Develop New and Innovative Investment Strategies in Infrastructure for New York City Employees' Retirement System (NYCERS) Pension Fund

May 2015

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Transport Workers Union (TWU) Local 100

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Acknowledgements

The Capstone team would like to thank the individuals who have guided and supported us throughout the spring 2015 semester and who have shared their valuable knowledge and expertise. We would like to firstly thank our SIPA faculty advisor, Professor Joah Sapphire, for his invaluable advice and guidance. We would also like to thank the staff at the Transport Workers Union (TWU) Local 100, the NYC Employees’ Retirement System, the Office of NYC Comptroller Scott Stringer, the Townsend Group, and Bloomberg, for their continuous feedback and for challenging us to produce quality work.

The following report was prepared by a Capstone team of graduate students from the School of International and Public Affairs (SIPA) at Columbia University for the Transport Workers Union Local 100. This publication was produced to assist TWU Local 100 in their ongoing efforts in the critical area of infrastructure investments in the New York metropolitan area. While the team consulted with TWU Local 100 to produce this publication, this is not a TWU Local 100 product.
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I. Executive Summary

The Problem

Currently, New York City Employees’ Retirement System (NYCERS) pension fund has minimal exposure to infrastructure. As one of the Trustees of NYCERS, Transport Workers Union (TWU) Local 100 requested our Capstone Team to recommend new infrastructure investments that are suitable for NYCERS. In addition, TWU challenged us to develop new criteria beyond traditional investment metrics such as risk-adjusted returns in order to better capture the benefit of infrastructure investments to TWU membership.

Methodology

We first reviewed NYCERS current infrastructure investment policy and infrastructure holdings. Then we summarized the universe of available infrastructure funds and companies investment options for NYCERS through research on Bloomberg and Preqin. We proposed new criteria, discussed those criteria with TWU and applied criteria to rank available infrastructure investments. We further created a new investment product with listed companies in the subway and bus manufacturing supply chain.

Solutions

The Capstone team found objective data to apply new criteria in evaluating an infrastructure investment’s exposure to the New York metro area, jobs created, and use of unionized workers as well as performance. While NYCERS has no exposure to listed infrastructure funds, the new criteria identified three suitable funds. In addition, the Capstone team’s new criteria identified ten unlisted infrastructure funds that perform well compared to industry benchmarks. NYCERS currently has no strategy to evaluate investments that support the supply chain of subway and bus manufacturers; therefore, we created a new listed infrastructure fund that outperforms the US equities market and has high likelihood to appreciate due to the MTA Capital Plan.

II. Overview of Transport Workers Union (TWU) Local 100

The Transport Workers Union of America (TWU), formed in 1934, serves over a hundred thousand member workers in fields related to transit, rail, and air. Its regional flagship chapter encompassing New York City is known as Local 100, and primarily represents workers of the city’s public transportation system as well as several private bus lines serving the metropolitan area. Headquartered in Brooklyn, New York, TWU Local 100 includes approximately 40,000 transportation workers employed by the Metropolitan Transportation Authority (MTA) New York City Transit, MTA Bus Company, Westchester Bee-Line, private paratransit as well as school bus companies, New York Waterway, and Citi Bike. Nearly 95% of the union, or approximately 38,000 members, is employed by the New York City Transit Authority. These workers maintain and operate 468 subway stations, 24 subway lines, 6,000 subway cars, and 4,500 buses. In addition to active workers, TWU also represents 26,000 retirees.
Since TWU Local 100 qualifies as one of the three unions in NYC with the largest number of participating employees, it acts as a Trustee on the Board of Trustees of the New York City Employees’ Retirement System (NYCERS), a $53.4 billion pension fund, which is part of the City’s primary pension funds. New York City has a total of five public pension systems that have combined assets of $160 billion and have the NYC Comptroller as custodian and financial advisor.¹

**Figure 1: NYCERS Board of Trustees**

The Board of Trustees (the Board) is the governing body of NYCERS. Its responsibilities include investing the assets of the retirement system, establishing the administrative budget of the system and promulgating rules and regulations necessary to carry out provisions of law. In addition to other duties, members of the Board are obligated to participate in the monthly investment meetings of NYCERS.

The NYCERS Board of Trustees, as prescribed by the law, consists of eleven members (see Figure 1): the Mayor’s Representative, the City Comptroller, the Public Advocate, the heads of the three unions with the largest number of participating employees, and the five Borough Presidents. The Board is responsible for appointing the Executive Director, who oversees the day-to-day operations of the system.²

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III. Value of Infrastructure Investments

TWU Local 100 recognizes that there is a tremendous need for capital to fund the construction, rehabilitation and expansion of public transportation infrastructure in NYC. According to the New York State (NYS) Office of the State Comptroller (OSC), the Metropolitan Transportation Authority (MTA) will need to invest $106 billion over the next 20 years to maintain and modernize its assets. Of the MTA’s $32 billion 2015-2019 Capital Program, $20 billion is set aside to invest in repairing and upgrading 736 subway and 248 rail stations, 6,000 buses, and over 2,000 miles of track. $10 billion is dedicated to expanding and enhancing the public transportation network. Investments in this category will focus on features such as more accessible stations for seniors and people with disabilities as well as countdown clocks to improve the convenience of traveling. Importantly, $5 billion will be used towards increase the system’s capacity to accommodate an additional 2.5 million residents in the metropolitan region by 2035 (Metropolitan Transportation Authority, 2014).

Historically, public transportation infrastructure in NYC is funded with pay-as-you-go funding from NYC, NYS, the Federal government, and municipal debt. Due to budgetary constraints at the Federal, State and Local level combined with the lack of public support for additional borrowing, there is a $15.2 billion gap in the MTA’s 2015-2019 Capital Program. Recently, many policy makers have looked to private capital, such as NYCERS pension funds, to fund critical investments in infrastructure. As the largest transportation union in the United States and a NYCERS Trustee, TWU enlisted students at Columbia University to study possible investments in infrastructure that not only offer sound risk-adjusted returns but also benefit the New York metropolitan area.

As Trustee, one of the methods in which TWU may assist NYCERS is through recommending financially sound investments. By directing NYCERS’ investments into infrastructure assets that improve the surface and air transportation infrastructure assets of NYC metro area, TWU may help stimulate new economic opportunity for its 40,000 members and support working families in its community.

The objective of this Capstone project is to recommend infrastructure strategies and specific investments that offer favorable risk adjusted returns for TWU, but that also benefit New York City’s metro area. Infrastructure investments will often directly or indirectly benefit the employees and members of TWU; for example, investing in a listed bus manufacturing company may lead to local bus drivers having access to more jobs while investing in a road engineering company could result in potentially safer roads.

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A traditional definition of infrastructure is, “The fundamental facilities and systems serving a community.” In terms of investing profile, infrastructure has several key advantages over comparable asset classes. Infrastructure assets typically display some or all of the following characteristics:

- Provider of Essential Services
- Monopolistic/Quasi Monopolistic
- High Barriers to Entry
- Extended Asset Life
- Stable and Predictable Cash Flows

TWU’s members hold jobs in many sectors of infrastructure, including most notably transport and utilities. As an asset class, infrastructure is also significantly less vulnerable to shocks and risk when compared to most other classes of investments.\(^5\)

**Figure 2: Infrastructure Transactions by Sector (2008-2013)**

<table>
<thead>
<tr>
<th>Sector</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilities</td>
<td>14%</td>
</tr>
<tr>
<td>Energy</td>
<td>15%</td>
</tr>
<tr>
<td>Renewable</td>
<td>29%</td>
</tr>
<tr>
<td>Transport</td>
<td>18%</td>
</tr>
<tr>
<td>Social</td>
<td>18%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
</tr>
</tbody>
</table>


Growth in the infrastructure market has been steady, with an increasing variety of investment opportunities available in the New York City metro area. The total number of infrastructure funds available has been rapidly increasing, having almost tripled from 2007 to 2012. Transport and utilities comprise almost a third of all infrastructure transactions as depicted in Figure 2, and many TWU members hold occupations in these sectors. Total assets under management has grown from $40 billion in 2007 to almost $100 billion in 2013. Figure 3 suggests that the total universe of infrastructure funds has expanded and the number of options available for investors has increased. These funds are the prime targets for our Capstone team’s recommendations, since investing in these funds would bring benefits such as increased employment in addition to financial returns for TWU, its members, and the residents of NYC.

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III. Overview of New York City Employees’ Retirement System

The New York City Employees’ Retirement System (NYCERS) is the largest municipal public employee retirement system in the United States with over 300,000 active members and retirees including civilian employees and uniformed employees.

NYCERS is a defined benefit retirement plan which offers statutory benefits to public sector employees. NYCERS performs many functions for members such as issuing loans, processing refunds and buyback applications, verifying retirement allowances, and much more. All benefits payable are funded by employee and employer contributions and from earnings on the invested assets of the system. NYCERS takes responsibility for maximizing investment returns on the funds of the system and making correct benefit payments under the schedule.
To provide its members, retirees, and beneficiaries with superior service, NYCERS has constructed a comprehensive organizational structure to support its various functions, which is governed by the Board of Trustees. One of its functions is to create the overall investment policy under which the pension funds are invested and in defining the investment objectives and develop a framework under which specific objectives are established with regard to allocating the assets of the pension funds among various investment types.

V. NYCERS Current Performance

Up to January 2015, NYCERS had $53.4 billion of assets under management, which positions it as the second largest public pension fund in NYC in terms of assets. These resources are allocated into two broad categories, equity and fixed income investments, with the former currently representing 65.9% of total assets, or $35.2 billion. Fixed income holdings are $18.2 billion, representing the remaining 34.1% of assets.

