COMMONWEALTH OF PENNSYLVANIA
PUBLIC SCHOOL EMPLOYEES' RETIREMENT SYSTEM

Public Investment Memorandum

NGP Natural Resources XII, L.P.

Commodities Commitment

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July 24, 2018

Recommendation:

Staff, together with Hamilton Lane, LLC, recommends to the Board a commitment of up to $225 million to NGP Natural Resources XII, L.P. (the "Fund"). Fund XII will endeavor to achieve superior risk adjusted returns by exploiting the expertise, scale and technological knowledge NGP has accumulated over nearly 30 years of successful upstream oil and gas investing.

Firm Overview:

NGP Energy Capital Management, L.L.C. ("NGP", the "Firm", or the "Investment Manager") is a global private equity manager specializing in upstream oil and natural gas development primarily in the United States. The firm was founded in 1988 by Ken Hersh, David Albin, John Foster and Gamble Baldwin. Since its founding, NGP has successfully raised $15.8B in commitments to 11 funds. The firm has grown to 59 employees including 32 investment professionals, 12 of whom are active partners. Today the founding partners have transitioned into advisory roles and the firm is led by Managing Partners, Tony Weber and Chris Carter, who have been with NGP for 14 and 11 years, respectively. This generational shift in leadership began in 2013 and was completed in 2016. NGP is headquartered in Irving, Texas with a satellite office in Houston.

In 2012, NGP entered into a strategic relationship with the Carlyle Group, which acquired a passive 47.5% revenue interest in the firm. Pursuant to this agreement, Carlyle acquired an additional 7.5% revenue interest in 2015. Carlyle holds two non-voting observer seats on the NGP investment committee; however, all investment and organizational decisions are made by the NGP partners.

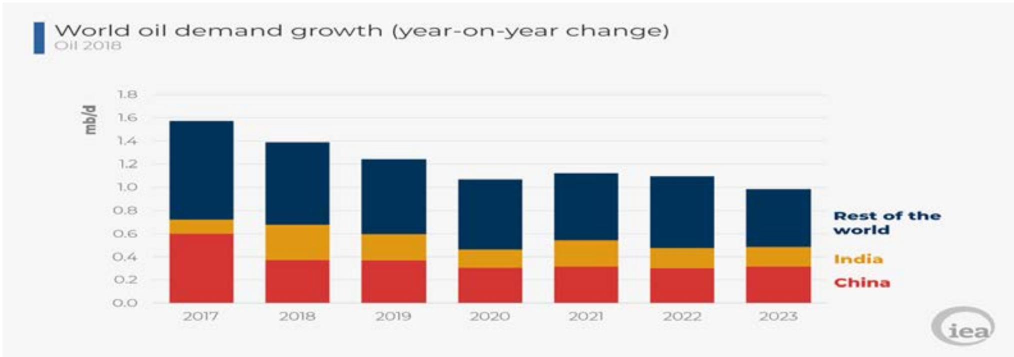
Fund Size:

NGP has targeted $5.3B of commitments for fund XII with a hard cap at $5.8B. The fund will focus on upstream oil and natural gas opportunities throughout North America with opportunistic investments in midstream assets and oilfield services. To date NGP XII has committed $1.4B to nine projects.

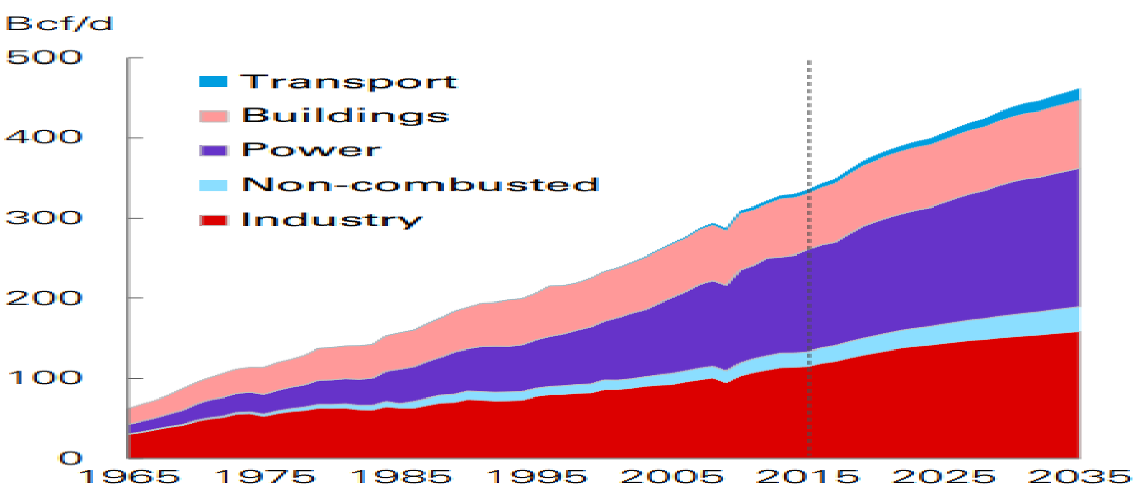
Market Opportunity:

