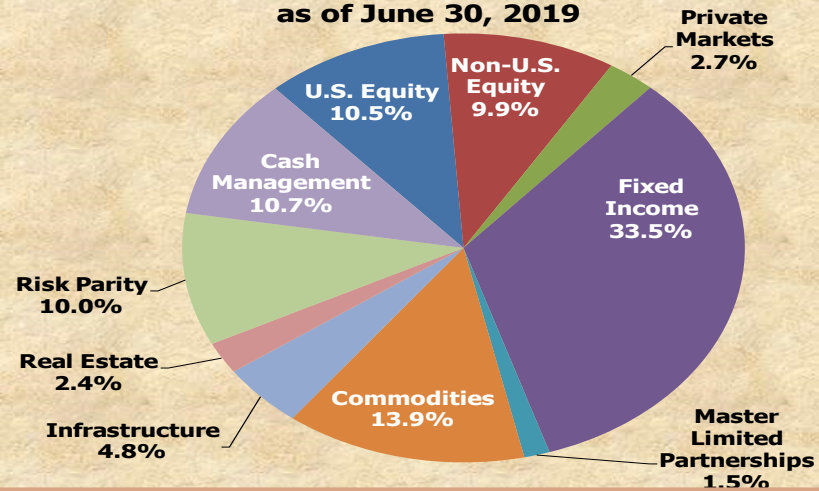


Table 12.2

Pennsylvania-Based External Managers

U.S. Equity:	Private Equity:
Radcliffe Capital Management, L.P.	Incline Equity Partners III, L.P.
	Incline Equity Partners IV, L.P.
Fixed Income:	Milestone Partners III, L.P.
LBC Credit Partners III, LP	Milestone Partners IV, L.P.
LBC Credit Partners-P Credit Fund, LP	PNC Equity Partners II, L.P.
Penn Mutual Management, LLC	
Radcliffe Capital Management, L.P.	Special Situations:
SEI Investments Company	Versa Capital Fund I, L.P.
	Versa Capital Fund II, L.P.
Master Limited Partnership:	Versa Capital Fund III, L.P.
Harvest Fund Advisors, LLC	
	Venture Capital:
Real Estate:	Adams Capital Management, L.P.
BPG/PSERS Co-Investment Fund	Co-Investment 2000 Fund, L.P.
Charter Oak Advisors, Inc.	Co-Investment Fund II, L.P.
Exeter Core Industrial Club Fund II, L.P.	Cross Atlantic Technology Fund II
Exeter Core Industrial Club Fund III, L.P.	Cross Atlantic Technology Fund, L.P.
Exeter Industrial Value Fund II, L.P.	LLR Equity Partners II, L.P.
Exeter Industrial Value Fund III, L.P.	LLR Equity Partners III, L.P.
Exeter Industrial Value Fund IV, L.P.	LLR Equity Partners IV, L.P.
GF Management	LLR Equity Partners V, L.P.
LEM Multifamily Senior Equity Fund IV, L.P.	NEPA Venture Fund II
LEM RE HY Debt & Preferred Equity Fund III, L.P.	Quaker BioVentures II, L.P.
LEM Real Estate Mezzanine Fund II, L.P.	Quaker BioVentures, L.P.
Property Management, Inc.	SCP Private Equity Partners I, L.P.
	SCP Private Equity Partners II, L.P.
Infrastructure:	TDH III, L.P.
International Infrastructure Finance Company Fund, L.P.	
International Infrastructure Finance Company Fund II, L.P.	

Section 3 - Investment Information

Investments in Pennsylvania-Based

Companies

(as of June 30, 2019)

Where investment characteristics including yield, risk, and liquidity are equivalent, the Board's policy favors investments that have a positive impact on the economy of Pennsylvania. The Board, in managing the investment portfolio, will also be cognizant of concentration risk to any one region, including Pennsylvania. The Fund will continue to seek investments in Pennsylvania-based companies when the investment characteristics are equivalent to other favorable investments, subject to diversification considerations.

U.S. Equities

PSERS invests in the stock of Pennsylvania-based companies through the various U.S. Equity portfolios managed by internal portfolio managers. PSERS has always had investments in large national firms located in Pennsylvania.

Fixed Income Securities

PSERS invests in the debt of Pennsylvania-based companies through the various Fixed Income portfolios managed by external and internal portfolio managers. PSERS has always had investments in large national firms located in Pennsylvania.

Private Real Estate

PSERS has investments in limited partnerships that have invested in Pennsylvania real estate properties. PSERS Real Estate program has committed \$17.5 billion to 134 partnerships. From the program inception to June 30, 2019, PSERS has committed capital to 18 partnerships headquartered in Pennsylvania.

Venture Capital

PSERS' Venture Capital program has committed \$3.2 billion to 60 partnerships. In addition to the

current geographically diverse scope of venture capital investments, a historical objective of this program has been to target partnerships that demonstrate an ability to invest in Pennsylvania-based companies. Selected partnerships offer diversification according to geographic region and financing stage within Pennsylvania. From the program inception to June 30, 2019, PSERS has committed capital to 30 partnerships headquartered in Pennsylvania.

Private Equity

PSERS' Private Equity program has committed \$21.8 billion to 164 partnerships. From the program inception to June 30, 2019, PSERS has committed capital to 8 partnerships headquartered in Pennsylvania.

Special Situations

PSERS' Special Situations program has committed \$5.5 billion to 36 partnerships. From the program inception to June 30, 2019, PSERS has committed capital to 3 partnerships headquartered in Pennsylvania.

Private Markets and Real Estate Pennsylvania In-House Co-Investment Program

In April 2015, PSERS' Board approved a \$250 million commitment for PSERS to co-investment in portfolio companies based in Pennsylvania. The portfolio companies are sourced from funds where PSERS or its consultant is an investor. As of June 30, 2019, PSERS has invested \$56.4 million. The market value of the investments total \$78.0 million. The number of employees, payroll, and market value are included within their respective asset class in Table 12.3.

Section 3 - Investment Information

Table 12.3 displays Pennsylvania-based investments and other statistics at June 30, 2019 (\$'s in millions)

Table 12.3

Statistics of Pennsylvania-Based Investments

<u>Asset Class</u>	<i>Total PA Market Value (PSERS' Portion)</i>	<i>Total PA Market Value (Total Invested)</i>	<i># of People Employed</i>	<i>Payroll</i>
US Equities	\$84.0	\$84.0	*	\$ *
Fixed Income	154.2	154.2	*	*
Private Real Estate	76.9	987.5	236	7.0
Private Markets:				
Venture Capital	112.6	735.2	2,117	60.9
Private Equity	1,280.8	22,689.1	37,292	443.4
Private Debt	409.7	12,488.9	10,603	97.6
Total	\$2,118.2	\$37,138.9	50,248	\$608.8

* Statistics for publicly traded companies not included due to the difficulty in obtaining the information.