Figure 5 shows the composition of the portfolio in January 31, 2015. US equities represent 33% of total assets, followed by Non-US Equities in Developed Markets and Private Equity with 10.4% and 6.9% of total assets, respectively. Infrastructure is included in the Real Assets class, along with Real Estate investments. Together they represent 4.6% of NYCERS’ assets, although its actual exposure to infrastructure is only through a $24 million investment in listed funds, which we describe below in section VIII.

In terms of performance, in the last 10 years NYCERS went from having a market value for its assets of $36.65 billion in the fiscal year ending in 2006 to the current level of $53.4 billion. Figure 6 shows the market value of assets for each year, where the impact of the Global Financial Crisis can be appreciated; the market value of total assets decreased by 8% and 20% for 2008 and 2009, respectively.
Figure 6: Market Value of Assets

Overall, the 10-year return to NYCERS’ portfolio up to January 31, 2015 was 6.90%, which is lower than the NYCERS' Policy Benchmark that takes into account the required returns for different types of investments and that equals 7.12%.\(^6\)

In terms of returns, the main driver of historical performance have been domestic equities, which over the last 10 years have had an annualized 7.86% return. For shorter periods, such as 5 years returns have been much higher, 15.53% for this category.

Real Assets –including infrastructure investments– have had a performance very much in line with equities. Currently this category represents 4.64% of the total portfolio, and during the last 10 years have had a return of 8.83%, somewhat larger than equities. During the last 5 years the return has been much higher, 14.56%, also in line with domestic stocks.

Two natural questions that arise are how this performance compares with what NYCERS Boards of Trustees expects and how it compares with what other pension funds, in particular public pension funds are doing. Regarding the official benchmarks, NYCERS missed the targeted return not only over 10 years as shown above, but also for shorter-term definitions. For 5 years return the gap is -0.51 percentage points (pp), -0.26pp for 3 years and -0.69pp for 1 year returns.

Since the portfolio composition is dominated by US Equities, its performance of total assets tends to mimic the results for US Equities, which as a group is currently close to its benchmark –the Russell 3000

\(^{6}\) The returns calculated using the market value of assets is different than the reported in the reported in the public agenda. Since the methodology is not disclosed we cannot address the differences in calculations.
index— but falls slightly short. For 10y returns the gap is -0.07pp, but is grows larger for 5 years (-0.3pp), 3 years (-0.25pp) and 1 year (-1.24pp).

VI. Comparison to Other Public Pension Funds

Regarding the comparison with other public pension funds, we take advantage of the dataset compiled by the Center for Retirement Research at Boston College, which includes information for 150 public pension funds (PPFs) across the country and reports data one asset allocation and performance — among other variables — between fiscal years 2001 and 2013. While a comprehensive review of this dataset is beyond the scope of this report, there are some comparisons that are useful in benchmarking NYCERS’ performance.

As of 2013, NYCERS was the 14th largest public pension fund in the US in terms of assets, while the two largest are the California Public Employees’ Retirement System (CalPERS) and the California Teachers Retirement System (CalTRS). Together they have around $428 billion of assets and over 2.5 million members.

Public Pension Funds present large variation in terms of their size (measured as assets or members) and in their asset allocation and performance. Table 1 presents some statistics on these issues for 2013 and also presents some data on asset allocation. On average PPFs have had a slightly better performance than NYCERS, both in the short-run with a 13% return for 2013 versus the 12.2% for NYCERS; and in the long-run, with a sample average of 7.3% 10-year return that is larger than the 6.77% of NYCERS.

7 The dataset is available at http://crr.bc.edu/data/public-plans-database/

8 Unfortunately, there is no data on infrastructure as an asset class. Moreover, while reviewing different funds’ policies, we noted that there is not even agreement about the asset class infrastructure is considered part of. Some funds — like NYCERS — put it in Real Assets, others in alternatives, others classify it in Other investments. To be consistent across funds, we use investment in Alternatives as a proxy for infrastructure; even though it may not be 100% accurate for all funds, it is not possible to know for which it is without more information.

9 The value of assets in the database not always matches the official reports by NYCERS. For instance, as shown in Figure 6 in 2013 NYCERS had market value of assets of $45.6 billion, while in the PPP database it is reported a market value of assets of $47.2 billion.
Table 1: Summary Statistics For Public Pension Funds Database For 2013

<table>
<thead>
<tr>
<th></th>
<th>Number of observations</th>
<th>Mean</th>
<th>Median</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Value of Assets</td>
<td>143</td>
<td>19,873</td>
<td>9,183</td>
<td>33,184</td>
<td>205</td>
<td>261,990</td>
</tr>
<tr>
<td>Members</td>
<td>137</td>
<td>178,864</td>
<td>86,094</td>
<td>248,946</td>
<td>3,343</td>
<td>1,671,212</td>
</tr>
<tr>
<td>1-year return (%)</td>
<td>149</td>
<td>13.0</td>
<td>12.7</td>
<td>2.9</td>
<td>4.4</td>
<td>22.5</td>
</tr>
<tr>
<td>5-year return (%)</td>
<td>149</td>
<td>6.2</td>
<td>5.2</td>
<td>3.1</td>
<td>0.7</td>
<td>14.8</td>
</tr>
<tr>
<td>10-year return (%)</td>
<td>147</td>
<td>7.3</td>
<td>7.3</td>
<td>0.8</td>
<td>5.0</td>
<td>9.7</td>
</tr>
<tr>
<td>Allocation to Equities (%)</td>
<td>150</td>
<td>45.9</td>
<td>50.6</td>
<td>18.2</td>
<td>0.0</td>
<td>78.0</td>
</tr>
<tr>
<td>Allocation to Fixed Income</td>
<td>150</td>
<td>21.7</td>
<td>23.0</td>
<td>9.6</td>
<td>0.0</td>
<td>57.8</td>
</tr>
<tr>
<td>Allocation to alternatives</td>
<td>150</td>
<td>14.6</td>
<td>13.9</td>
<td>11.1</td>
<td>0.0</td>
<td>47.0</td>
</tr>
</tbody>
</table>


VII. Impact of Alternative Investments

A first useful relationship we can examine is whether allocation to Alternatives varies by fund size. While it should be expected that the amount allocated would be larger, the answer is not clear in terms of share of total assets. If larger funds allocate relatively more to Alternatives, then exposure to this asset class would “eventually” come as assets grow. If not, then there is a case for investment policies that lead to higher exposure.

Figure 7 shows that the relationship, if any, is negative, although the coefficient is not statistically significant. In a red dot is NYCERS, which has an exposure to Alternatives according to what would be predicted, given its size (the dot is close to the line of predicted values).

Source: Own construction based on the Public Plans Database.
Given that size does not necessarily lead to more exposure to Alternatives, a second useful relationship is between exposure to this category and performance. Since the first responsibility of a pension fund is to generate returns for its members, then examining past decisions and the terms of performance can teach useful lessons for future choices.

Figure 8 presents the relationship between allocation to Alternatives and long-term performance. To examine the role of previous decisions we use allocation to alternatives 10 years ago. The plot shows that funds that allocated more to Alternatives ten years ago experienced a higher return on average. Moreover, the slope of the relationship is statistically significant and equal to 7.6%, which means that increasing allocation to Alternatives in 1 percentage point is associated with 7.6 basis points of higher return.\(^{10}\) Again, in a red dot is NYCERS, which 10 years ago barely had any exposure to Alternatives at only 0.4%.

![Figure 8: Relationship Between Alternatives And Performance](#)

Source: Own construction based on the Public Plans Database.

Overall, the evidence from public pension funds show that there is large variation in terms of both investment strategies and performance, and that there is no single recipe for success. NYCERS is in the upper part in terms of size, but has had only an average performance. The last piece of evidence suggests that exposure to Alternatives and –as we argue– Infrastructure can help boost returns, to provide diversification and to help develop the New York City region.

\(^{10}\) The calculation is 1\%*7.6\%=0.00076 or 0.076\%. 

VIII. NYCERS Current Infrastructure Exposure

NYCERS established the Infrastructure Program in December of 2012 on behalf of its beneficiaries to participate in attractive long-term investment opportunities and to provide diversification to its overall pension investment portfolio. The Program seeks to invest in opportunities in a variety of infrastructure sectors, including but not limited to, transportation, energy, power, utilities, water, wastewater, communications and social infrastructure. Since inception through September 30, 2014, the Program has committed US$195.0 million to three unlisted infrastructure funds and only $25.5 million has been contributed. As the Program matures, the percentage of its market value relative to the total NYCERS pension assets as well as total Real Assets will continue to increase.

NYCERS’ Real Assets Investment Policy Statement (the “IPS”) sets forth its investment principles and guidelines associated with the infrastructure program (the “Infrastructure Program”). Strategic objectives of investing in real assets include getting a hedge against inflation, gaining diversification benefits due to the low correlation to other asset classes and capturing superior risk adjusted returns. “The Program will be funded by an allocation of up to 6% (plus or minus 2%) of the System’s assets. This allocation will be prudently diversified within each component asset class,” according to the IPS. To further mitigate risks, the maximum commitment to a single investment is limited to no more than 15% of a single fund-raise. The Core Infrastructure Investments will represent a majority (60 - 100%) of the Infrastructure Program. The remaining allocation will be invested in Non-Core Infrastructure opportunities that emerge over the market cycle.

A single General Partner is limited to manage no more than 10% of the total Real Assets Program allocation when fully invested. The leverage of all investments in Infrastructure Program will average no higher than 65%. The performance benchmark for the Infrastructure Portfolio is to attain or exceed the Consumer Price Index (“CPI”) plus 4% net of fees over a rolling 5-year period. The Infrastructure Portfolio is expected to generate a total return, net of investment management fees, of at least 6.5%.