NGP seeks to profit from growing global energy demand as emerging markets industrialize and experience higher GDP per capita and greater energy consumption. The EIA (Energy Information Administration) projects that global oil demand will grow from 98.4 million barrels per day in the first quarter of 2018 to 101.5M barrels per day in 2020[1] and that annual demand growth will continue at a rate of 1.0M barrels per day through 2023. India and China alone are expected to contribute nearly half of this growth.[2]. Global natural gas demand has grown from 243B cubic feet per day (Bcf/d) in 2000 to 336 Bcf/d in 2015 and is expected to hit 402 Bcf/d by 2025.[3]

[1] Robert S. Kaplan president and CEO of the Federal Reserve Bank of Dallas "A Perspective on Oil" June 19, 2018
[2] IEA Oil 2018 Executive summary "Analysis and Forecasts to 2023"
[3] NGP Natural Resources XII, L.P. Private Placement Memorandum

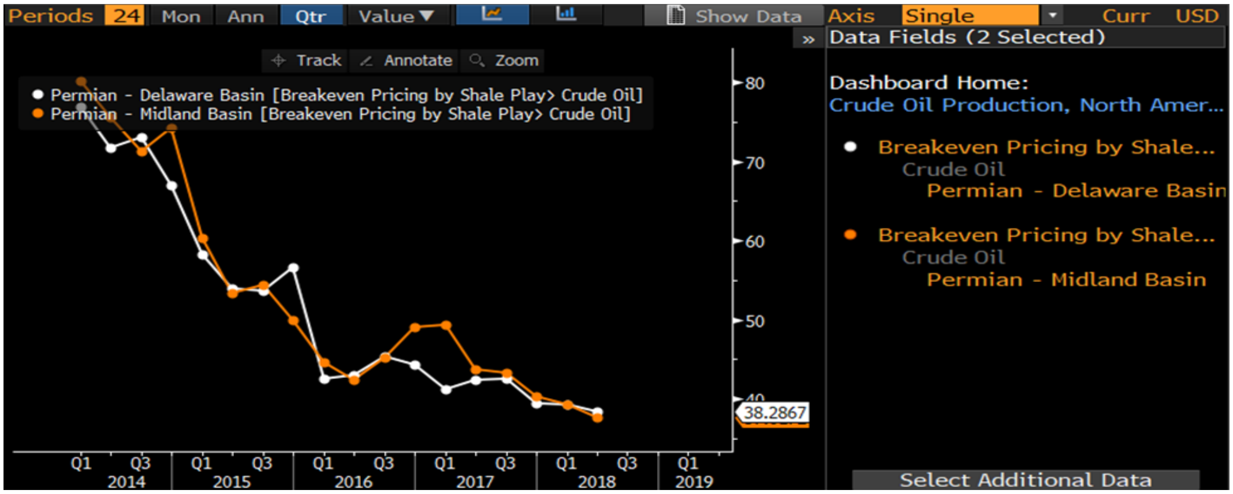


Natural Gas Consumption by Sector[4]



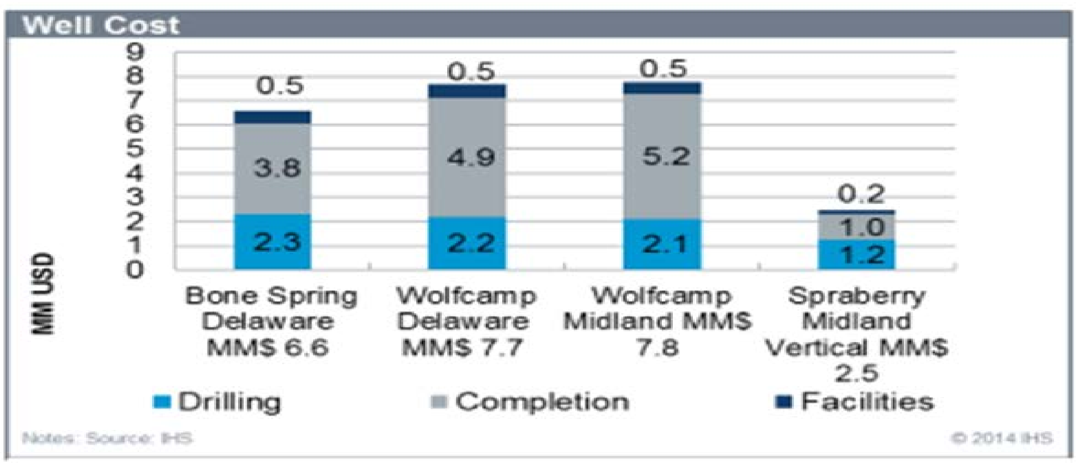
Advances in shale technology, including hydraulic fracturing and horizontal drilling techniques, have allowed the continental United States to act as the primary new source of supply for this growing energy demand. U.S. oil production has grown from 5.5M barrels per day in 2010 to 10.4M bpd today[5] with the US poised to become the world's largest crude oil producer in 2018. Continued technological advances including longer laterals, more efficient fracks and multi-leveled wells position the US for continued growth in production. Indeed, the Permian basin alone is projected to grow from 3.3M barrels per day to 5.4M by 2023 making this single region a more prolific supplier than any single OPEC member other than Saudi Arabia.[6] With regards to natural gas, the US has seen production grow from 61.3B cubic feet per day in 2010 to 98.3 Bcf/d in 2018.[7] Most significantly, these technological advances have allowed NGP portfolio companies to operate profitably at even lower commodity prices. The manager estimates that today's Permian wells can deliver higher returns at oil prices of $50/barrel than those drilled in 2014 did with $90 crude.