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11 “Core Infrastructure Investments include the lower risk strategies that acquire assets that operate in an environment of limited competition as a result of natural monopolies, government regulation or concessions, and generate a reliable income stream.” (NYCERS IPS)

12 “Non-Core Infrastructure Investments seek to capture superior risk-adjusted returns caused by market imbalances. These types of investments are part of opportunistic strategies and will have higher risk driven by the following factors: competition, growth, construction, development, technology, and commodity pricing. Non-Core Infrastructure opportunities include but are not limited to investing in Greenfield projects.” (NYCERS IPS)
A. NYCERS Current Infrastructure Investment Portfolio

Currently, NYCERS is investing in three unlisted infrastructure funds, Brookfield Infrastructure Fund II, IFM Global Infrastructure Fund, and First Reserve Energy Infrastructure Fund II.

As of September 30, 2014

<table>
<thead>
<tr>
<th>Vintage Year</th>
<th>Investment Fund</th>
<th>Closing Date</th>
<th>Committed Capital</th>
<th>Contributed Capital</th>
<th>Distributed Capital</th>
<th>Market Value</th>
<th>TVPI</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Brookfield</td>
<td>7/8/2013</td>
<td>$75,000,000</td>
<td>$25,556,099</td>
<td>$860,836</td>
<td>$25,501,490</td>
<td>NM</td>
<td>NM</td>
</tr>
<tr>
<td></td>
<td>Infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fund II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>IFM Global</td>
<td>1/2/2014</td>
<td>75,000,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fund</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>First Reserve</td>
<td>4/16/2014</td>
<td>45,000,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Energy Infrastructure Fund II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$195,000,000</td>
<td>$25,556,099</td>
<td>$860,836</td>
<td>$25,501,490</td>
<td>1.03x</td>
<td>8.2%</td>
</tr>
</tbody>
</table>

B. Performance Summary

As of September 30, 2014, the Infrastructure Program has achieved a Total Value to Paid-In (TVPI) multiple of 1.03x invested capital and an IRR of 8.2%. TVPI Net of management fees and IRR Net of management fees were also 1.03x and 8.2%, respectively. Note that, given the relative immaturity of the Portfolio and underlying fund investments, the current performance to-date is not meaningful.

C. Portfolio Performance vs. Benchmarks

The performance benchmark for the Infrastructure Portfolio is to meet or exceed the Consumer Price Index ("CPI") plus 4% net of fees over a rolling 5-year period. The Infrastructure Portfolio is expected to generate a total return, net of investment management fees, of at least 6.5%. As of September 30, 2014, the Program outperformed the benchmark by 1.7 percentage points.

Table 2 illustrates that none of NYCERS current infrastructure funds have exposure to New York metro area.
Table 2: NYCERS Infrastructure Holdings

<table>
<thead>
<tr>
<th>Fund Type</th>
<th>Fund Name</th>
<th>Holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlisted</td>
<td>Brookfield Infrastructure Fund II</td>
<td>Entergy Solutions--New Orleans</td>
</tr>
<tr>
<td>Unlisted</td>
<td>Brookfield Infrastructure Fund II</td>
<td>VLI--Brazil</td>
</tr>
<tr>
<td>Unlisted</td>
<td>IFM Global Infrastructure Fund</td>
<td>Arqiva--UK</td>
</tr>
<tr>
<td>Unlisted</td>
<td>IFM Global Infrastructure Fund</td>
<td>50Hertz Transmission--Germany</td>
</tr>
<tr>
<td>Unlisted</td>
<td>IFM Global Infrastructure Fund</td>
<td>Dalkia Polska--Poland</td>
</tr>
<tr>
<td>Unlisted</td>
<td>IFM Global Infrastructure Fund</td>
<td>Wales and West Utilities--UK</td>
</tr>
<tr>
<td>Unlisted</td>
<td>IFM Global Infrastructure Fund</td>
<td>Vienna International Airport--Austria</td>
</tr>
<tr>
<td>Unlisted</td>
<td>IFM Global Infrastructure Fund</td>
<td>Freeport LNG Terminal--Texas</td>
</tr>
<tr>
<td>Unlisted</td>
<td>IFM Global Infrastructure Fund</td>
<td>OPI--Mexico</td>
</tr>
<tr>
<td>Unlisted</td>
<td>IFM Global Infrastructure Fund</td>
<td>Indiana Toll Road</td>
</tr>
<tr>
<td>Unlisted</td>
<td>First Reserve Energy Infrastructure Fund II</td>
<td>PetroFirst--Houston</td>
</tr>
</tbody>
</table>

Source: Preqin

IX. New Infrastructure Investment Criteria

The Capstone team consulted with the Transport Workers Union Local 100 in order to form a set of possible criteria suiting their needs as a NYCERS Trustee as well as the union representing transportation workers. The client’s foremost concern was sound risk-adjusted returns. The client also expressed preferences for investments that support:

- Projects in New York metro area
- The creation of new or higher-paying jobs in New York metro area
- An investment manager or company with reasonable executive pay relative to its median worker salary
- Lower fees relative to the median fee structure of investment funds
- Companies offering services to greenfield design-build infrastructure projects
- Companies with labor neutrality agreements in place or a commitment to adopt labor neutrality agreements
- Companies that are employee owned such as Employee Stock Owned Corporations
- Ethically or socially responsible projects
Due to the lack of available data for many of these categories, the Capstone team was able to focus on only four of the client’s requested criteria: fund performance, projects in the New York metro area, the number of jobs created, and the use of unionized workers. Importantly, these criteria are objective measurements, which allowed us to quantitatively analyze possible investments.

X. Available Options Under Current Infrastructure Investment Policy

A. Listed and Unlisted Infrastructure Funds

Our Capstone Team explored listed and unlisted available infrastructure funds meeting current infrastructure investment policy through Preqin database. According to the Preqin database there are 417 unlisted infrastructure fund managers and 50 listed infrastructure fund managers. This is the entire universe of infrastructure funds as of April 2015, according to Preqin.

Of the 417 unlisted infrastructure fund managers, there are 53 infrastructure fund managers that have a US fund focus and invest in US assets. Of the 50 listed infrastructure fund managers, there are 9 infrastructure fund managers that have a US fund focus and invest in US assets.

Of the 53 unlisted infrastructure fund managers that have a US fund focus and invest in US assets, only 13 have a specific investment industry preference of surface and air transportation. Of these 9 listed infrastructure fund managers that have a US fund focus and invest in US assets, only 2 have a specific investment industry preference of surface and air transportation. After this, we ended with 13 unlisted fund managers and 9 listed fund managers.

Our Capstone Team then downloaded all the completed deals in the industries related to infrastructure (see footnote 13). In the Preqin database there are 118 deals (after we removed deals that are either Bids and Failed Bids). After that we manually matched the completed deals to the 13 unlisted fund managers and 2 listed fund managers. By doing so, we identified 55 deals completed by the 13 unlisted fund managers and 2 deals completed by the 2 listed fund managers. Of these 57 deals (55+2) we found 11 deals that are investments directly into New York metro area.

The Capstone team then also consulted with the Townsend Group who recommended infrastructure investment to NYCERS. We looked at their recommended list and completed additional searches with Preqin, identifying 25 more deals in Power Generation, Power Transmission, Renewable Energy, and Broadband Internet industries. This may be slightly outside of the scope the client is seeking but the Capstone team decided we should add to our list to at least consider at the very beginning.

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Here is the list that meets our criteria of investments directly supporting New York City metro area’s infrastructure:

<table>
<thead>
<tr>
<th>Table 3: Listed And Unlisted Funds With Assets In New York Metro Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fund Type</td>
</tr>
<tr>
<td>Listed</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Unlisted</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<tr>
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<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>

Source: Preqin and conversations with Townsend Group

B. Listed Infrastructure Companies

As the union representing NYC’s bus and subway workers, TWU seeks to ensure that the United States public transit supply chain is well-capitalized. To narrow the universe of listed surface transportation-related companies, the Capstone Team reviewed the MTA’s 2015-2019 Capital Program and identified rolling stock and bus manufacturers as top areas for investment. Over 15% of the total capital program, or $5 billion, is allocated for replacing trains, subway cars, and buses.\(^\text{14}\) Using Bloomberg, we performed a supply chain analysis to the MTA and the NYC Transit Authority. This process yielded two rolling stock manufacturers (Kawasaki and Bombardier) and two bus manufacturers (Volvo and New Flyer). These firms’ contracts for supplying commercial vehicles to the MTA and the NYC Transit Authority are collectively valued at over $2.3 billion. Additionally, we selected ten US-based companies that manufacture $7.6 billion in components used in the final assembly of rolling stock and commuter and city buses.

---

Table 4: Companies In MTA Supply Chain Analysis

<table>
<thead>
<tr>
<th>Tickers</th>
<th>Company</th>
<th>Tier</th>
<th>Annual Relationship Value (in $millions)</th>
<th>Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBD/CN</td>
<td>Bombardier</td>
<td>Vehicle Assembly/Manufacturing</td>
<td>$197</td>
<td>MTA</td>
</tr>
<tr>
<td>PH</td>
<td>Parker-Hannifin</td>
<td>Component Manufacturing</td>
<td>$357</td>
<td>Bombardier</td>
</tr>
<tr>
<td>GE</td>
<td>General Electric</td>
<td>Component Manufacturing</td>
<td>$317</td>
<td>Bombardier</td>
</tr>
<tr>
<td>HON</td>
<td>Honeywell</td>
<td>Component Manufacturing</td>
<td>$241</td>
<td>Bombardier</td>
</tr>
<tr>
<td>KWHIY</td>
<td>Kawasaki Heavy Industries</td>
<td>Vehicle Assembly/Manufacturing</td>
<td>$1,830</td>
<td>MTA</td>
</tr>
<tr>
<td>PCP</td>
<td>Precision Castparts</td>
<td>Component Manufacturing</td>
<td>$1,840</td>
<td>Kawasaki</td>
</tr>
<tr>
<td>FDML</td>
<td>Federal Mogul Holdings</td>
<td>Component Manufacturing</td>
<td>$807</td>
<td>Kawasaki</td>
</tr>
<tr>
<td>RS</td>
<td>Reliance Steel and Aluminum</td>
<td>Component Manufacturing</td>
<td>$594</td>
<td>Kawasaki</td>
</tr>
<tr>
<td>NFI CN</td>
<td>New Flyer</td>
<td>Vehicle Assembly/Manufacturing</td>
<td>$138</td>
<td>MTA</td>
</tr>
<tr>
<td>ALSN</td>
<td>Allison Transmission</td>
<td>Component Manufacturing</td>
<td>$5.4</td>
<td>New Flyer</td>
</tr>
<tr>
<td>VOL VB SS</td>
<td>Volvo</td>
<td>Vehicle Assembly/Manufacturing</td>
<td>$1,436</td>
<td>NYC Transit Authority</td>
</tr>
<tr>
<td>M TOR</td>
<td>Meritor</td>
<td>Component Manufacturing</td>
<td>$1,880</td>
<td>Volvo</td>
</tr>
<tr>
<td>CMI</td>
<td>Cummins</td>
<td>Component Manufacturing</td>
<td>$1,660</td>
<td>Volvo</td>
</tr>
<tr>
<td>WBC</td>
<td>Wabco</td>
<td>Component Manufacturing</td>
<td>$600</td>
<td>Volvo</td>
</tr>
</tbody>
</table>

Source: Bloomberg. Note: the quantified relationship value for Volvo was not found in Bloomberg.15

XI. Analysis and Recommendations

Here we present the analysis separated in three areas, each of which results in a specific recommendation from the Capstone team that would improve NYCERS’ exposure to infrastructure, its performance in terms of returns, and its contribution to the NYC area.

A. Listed Infrastructure Funds

**Recommendation 1:** The Capstone team recommends that NYCERS consider investing in these three listed infrastructure funds with exposure to the New York metro area.

Recognizing that the Brookfield Infrastructure Partners, Brookfield Renewable Energy Partners and Macquarie Infrastructure Company all have exposure to New York metro area projects, we analyzed their performance over five time periods; year to date (YTD), one year, three years, five years and ten years in order to fully evaluate if these are attractive investments for NYCERS.

---

Performance of Brookfield Infrastructure Partners

<table>
<thead>
<tr>
<th>Period</th>
<th>Change</th>
<th>Return</th>
<th>Annual Return</th>
<th>Volatility</th>
<th>Sharpe Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>YTD</td>
<td>3</td>
<td>7.7%</td>
<td>7.7%</td>
<td>20.2%</td>
<td>0.38</td>
</tr>
<tr>
<td>One Year</td>
<td>7</td>
<td>19.1%</td>
<td>19.1%</td>
<td>17.2%</td>
<td>1.11</td>
</tr>
<tr>
<td>Three Years</td>
<td>17</td>
<td>60.3%</td>
<td>20.1%</td>
<td>16.9%</td>
<td>1.19</td>
</tr>
<tr>
<td>Five Years</td>
<td>31</td>
<td>215.2%</td>
<td>43.0%</td>
<td>19.9%</td>
<td>2.16</td>
</tr>
<tr>
<td>Ten Years</td>
<td>32</td>
<td>249.3%</td>
<td>24.9%</td>
<td>28.1%</td>
<td>0.89</td>
</tr>
</tbody>
</table>

Performance of Brookfield Renewable Energy Partners

<table>
<thead>
<tr>
<th>Period</th>
<th>Change</th>
<th>Return</th>
<th>Annual Return</th>
<th>Volatility</th>
<th>Sharpe Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>YTD</td>
<td>3</td>
<td>8.3%</td>
<td>8.3%</td>
<td>22.7%</td>
<td>0.37</td>
</tr>
<tr>
<td>One Year</td>
<td>6</td>
<td>20.2%</td>
<td>20.2%</td>
<td>21.7%</td>
<td>0.93</td>
</tr>
<tr>
<td>Three Years</td>
<td>9</td>
<td>34.7%</td>
<td>11.6%</td>
<td>20.4%</td>
<td>0.57</td>
</tr>
<tr>
<td>Five Years</td>
<td>15</td>
<td>82.1%</td>
<td>16.4%</td>
<td>22.0%</td>
<td>0.75</td>
</tr>
<tr>
<td>Ten Years</td>
<td>21</td>
<td>178.9%</td>
<td>17.9%</td>
<td>23.1%</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Performance of Macquarie Infrastructure Company

<table>
<thead>
<tr>
<th>Period</th>
<th>Change</th>
<th>Return</th>
<th>Annual Return</th>
<th>Volatility</th>
<th>Sharpe Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>YTD</td>
<td>12</td>
<td>17.7%</td>
<td>17.7%</td>
<td>16.7%</td>
<td>1.06</td>
</tr>
<tr>
<td>One Year</td>
<td>29</td>
<td>55.5%</td>
<td>55.5%</td>
<td>21.5%</td>
<td>2.58</td>
</tr>
<tr>
<td>Three Years</td>
<td>54</td>
<td>184.5%</td>
<td>61.5%</td>
<td>21.2%</td>
<td>2.90</td>
</tr>
<tr>
<td>Five Years</td>
<td>69</td>
<td>648.7%</td>
<td>129.7%</td>
<td>27.4%</td>
<td>4.73</td>
</tr>
<tr>
<td>Ten Years</td>
<td>66</td>
<td>390.1%</td>
<td>39.0%</td>
<td>61.7%</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Then we benchmarked each fund to the S&P 500. We find that all these three funds outperform S&P 500 in terms of annual return, especially in the long run. Even though their volatilities are a little high, their Sharpe Ratios are desirable.

Performance of Brookfield Infrastructure Partners

<table>
<thead>
<tr>
<th>10-year</th>
<th>Total Return</th>
<th>Annualized Return</th>
<th>Annualized Standard Deviation</th>
<th>Beta</th>
<th>Alpha</th>
<th>Sharpe Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIP</td>
<td>249.3%</td>
<td>24.9%</td>
<td>28.1%</td>
<td>0.58</td>
<td>0.05%</td>
<td>0.89</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>85.0%</td>
<td>8.5%</td>
<td>20.5%</td>
<td>1.00</td>
<td>0.00%</td>
<td>0.42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R-square</th>
<th>Correlation</th>
<th>Number of Observations</th>
<th>Tracking Error</th>
<th>Information Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIP</td>
<td>18.0%</td>
<td>42.4%</td>
<td>2,516</td>
<td>1.69%</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>100.0%</td>
<td>100.0%</td>
<td>2,516</td>
<td></td>
</tr>
</tbody>
</table>
We find that Information Ratios for all three funds are high, indicating that they are all good investments with high risk-adjusted returns.

B. Unlisted Infrastructure Funds

**Recommendation 2:** The Capstone team recommends that NYCERS should apply new criteria based on factors in addition to returns in order to identify new unlisted infrastructure funds benefiting the New York metro area.

Unlisted funds have the benefit of generating a more direct exposure to particular projects, since these funds often acquire 100% of the assets. At the same time, unlisted funds achieve more diversification than direct exposure by pooling several investors. For this reason, unlisted funds may invest large in more than one project, while individual smaller investors might face limited resources.

A second advantage of unlisted funds is that in the case of being a large contributor to the fund, NYCERS can request that investments meet certain conditions. For example, NYCERS may say, “We will only commit capital as long as it goes to X type of projects.” This particular feature allows NYCERS to introduce more variables into the evaluation of projects and their benefits to the NYC area.

As shown above in Table 2, we identified a total of 13 unlisted fund managers that are involved in deals in the New York metro area. We investigated the funds’ projects and filtered out those that are located in the area thus are more likely to benefit the New York metro. We found that the 13 unlisted funds have 23 projects directly related with New York.
One caveat of this exercise is that unlisted funds, as their name says, are not openly traded on a frequent basis. When a fund managers decide to create a new fund, they meet with potential investors searching for capital. When the desired pool of resources is met, the fund is closed and the stage of investment begins. Since all the funds we include here have passed the investing stage, we are not actually recommending them because it would not be possible to commit capital. We use them as examples of the type of options that are available, but more importantly as an applied illustration of how the Capstone criteria works in practice.

From the outset of the Capstone and with TWU’s input, our group defined a few select criteria with which to measure potential investments. These include the financial returns of the fund, the fees charged, and the potential for job creation in the New York metro area, which is better if these positions are union jobs. We also included executive compensation, benefiting projects with reasonable levels; labor neutrality agreements; and employee stock ownership.

Some variables are more conventional, such as projected returns and fees. Others, such as employer compensation, are intended to reflect potential differences in the fairness of projects’ wages through determining whether the deals completed by these funds support reasonable executive pay relative to its median worker salary. In order to search for a comprehensive database of US employer compensation, our capstone group utilized Columbia Business School resources to access Standard and Poor’s Execucomp, which “offers extensive, transparent executive compensation data, including current, historical, total compensation, executive options, and compensation of industry peers.” Unfortunately however, the details for executive compensation in Execucomp did not reach the level of detail required for adequate comparisons. We obtained similarly limited results when searching for labor neutrality agreements and employee stock ownership.