[4] BP-Energy Outlook 2017
[5] EIA Monthly U.S. Crude Oil Production (June 2018)
[6] EIA Drilling Productivity Report, Reuters "Permian Basin Oil" June 13, 2018 (reference IHS Markit Report)
[7] EIA Monthly U.S. Natural Gas Production (March 2018)



Source: Bloomberg

The increased profitability of modern wells requires both scale and capital. While the small vertical wells of the past could be completed for $2.6M or less, the horizontal wells and hydraulic techniques currently deployed can cost $6.5M to $10M. Additionally, fractured wells tend to have accelerated depletion times, hitting peak production in the first few months and seeing declines of up to 80% in the first year. This dynamic means that scale and continued access to capital are critical components to success.



Source: IHS, EIA "Trends in US Oil and Natural Gas Upstream Costs" March, 2016.

Portfolio Fit:

A commitment to the Fund will be allocated to PSERS' Commodity portfolio in a fashion similar to the recently approved allocation to private mining via Denham Mining Fund L.P. In order to achieve effective protection from inflationary environments, the PSERS' strategic asset allocation targets an 8% allocation to commodities. While commodities provide strong inflation hedging attributes, they also have a relatively low Sharpe ratio (0.14 vs. 0. 35 for equities and 0.55 for global bonds).[8] An allocation to private energy development is designed to retain the inflation hedging elements of commodities (as prices rise, more technically challenging hydrocarbons may become economically viable for extraction) in addition to the basic private equity value proposition (skilled managers improving business economics and selling as cash flow grows). The strategy does require some sacrifice of liquidity; however, this opportunistic allocation

[8] Bridgewater Associates presentation to PSERS board September 14, 2017.

remains modest vs. the overall PSERS commodities allocation of over $4.2 billion, the vast majority of which currently offers daily liquidity. We estimate that oil and natural gas comprise approximately 30% of the overall Bloomberg Commodity Index, implying a look-through allocation of $1.3 billion to this market segment.

Investment Strategy:

NGP deploys a "buy and build strategy" which seeks to acquire contiguous acreage in the core areas of leading basins throughout the U.S. by partnering with local operating teams to achieve scale, navigate technical challenges, bring assets into production and enhance efficiency. Ultimately, these scaled projects are exited either through sales to strategic buyers or public investors. NGP uses minimal leverage and hedges production whenever possible, choosing to rely on development skill rather than financial engineering or commodity price volatility to drive returns. Key aspects of the strategy include:

- **Management Teams With Historical Success**
- **Control Positions Allowing Creativity**
- **Capital Discipline that Feeds The Winners**
- **Risk Aversion**.

Investment Instruments:

Given the potential for attenuated investment cycles, operational delays and vicissitudes of commodity prices, NGP relies primarily on equity, and not debt, to finance its investments. In most cases NGP will only hold private equity positions; however, on occasion, NGP may continue to hold public equities after an initial public offering due to lock-up provisions or a belief that the securities remain undervalued. NGP will hedge production whenever possible utilizing an array of derivative instruments including swaps, futures and options but the firm will not speculate on commodity prices.

Investment Team:

Having completed its generational management transition, NGP is currently led by managing partners Tony Weber and Chris Carter. Equity has been distributed to 11 additional individuals listed below. All partners participate on the investment committee. While a majority of votes is required to approve an investment, the process is collaborative, ensuring that concerns are addressed and that consensus is achieved by the time of a vote.