In many of our searches, the main obstacle to applying the Criteria is first finding the relevant data. While traditional sources as Bloomberg or Preqin include a relatively complete set of information for listed instruments, for unlisted investments it is generally harder to gather data. For these, usually returns are reported; however, other metrics such as fees, the size of the deals involved, or the existence of unions are frequently absent. This made it more difficult to incorporate all the factors we discussed for in the New Infrastructure Investment Criteria section. Thus we decided to reduce the number of variables we focus on to four, which we describe now and are summarized in Table 4.

The first variable is performance, which for unlisted funds is generally reported as the Internal Rate of Return (IRR), defined as the discount rate that makes the Net Present Value of the discounted cash flows of a project equal to zero. While the details require some knowledge of financial arithmetic, what is important is that when comparing two projects with the same characteristics, the alternative with higher IRR will be a better choice.

A second measure of performance we included is the Multiple. It is defined as the ratio of the total benefits derived from investing in one project—including any distributed cash plus the value of the remaining interests in the project, and the total investment in the project. For example if an initial
An investment of $100 has provided the investor of $5 in cash distributions and is currently valued by the market at $102, then the multiple is 1.07x, which is equal to ($102+$5)/$100=1.07.\textsuperscript{17}

The second variable we use in our ranking of alternatives is an estimation of jobs created by the project. Unfortunately it is not possible to directly address the number of positions that a project generates. In lieu of that, we relied in the Regional Input-Output Modeling System (RIMS II) developed by the Bureau of Economic Analysis (BEA) starting in the 1970s. This methodology uses Input-Output models to estimate multipliers of economic activity, and provides a way to estimate the economy-wide effects that an initial change in economic activity has on a particular economy.

While a full description of the methodology, with its assumptions, strengths and weaknesses is beyond the scope of this report, it is worth noting that the RIMS II model provides an estimation of the regional impact of an economic shock. The underlying idea is that investments in a particular industry do not only create economic benefits directly linked to it, but also generate spillovers that benefit other industries. If we take the case of an airport, its total impact will not be limited to what airlines do, but also include other indirect impacts that are linked to its construction which falls under other industries. For instance, an airport will increase retail sales through coffee shops and newsstands located inside. This will then increase the flow of taxis and public transportation, and might even trigger the construction of new infrastructure such as a toll road and parking spaces.

The RIMS II model includes four measures of changes in total economic activity that can be estimated, gross output, value added, earnings, and employment; however, we only consider the latter for our estimations. Each of these metrics considers the total impact across all sectors for a $1 million investment in a particular industry.

We acquired the RIMS II data for the NY-NJ-PA metropolitan area, which includes New York City, Newark and Jersey City.\textsuperscript{18} This is the most accurate definition of multipliers benefiting New York Metro area, although some of the projects presented below are located in other regions, like upstate New York. However, since we are measuring the effect on the New York metro area, we use the same multipliers across all projects.

To construct our measure of job creation we use the size of each project. This was the hardest piece of data to obtain, since for many of them it was not listed in traditional sources such as Preqin. Thus we relied on news reports or other results of web searches. Using our estimation for the size, we applied the job-multipliers for each industry in which the project is categorized. The size (in millions of dollars) times the multiplier provides us with a rough estimation of the number of jobs derived from the project across all industries.

\textsuperscript{17} One important characteristic of using multiples as measure of performance is that it does not consider the time value of money –namely that receiving $100 today is better than receiving the same $100 in one year from now. Thus an investment that delivers $110 today to the investor for every $100 allocated will have the same multiple that other that returns $110 for every $100, but five years from now.

\textsuperscript{18} To be precise, the region includes Bergen, NJ; Essex, NJ; Hudson, NJ; Hunterdon, NJ; Middlesex, NJ; Monmouth, NJ; Morris, NJ; Ocean, NJ; Passaic, NJ; Somerset, NJ; Sussex, NJ; Union, NJ; Bronx, NY; Dutchess, NY; Kings, NY; Nassau, NY; New York, NY; Orange, NY; Putnam, NY; Queens, NY; Richmond, NY; Rockland, NY; Suffolk, NY; Westchester, NY; Pike, PA.
The third variable we included is the existence of unions in the project. The underlying idea is that for two similar projects, the Capstone criteria will prioritize the one that has unionized jobs over the one which does not. To find this information we researched whether employees at the projects are represented by a union recognized by the National Labor Relations Board, an independent federal agency that conducts elections for labor union representation.

Finally, we included a variable that accounts for whether the project is located in the New York metro area and thus will benefit the area. Since the initial idea for the development of the Criteria was to evaluate how different projects benefit the area and to be able to identify those who do not, this is an important part of the valuation. In our example below all projects are related to New York metro area, thus this variable does not generate any value added; however, when comparing with the current exposure to infrastructure funds, which are not necessarily are exposed to the region, it will become more important.

Among the 23 project options we found, we were able to gather a complete set of information for 11 projects from 10 different fund managers. These are shown in Table 5. As we explain above, the value of job creation comes from multiplying the size of the project (in millions of dollars) and the multiplier for the industry. There is wide variation in terms of the size of the projects, ranging from almost $3 billion for Port Elizabeth in New Jersey, to smaller airplane leasing projects from three airlines. Also, four projects do not have data on IRR so for our analysis we use multiples. However, since both measure different elements of the actual return – in particular multiples do not consider the timing of the cash flows – it would be important to complement the analysis by gathering information about IRR.

To increase the scope of our analysis we gathered as much data as we could for the three funds in which NYCERS currently has committed capital. Although we only could find complete data for a subset of the projects, we aggregate them to compare how the Capstone criteria applies to the current exposure and how it would do to other projects we identified. Table 5 summarizes the key variables for the Capstone criteria applied to all the funds we study here.
Table 5: Summary Statistics For Unlisted Fund Projects To Apply Capstone Criteria

<table>
<thead>
<tr>
<th>Fund</th>
<th>Project Short name</th>
<th>Industry</th>
<th>Size ($mn)</th>
<th>New York Performance (IRR)</th>
<th>New York Performance (Multiple)</th>
<th>NY Jobs</th>
<th>Union</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highstar Capital Fund III</td>
<td>Ports America</td>
<td>Seaports</td>
<td>$2,900</td>
<td>1</td>
<td>3.50</td>
<td>1.16</td>
<td>25,231</td>
</tr>
<tr>
<td>Meridian North American Infrastructure Fund</td>
<td>LaGuardia Airport</td>
<td>Airports</td>
<td>$2,595</td>
<td>1</td>
<td>2.30</td>
<td>1.04</td>
<td>32,176</td>
</tr>
<tr>
<td>Gulf Pacific Power</td>
<td>Astoria Energy</td>
<td>Power Generation</td>
<td>$1,300</td>
<td>1</td>
<td>n.a.</td>
<td>1.03</td>
<td>6,963</td>
</tr>
<tr>
<td>United States Power Fund II</td>
<td>Hudson Transmission-EIF</td>
<td>Power Transmission</td>
<td>$850</td>
<td>1</td>
<td>4.20</td>
<td>1.26</td>
<td>4,553</td>
</tr>
<tr>
<td>Starwood Energy Infrastructure Fund</td>
<td>Hudson Transmission-SEGG</td>
<td>Power Transmission</td>
<td>$850</td>
<td>1</td>
<td>10.10</td>
<td>1.34</td>
<td>4,553</td>
</tr>
<tr>
<td>Energy Capital Partners</td>
<td>Besicorp-Empire</td>
<td>Power Generation</td>
<td>$800</td>
<td>1</td>
<td>n.a.</td>
<td>0.89</td>
<td>4,285</td>
</tr>
<tr>
<td>Partners Group Direct Infrastructure 2011</td>
<td>Seabras</td>
<td>Broadband Internet</td>
<td>$500</td>
<td>1</td>
<td>n.a.</td>
<td>0.90</td>
<td>8,659</td>
</tr>
<tr>
<td>Castle Harlan Partners V</td>
<td>Tensar</td>
<td>Transportation Construction</td>
<td>$400</td>
<td>1</td>
<td>32.70</td>
<td>1.55</td>
<td>5,329</td>
</tr>
<tr>
<td>Alterna Core Capital Asset Fund I</td>
<td>American Airlines/Delta Airlines/Evergreen International Airlines</td>
<td>Airplane Leasing</td>
<td>$196</td>
<td>1</td>
<td>10.30</td>
<td>1.32</td>
<td>2,430</td>
</tr>
<tr>
<td>Macquarie Infrastructure and Real Assets</td>
<td>Icon Parking and Goethals Bridge</td>
<td>Several</td>
<td>$2,134</td>
<td>1</td>
<td>n.a.</td>
<td>1.00</td>
<td>30,397</td>
</tr>
<tr>
<td>NYCERS current exposure</td>
<td>Several</td>
<td>Several</td>
<td>$15,110</td>
<td>0</td>
<td>8.20</td>
<td>1.03</td>
<td>21,044</td>
</tr>
</tbody>
</table>

Notes: The column for jobs is derived from the multiplication of the column Size and the multipliers from the RIMS II model from the BEA for each industry. All multipliers are for the NY-NJ-PA metropolitan statistical area. Each entry represents the total change in number of jobs that occurs in all industries for each additional 1 million dollars of output delivered to final demand by the industry corresponding to the entry. According to the BEA, the employment multipliers are based on 2010 data, so to properly reflect the effect we use the size in 2010 dollars, assuming all reported values are for 2014. The number of jobs created for the current NYCERS exposure considers that each position created in the US but outside New York only counts for one quarter of a New York job. This is arbitrary but gives some weight to job creation in the country, although not the same to one in the NY since these do not benefit TWU members.

We have four variables; performance measured as multiple, job creation, an indicator of project located in the New York metro area and the existence of unions. The two former can take different values, while the New York and union indicators are binary and can only be zero or one. Thus a first challenge is how to rank the different alternatives. Since our methodology up to this point allows us to compare between alternatives, at this level of the analysis we are not concerned with the level of a particular variable, only with its ranking within all the options.

For our measures of performance and job creation we proceed by ranking all the different projects and assigning scores based on where they locate in the ranking. We arbitrarily chose to assign four different scores; thus the two best levels of performance get a score of 4, the following three get a score of 3, the next three get a score of 2 and the bottom three receive a score of 1. The scores for each fund are presented in Table 6.
Table 6: Scores For The Variables In The Capstone Criteria

<table>
<thead>
<tr>
<th>Fund</th>
<th>New York</th>
<th>Performance (Multiple)</th>
<th>Jobs</th>
<th>Union</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highstart Capital Fund III</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Meridiam North American Infrastructure Fund</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Gulf Pacific Power</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>United States Power Fund II</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Starwood Energy Infrastructure Fund</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Energy Capital Partners</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Partners Group Direct Infrastructure 2011</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Castle Harlan Partners V</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Alterna Core Capital Asset Fund I</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Macquarie Infrastructure and Real Assets</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>NYCERS exposure</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: For Performance and Jobs, the higher the score the better

For example, in the fifth row, Starwood Energy Infrastructure Fund invested in the Hudson Transmission project. This project brings energy from the PJM system to NYC through a station located in New Jersey (see Table A1 in the Appendix for complete descriptions of the projects). As reported in Preqin, this fund currently has a Multiple of 10.10, thus receives a high score for that, a 4. But the since the project is relatively small—compared to others in the sample, and is in an industry with a relatively low multiplier, our estimation is that it only creates around 4,600 jobs, and thus does not do well relative to other alternatives, receiving a score of 1.

Having created the relative rankings, now our final score is a weighted average of the variables of interest. However, assigning the weights is a challenging task since any choice can be interpreted as arbitrary. Here we work with four different cases that each put more weight to different variables. Analyzing different scenarios is useful to highlight the robustness that a sound investment should present. If a given project performs very well in only one scenario, but does poorly in all the others, then it is hard to make the cases that this project will be a good investment benefiting New York.

We use a case where only performance matters as a benchmark, which is equivalent to putting a weight of 100% to performance and 0 to the other variables. Then we work with a equal-weights case, one-quarter to each variable; the “Performance” scenario that puts 40% weight to performance, keeps 25% for New York and unions and the rest (10%) to jobs; a “Job creation” scenario, with 40% to jobs, one quarter to unions and New York and the remaining 10% to performance; a “Union” scenario, with 40% to this variable, 25% to New York and the remaining 35% splitted between performance and jobs (17.5% each); and a New York scenario, with 40% to this indicator and 20% for each of the other three variables. One can think of infinitely many other possible cases; the objective of this exercise is to show the workings of the Criteria. Adjusting the weights in the template will work for any given values.

Table 7 shows the rankings for each fund for every one of the four cases, where “greener” colors show better scores while “redder” cells mean worse scores; yellow and orange cells imply an intermediate ranking. In the first column is the benchmark of “Performance only”, where Starwood Energy
Infrastructure Fund (SEIF) and Castle Harlan Partners V (CHPV) are at the top. Then the four other cases are presented, and in the last two columns we present the median ranking and the standard deviation of them. Ideally a sound investment will be one that is consistently at high levels in the ranking, such as CHPV or Alterna Core Capital Asset Fund I.

<table>
<thead>
<tr>
<th>Fund</th>
<th>Performance only</th>
<th>Equal weights</th>
<th>Performance Job creation</th>
<th>Unions New York</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highstart Capital Fund III</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Meridiam North American Infrastructure Fund</td>
<td>6</td>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Gulf Pacific Power</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>United States Power Fund II</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Starwood Energy Infrastructure Fund</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Energy Capital Partners</td>
<td>9</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Partners Group Direct Infrastructure 2011</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Castle Harlan Partners V</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Alterna Core Capital Asset Fund I</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Macquarie Infrastructure and Real Assets</td>
<td>9</td>
<td>3</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>NYCERS exposure</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>

In order to present the results in a more straightforward way, Table 8 shows the median ranking for each fund, along with the standard deviation of the rankings across the different scenarios. Since up to this point there is no single optimal weights for each variable, a sound investment will be one that scores well on average (or median in this case) and is consistently in the top performers.

This is the case of Meridiam North American Infrastructure Fund, which was consistently ranked first among this list. Note also that in this list there are four funds that are tied in their median ranking, although the Highstart Capital Fund III is the best in terms of having a lower standard deviation.

The results for the current NYCERS exposure are worth mentioning. Across all the possible scenarios it is in the bottom categories of the ranking. In fact, ranking only based on performance results in the best ranking, though only tied in 6th place, as shown in Table 7. These results highlight the importance of other variable in addition to performance. While net returns are still one of the main drivers of asset
allocation, for a union and a pension fund with a fiduciary responsibility there may be other mechanisms that could complement it.

The variables included here are an illustration of this. Projects that benefit the New York metro area are important for those who live there, as many TWU members are residents of the area. Improving their quality of life may improve their health conditions. Likewise, pension funds have two ways to increase their asset base; higher returns and higher contributions. Job creation can be a powerful tool to increase the asset base, especially if those jobs are union jobs, which is also another important variable for TWU.

<table>
<thead>
<tr>
<th>Fund</th>
<th>Median ranking</th>
<th>Standard deviation of rankings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meridiam North American Infrastructure Fund</td>
<td>1</td>
<td>2.49</td>
</tr>
<tr>
<td>Highstart Capital Fund III</td>
<td>3</td>
<td>1.10</td>
</tr>
<tr>
<td>Starwood Energy Infrastructure Fund</td>
<td>3</td>
<td>2.51</td>
</tr>
<tr>
<td>Castle Harlan Partners V</td>
<td>3</td>
<td>2.51</td>
</tr>
<tr>
<td>Macquarie Infrastructure and Real Assets (MIRA)</td>
<td>3</td>
<td>3.24</td>
</tr>
<tr>
<td>Alterna Core Capital Asset Fund I</td>
<td>4</td>
<td>2.79</td>
</tr>
<tr>
<td>Gulf Pacific Power</td>
<td>6</td>
<td>1.14</td>
</tr>
<tr>
<td>United States Power Fund II</td>
<td>6</td>
<td>2.30</td>
</tr>
<tr>
<td>NYCERS exposure</td>
<td>9</td>
<td>1.52</td>
</tr>
<tr>
<td>Partners Group Direct Infrastructure 2011</td>
<td>9</td>
<td>2.39</td>
</tr>
<tr>
<td>Energy Capital Partners</td>
<td>11</td>
<td>0.89</td>
</tr>
</tbody>
</table>
C. Listed Companies

Recommendation 3: The Capstone team recommends that NYCERS develop strategies to invest in companies that capture the value generated by transportation investments in the New York metro area.

Based on the 14 selected listed companies that play important roles in the public transit supply chain, our capstone team constructed a capstone portfolio with a total amount of $100,000,000 that includes the stocks of these listed companies.

Methodology for Constructing Capstone Portfolio

1) Size each position within the listed infrastructure fund based on approximately 10% of each individual stock’s 30-day average trading volume.

<table>
<thead>
<tr>
<th>Tickers</th>
<th>Company</th>
<th>Average 30-Day Trading Volume (shares)</th>
<th>10% of Average 30-Day Trading Volume (shares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDRBF</td>
<td>Bombardier</td>
<td>317,000</td>
<td>31,700</td>
</tr>
<tr>
<td>PH</td>
<td>Parker-Hannifin</td>
<td>1,350,000</td>
<td>135,000</td>
</tr>
<tr>
<td>GE</td>
<td>General Electric</td>
<td>56,013,000</td>
<td>5,601,300</td>
</tr>
<tr>
<td>HON</td>
<td>Honeywell</td>
<td>2,989,000</td>
<td>298,900</td>
</tr>
<tr>
<td>KWHIY</td>
<td>Kawasaki Heavy Industries</td>
<td>15,100,000</td>
<td>1,510,000</td>
</tr>
<tr>
<td>PCP</td>
<td>Precision Castparts</td>
<td>954,000</td>
<td>95,400</td>
</tr>
<tr>
<td>FDML</td>
<td>Federal Mogul Holdings</td>
<td>150,000</td>
<td>15,000</td>
</tr>
<tr>
<td>RS</td>
<td>Reliance Steel and Aluminum</td>
<td>700,000</td>
<td>70,000</td>
</tr>
<tr>
<td>NFYEF</td>
<td>New Flyer</td>
<td>2,000</td>
<td>200</td>
</tr>
<tr>
<td>ALSN</td>
<td>Allison Transmission</td>
<td>1,800,000</td>
<td>180,000</td>
</tr>
<tr>
<td>VOLVY</td>
<td>Volvo</td>
<td>30,000</td>
<td>3,000</td>
</tr>
<tr>
<td>MTO</td>
<td>Meritor</td>
<td>1,500,000</td>
<td>150,000</td>
</tr>
<tr>
<td>CMI</td>
<td>Cummins</td>
<td>2,000,000</td>
<td>200,000</td>
</tr>
<tr>
<td>WBC</td>
<td>Wabco</td>
<td>600,000</td>
<td>60,000</td>
</tr>
</tbody>
</table>

2) Exclude stocks for which limits are less than 50,000 shares

3) Calculate market value for each stock.

Market value = shares buying * closing price on 04/28/2015.
Table 10: More Information About Listed Companies In The Capstone Portfolio

<table>
<thead>
<tr>
<th>Tickers</th>
<th>Company</th>
<th>10% of Average 30-Day Trading Volume (shares)</th>
<th>Closing Price on 4/28/2015 ($)</th>
<th>Market Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDRBF</td>
<td>Bombardier</td>
<td>31,700</td>
<td>2.02</td>
<td>64,034</td>
</tr>
<tr>
<td>PH</td>
<td>Parker-Hannifin</td>
<td>135,000</td>
<td>120.28</td>
<td>16,237,800</td>
</tr>
<tr>
<td>GE</td>
<td>General Electric</td>
<td>5,601,300</td>
<td>27.12</td>
<td>151,907,256</td>
</tr>
<tr>
<td>HON</td>
<td>Honeywell</td>
<td>298,900</td>
<td>102.93</td>
<td>30,765,777</td>
</tr>
<tr>
<td>KWHIY</td>
<td>Kawasaki Heavy Industries</td>
<td>1,510,000</td>
<td>21.34</td>
<td>32,223,400</td>
</tr>
<tr>
<td>PCP</td>
<td>Precision Castparts</td>
<td>95,400</td>
<td>207.96</td>
<td>19,839,385</td>
</tr>
<tr>
<td>FDML</td>
<td>Federal Mogul Holdings</td>
<td>15,000</td>
<td>13.34</td>
<td>200,100</td>
</tr>
<tr>
<td>RS</td>
<td>Reliance Steel and Aluminum</td>
<td>70,000</td>
<td>65.41</td>
<td>4,578,700</td>
</tr>
<tr>
<td>NFYEF</td>
<td>New Flyer</td>
<td>200</td>
<td>11.64</td>
<td>2,328</td>
</tr>
<tr>
<td>ALSN</td>
<td>Allison Transmission</td>
<td>180,000</td>
<td>30.89</td>
<td>5,560,200</td>
</tr>
<tr>
<td>VOLVY</td>
<td>Volvo</td>
<td>3,000</td>
<td>13.77</td>
<td>41,310</td>
</tr>
<tr>
<td>MTOR</td>
<td>Meritor</td>
<td>150,000</td>
<td>12.84</td>
<td>1,926,000</td>
</tr>
<tr>
<td>CMI</td>
<td>Cummins</td>
<td>200,000</td>
<td>137.25</td>
<td>27,450,000</td>
</tr>
<tr>
<td>WBC</td>
<td>Wabco</td>
<td>60,000</td>
<td>36.48</td>
<td>2,188,800</td>
</tr>
</tbody>
</table>

4) Divide the companies into large companies and small companies.

Based on the market value calculated above, we can divide companies into large companies and small companies, with the dividing line of $10 million. For small companies, we buy the actual level, while for large companies, we want to change their relative allocation based on their roles in MTA's supply chain.

Our calculation shows that there are four small companies: Reliance Steel and Aluminum, Allison Transmission, Meritor, and Wabco. When we buy their shares equal to 10% of average 30-day trading volume, total market value of these shares would be $14,253,700, leaving $85,746,300 to large companies.
<table>
<thead>
<tr>
<th>Tickers</th>
<th>Company</th>
<th>Market Value ($)</th>
<th>Market value of Small Companies ($)</th>
<th>Market value of Large Companies ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDRBF</td>
<td>Bombardier</td>
<td>excluded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PH</td>
<td>Parker-Hannifin</td>
<td>16,237,800</td>
<td>16,237,800</td>
<td></td>
</tr>
<tr>
<td>GE</td>
<td>General Electric</td>
<td>151,907,256</td>
<td>151,907,256</td>
<td></td>
</tr>
<tr>
<td>HON</td>
<td>Honeywell</td>
<td>30,765,777</td>
<td>30,765,777</td>
<td></td>
</tr>
<tr>
<td>KWHIY</td>
<td>Kawasaki Heavy Industries</td>
<td>32,223,400</td>
<td>32,223,400</td>
<td></td>
</tr>
<tr>
<td>PCP</td>
<td>Precision Castparts</td>
<td>19,839,385</td>
<td>19,839,385</td>
<td></td>
</tr>
<tr>
<td>FDML</td>
<td>Federal Mogul Holdings</td>
<td>excluded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS</td>
<td>Reliance Steel and Aluminum</td>
<td>4,578,700</td>
<td>4,578,700</td>
<td></td>
</tr>
<tr>
<td>NFYEF</td>
<td>New Flyer</td>
<td>excluded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALSN</td>
<td>Allison Transmission</td>
<td>5,560,200</td>
<td>5,560,200</td>
<td></td>
</tr>
<tr>
<td>VOLVY</td>
<td>Volvo</td>
<td>excluded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTOR</td>
<td>Meritor</td>
<td>1,926,000</td>
<td>1,926,000</td>
<td></td>
</tr>
<tr>
<td>CMI</td>
<td>Cummins</td>
<td>27,450,000</td>
<td></td>
<td>27,450,000</td>
</tr>
<tr>
<td>WBC</td>
<td>Wabco</td>
<td>2,188,800</td>
<td>2,188,800</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>14,253,700</td>
<td>278,423,618</td>
<td></td>
</tr>
</tbody>
</table>

5) Allocate the $85,746,300 between large companies by their potential benefit from MTA Capital Program.

According to MTA Capital Program 2015-2019, MTA will make purchases of $2,775 million subway cars and $1,002 million buses. We want to give higher weights in our portfolio to the companies that would benefit more from these purchases. The quantitative measure of this benefit is the percentage of company’s total revenue that comes from MTA or the four MTA suppliers (referred to as “revenue percentage”), which equals to yearly relationship value divided by 2014 total revenue. We can then calculate proration ratios between these percentages. Proration ratio for each stock = revenue percentage for each stock / sum of all revenue percentages. Using the proration ratio, we are able to allocate the money between these large companies. Market value of each company’s shares = proration ratio * $85,746,300.
Table 12: Allocation Of Funds To Large Companies

<table>
<thead>
<tr>
<th>Tickers</th>
<th>Company</th>
<th>Relationship Value ($)</th>
<th>Total Revenue ($)</th>
<th>Revenue Percentage</th>
<th>Proration Ratio</th>
<th>Market value of shares purchased ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td>Parker-Hannifin</td>
<td>357,320,000</td>
<td>13,215,970,000</td>
<td>2.7%</td>
<td>5.7%</td>
<td>4,926,272</td>
</tr>
<tr>
<td>GE</td>
<td>General Electric</td>
<td>317,160,000</td>
<td>148,600,000,000</td>
<td>0.2%</td>
<td>0.5%</td>
<td>388,884</td>
</tr>
<tr>
<td>HON</td>
<td>Honeywell</td>
<td>240,560,000</td>
<td>40,300,000,000</td>
<td>0.6%</td>
<td>1.3%</td>
<td>1,087,623</td>
</tr>
<tr>
<td>KWHIY</td>
<td>Kawasaki Heavy Industries</td>
<td>1,830,000,000</td>
<td>11,631,000,000</td>
<td>15.7%</td>
<td>33.4%</td>
<td>28,667,782</td>
</tr>
<tr>
<td>PCP</td>
<td>Precision Castparts</td>
<td>1,840,000,000</td>
<td>9,600,000,000</td>
<td>19.2%</td>
<td>40.7%</td>
<td>34,922,607</td>
</tr>
<tr>
<td>CMI</td>
<td>Cummins</td>
<td>1,660,000,000</td>
<td>19,200,000,000</td>
<td>8.6%</td>
<td>18.4%</td>
<td>15,753,132</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>100.0%</td>
<td></td>
<td>85,746,300</td>
</tr>
</tbody>
</table>

6) Calculate shares to buy of each company.

Shares bought from each company equals the market value of each company’s shares divided by the closing price on 04/28/2015. The following chart presents the allocation of our capstone portfolio. Note that the number of shares we will purchase from Precision Castparts surpasses 10% of its average 30-day trading volume. However, given its large market capitalization of $29,338,000,000, a $34,922,607 purchase is unlikely to interfere with the market.

Table 13: Shares To Buy For Each Company

<table>
<thead>
<tr>
<th>Tickers</th>
<th>Company</th>
<th>Final Market Value ($)</th>
<th>Closing Price on 4/28/2015 ($)</th>
<th>Shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDRBF</td>
<td>Bombardier</td>
<td>-</td>
<td>2.02</td>
<td>-</td>
</tr>
<tr>
<td>PH</td>
<td>Parker-Hannifin</td>
<td>4,926,272</td>
<td>120.28</td>
<td>40,957</td>
</tr>
<tr>
<td>GE</td>
<td>General Electric</td>
<td>388,884</td>
<td>27.12</td>
<td>14,339</td>
</tr>
<tr>
<td>HON</td>
<td>Honeywell</td>
<td>1,087,623</td>
<td>102.93</td>
<td>10,567</td>
</tr>
<tr>
<td>KWHIY</td>
<td>Kawasaki Heavy Industries</td>
<td>28,667,782</td>
<td>21.34</td>
<td>1,343,382</td>
</tr>
<tr>
<td>PCP</td>
<td>Precision Castparts</td>
<td>34,922,607</td>
<td>207.96</td>
<td>167,929</td>
</tr>
<tr>
<td>FDML</td>
<td>Federal Mogul Holdings</td>
<td>-</td>
<td>13.34</td>
<td>-</td>
</tr>
<tr>
<td>RS</td>
<td>Reliance Steel and Aluminum</td>
<td>4,578,700</td>
<td>65.41</td>
<td>70,000</td>
</tr>
<tr>
<td>NFYEF</td>
<td>New Flyer</td>
<td>-</td>
<td>11.64</td>
<td>-</td>
</tr>
<tr>
<td>ALSN</td>
<td>Allison Transmission</td>
<td>5,560,200</td>
<td>30.89</td>
<td>180,000</td>
</tr>
<tr>
<td>VOLVY</td>
<td>Volvo</td>
<td>-</td>
<td>13.77</td>
<td>-</td>
</tr>
<tr>
<td>MTOC</td>
<td>Meritor</td>
<td>1,926,000</td>
<td>12.84</td>
<td>150,000</td>
</tr>
<tr>
<td>CMI</td>
<td>Cummins</td>
<td>15,753,132</td>
<td>137.25</td>
<td>114,777</td>
</tr>
<tr>
<td>WBC</td>
<td>Wabco</td>
<td>2,188,800</td>
<td>36.48</td>
<td>60,000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100,000,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After constructing the portfolio, we would like to compare its historical performance to benchmarks: S&P 500 and CPI plus 4% to check whether it is a sound investment for NYCERS.
Methodology for Comparing Capstone Portfolio’s Historical Performance to Benchmarks

1) Calculate daily historical market value of our capstone portfolio.

Calculate the daily historical market value of our capstone portfolio over the last ten years (from 04/28/2005 to 04/28/2015), with shares for each stock fixed to the quantities we determined. Daily market value for the portfolio = sum of daily market value for each stock. Daily market value for each stock = daily closing price * shares purchased. For some stocks that have not been listed for ten years, we use the closing price for the first day of initial public offering as substitute for the prices before they were listed.

2) Compare the performance of capstone portfolio and benchmarks (S&P 500 and CPI+4%) in terms of total return, annual return, volatility and Sharpe Ratio over various time periods.

Performance of Capstone Portfolio

<table>
<thead>
<tr>
<th>Period</th>
<th>Change</th>
<th>Return</th>
<th>Annual Return</th>
<th>Volatility</th>
<th>Sharpe Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>YTD</td>
<td>(2,729,612)</td>
<td>-2.7%</td>
<td>-2.7%</td>
<td>17.0%</td>
<td>(0.16)</td>
</tr>
<tr>
<td>One Year</td>
<td>1,517,510</td>
<td>1.5%</td>
<td>1.5%</td>
<td>15.7%</td>
<td>0.10</td>
</tr>
<tr>
<td>Three Years</td>
<td>27,157,040</td>
<td>37.3%</td>
<td>12.4%</td>
<td>17.1%</td>
<td>0.72</td>
</tr>
<tr>
<td>Five Years</td>
<td>40,569,636</td>
<td>72.3%</td>
<td>14.5%</td>
<td>20.2%</td>
<td>0.72</td>
</tr>
<tr>
<td>Ten Years</td>
<td>65,018,126</td>
<td>185.9%</td>
<td>18.6%</td>
<td>20.1%</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Performance of SPX (S&P 500)

<table>
<thead>
<tr>
<th>Period</th>
<th>Change</th>
<th>Return</th>
<th>Annual Return</th>
<th>Volatility</th>
<th>Sharpe Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>YTD</td>
<td>56</td>
<td>2.7%</td>
<td>2.7%</td>
<td>12.9%</td>
<td>0.21</td>
</tr>
<tr>
<td>One Year</td>
<td>251</td>
<td>13.5%</td>
<td>13.5%</td>
<td>11.6%</td>
<td>1.17</td>
</tr>
<tr>
<td>Three Years</td>
<td>711</td>
<td>50.7%</td>
<td>16.9%</td>
<td>11.9%</td>
<td>1.42</td>
</tr>
<tr>
<td>Five Years</td>
<td>931</td>
<td>79.9%</td>
<td>16.0%</td>
<td>15.9%</td>
<td>1.01</td>
</tr>
<tr>
<td>Ten Years</td>
<td>972</td>
<td>85.0%</td>
<td>8.5%</td>
<td>20.5%</td>
<td>0.42</td>
</tr>
</tbody>
</table>

We can see that even though the portfolio did not perform well in the short term, it has great performance over the long run, especially in a period of ten years. Because infrastructure investments are mostly long-term investments, performance over ten years is what we emphasize. Annual return of the capstone portfolio over ten years is 18.6%, compared to 8.5% for SPX. The last decade covers the 2008 financial crisis, during which our portfolio outperformed the market in the crisis, indicating that our portfolio is less vulnerable during times of crisis. In terms of volatility, the volatility of the capstone portfolio is a little higher than that of SPX. Sharpe Ratio is a measure for calculating risk-adjusted return. It is the average return earned in excess of the risk-free rate per unit of volatility or total risk. Generally, the greater the value of the Sharpe Ratio, the more attractive the risk-adjusted return. The ten-years Sharpe Ratio of capstone portfolio is higher than that of S&P 500, meaning that our portfolio outperform SPX in terms of risk-adjusted return over ten years.

Annual return of capstone portfolio over the past three years, five years and ten years are higher than CPI+4% (appropriately 8%).
3) Compare the performance of capstone portfolio and S&P 500 in terms of further analysis.

<table>
<thead>
<tr>
<th></th>
<th>10-year</th>
<th>Total Return</th>
<th>Annualized Return</th>
<th>Annualized Standard Deviation</th>
<th>Beta</th>
<th>Alpha</th>
<th>Sharpe Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capstone</td>
<td></td>
<td>185.9%</td>
<td>18.6%</td>
<td>20.1%</td>
<td>0.77</td>
<td>0.02%</td>
<td>0.92</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td></td>
<td>85.0%</td>
<td>8.5%</td>
<td>20.5%</td>
<td>1.00</td>
<td>0.00%</td>
<td>0.42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>R-square</th>
<th>Correlation</th>
<th>Number of Observations</th>
<th>Tracking Error</th>
<th>Information Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capstone</td>
<td>61.8%</td>
<td>78.6%</td>
<td>2,516</td>
<td>0.84%</td>
<td>2.92%</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>100.0%</td>
<td>100.0%</td>
<td>2,516</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Over ten-year time period, compared to S&P 500, our capstone portfolio has lower beta, higher alpha, which means that our portfolio has lower volatility and performs better than the market. R-square=61.8%, correlation=78.6%, and tracking error=0.84%. Tracking error = standard deviation of the difference between returns of the portfolio and the returns of SPX. These show that our portfolio is associated with the market, meaning that its risk is quite low.

Information ratio is a ratio of portfolio returns above the returns of SPX to the volatility of those returns. Information ratio = alpha / tracking error = (return of our portfolio – return of SPX) / tracking error. The higher the information ratio, the more excess returns is generated relative to SPX. A high information ratio can be achieved by having a high return in the portfolio, a low return of the index and a low tracking error. Information ratio of our portfolio is 2.92%, which is high enough to show a good investment.

Figure 9 details a comparison of the three listed infrastructure funds (Brookfield Infrastructure Partners—BIP, Brookfield Renewable Energy Partners—BEP, Macquarie Infrastructure Company—MIC) that are recommended, the new listed infrastructure fund product or the Capstone Portfolio and the S&P 500 (SPX).
Figure 9: Comparison Of Capstone Portfolio And Benchmarks

**Annual Return of Capstone Portfolio, BIP, BEP, MIC and SPX compared**

**Volatility of Capstone Portfolio, BIP, BEP, MIC and SPX compared**

**Sharpe Ratio of Capstone Portfolio, BIP, BEP, MIC and SPX compared**

Source: Described in the text.
Figure 10 illustrates that over the past ten years all three recommended listed infrastructure funds and the Capstone Portfolio outperform the US equity index based on total cumulative returns.

Source: Own construction.
XII. Conclusion

The Capstone team found objective data to apply new criteria in evaluating an infrastructure investment’s exposure to the New York metro area, jobs created, and use of unionized workers as well as performance. While NYCERS has no exposure to listed infrastructure funds, the new criteria identified three suitable funds. In addition, the Capstone team’s new criteria identified nine unlisted infrastructure funds that perform well compared to industry benchmarks. NYCERS currently has no strategy to evaluate investments that support the supply chain of subway and bus manufacturers; therefore, we created a new listed infrastructure fund that outperforms the US equities market and has high likelihood to appreciate due to the MTA Capital Plan.

Based on these findings, the Capstone team recommends that NYCERS:

- Consider investing in the three listed infrastructure funds with exposure to the New York metro area;
- Apply new criteria based on factors in addition to returns in order to identify new unlisted infrastructure funds benefiting the New York metro area; and
- Develop strategies to invest in companies that capture the value generated by transportation investments in the New York metro area.

A key aspect of the Capstone team’s constructed portfolio is its financially sound risk adjusted returns. Reaching an investment return threshold above the pension benefits paid out monthly is critical to NYCERS’ operations. Furthermore, our proposed investments offer both lower volatility and better returns than most comparable options. This suggests that the Capstone portfolio is well-suited to the needs of NYCERS as an institutional investor, and its funds could be an advantageous investment over the long-term. Since NYCERS is a defined-benefit pension plan, there is an interaction with tax frameworks that favors investing in New York metro area infrastructure funds. If its local investments perform well, NYCERS and the local and state government will not need to depend as heavily on tax returns to support pension liabilities. This would likely lead to a reduced tax burden on local taxpayers and TWU’s members.

Ultimately, the Capstone criteria and portfolio are intended not just to highlight potential investments but more importantly our means of evaluating them. By analyzing the funds we selected, our Capstone team determined that their historical returns and performance are desirable when compared to benchmarks such as the S&P 500 for listed products and CPI plus 4% for unlisted products. Our results also showed that NYCERS may benefit by investing in companies that do business with the MTA. Significantly, investments made by these infrastructure funds in New York metro area may augment the local economy, increasing employment rates and economic spillover. This induced industry activity will likely expand the regional tax base and reduce pressure on state and local government budgets. Implementing the Capstone portfolio’s enhanced analysis offers NYCERS the ability to achieve its fiduciary responsibilities and better target its investments to generate numerous additional economic benefits that support the continued sustainability of defined benefit retirement systems.
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