Name	Role	Investment Team	Yrs. Experience Total/NGP	Prior Experience
Tony Weber	Managing Partner	Yes	32 /14	Merit Energy, Union Bank of California
Chris Carter	Managing Partner	Yes	13 /11	McKinsey & Company, Deutsche Bank
Richard Covington	Partner	Yes	34/21	Thompson & Knight LLP
David Hayes	Partner	Yes	21/17	Charles Bank Capital Partners, Merrill Lynch
Craig Glick	Partner	Yes	32/11	NGP Midstream & Resources, Kosmos Energy Holding, Hunt Resources, Hunt Oil Company, Gulf Canada Resources, Vinson & Elkins LLP, Torch Energy Advisors
Scott Gieselman	Partner	Yes	30/11	Goldman Sachs & Co.
Brian Minnehan	Partner	Yes	21/11	Prudential Capital Group, Rothschild, Inc., Arthur Andersen

Robert Edwards	Partner	Yes	39/8	BP plc., McKinsey & Company, Marathon Oil Company, Brown and Root International
Patrick McWilliams	Partner	Yes	17/3	J.P. Morgan Securities
James Wallis	Partner	Yes	13/1	Lime Rock Partners, Merrill Lynch, Petrie Parkman & Co.
Jill Lampert	Chief Financial & Administrative Officer	Yes	29/11	NGP Midstream & Resources, Arthur Andersen
Jeff Zlotky	Partner/General Counsel	Yes	32/3	Thompson & Knight LLP
Brian Patterson	Partner/Investor Relations	Yes	17/2	Notre Dame University Investment Office, Goodwin Proctor, LLP, Verrill Dana LLP

Investment Highlights:

Uniquely Positioned Management Team Leveraging Scale and Expertise
NGP's long tenure provides a competitive edge when sourcing top operating partners. Over 95% of the manager's historical transactions have come through proprietary sources including repeat management teams and organically cultivated relationships. NGP's scale offers operators confidence that successful projects will have access to follow-on capital. Such funding is a pivotal component of modern resource development, which leverages larger, more capital intensive, technologically sophisticated extraction techniques to operate profitably at lower natural resource prices.
Diversified Portfolio Construction Philosophy and Aversion to Leverage Limit Downside
NGP deploys a risk averse strategy that focuses on core areas of the top hydrocarbon basins in North America. Further protection is offered through diversification by targeting 30-40 investments and channeling follow-on capital to the most successful projects. NGP eschews financial leverage, allowing the manager to retain control of assets through a commodity cycle. In aggregate, this conservative approach has allowed the manager to hold its loss ratio to just ~18% and deliver a profit in all of its historical funds.
Attractive Way To Protect Against Inflation
Liquid commodities offer low long-run expected returns (typically in line with inflation) while incurring substantial volatility. The most common method for gaining exposure is through futures contracts, introducing the potential that roll yield (the difference between the futures price and expected spot price) can overwhelm the actual commodity return. By contrast NGP targets returns in line with other private equity strategies and offers the inflation hedging aspects of owning physical commodities (i.e. hydrocarbons in the ground). Moreover, technological advances provide protection against falling commodity prices by reducing extraction costs.
Savvy Exploitation of Public/Private Exit Opportunities
NGP has demonstrated an ability to consolidate positions into larger companies that can appeal to both the major E&P operators and the public IPO market. This ability to access multiple exit channels enhances flexibility and transaction multiples.
Ancillary Energy Businesses Enhance Diversification and Can Boost Returns
NGP's historical relationships, repeat management teams and creative structuring have allowed the manager to develop companies that play supporting roles in upstream energy development including frack-sand miners and mid-stream MLPs. In addition to lifting profit margins for upstream companies, these ancillary businesses can provide independent sources of return, further diversifying the return stream.

Investment / Risk Considerations:

Regulatory and Environmental Risk
Although NGP has a thoughtful and thorough environmental, social and governance policy, energy exploration and development involves environmental and regulatory risks that cannot be completely avoided. We take comfort in the fact that NGP's long operating history and diligent attention to these issues position it to minimize any issues and navigate both the existing and future regulatory frameworks. Moreover, NGP's scale affords the company with substantial resources to dedicate toward these issues.
Founding Partners Transition To Advisory Status
In 2016 NGP Founders and Managing Partners transitioned to advisory roles. Current Managing Partners, Tony Weber and Chris Carter, have been with the firm for 14 and 11 years, respectively, and have been deeply involved

in management of the firm. The firm's deep bench of talent includes 11 additional partners, 7 of whom have been with NGP for a decade or longer. The strong performance of Fund XI, the predecessor to Fund XII, provides evidence of a successful management transition.
Fossil Fuel Disruption
The combination of electric vehicles and enhanced fuel efficiency (via self-driving cars and other technology) introduces the risk that oil demand could peak and ultimately decline. While we acknowledge this long run possibility, we note that annual global oil demand is projected to grow by 1M barrels per day through 2023 due largely to emerging market growth. Importantly, as natural gas takes market share from coal in the generation of electricity, NGP stands to benefit from the ultimate shift to electric vehicles. Finally we would point to the relentless pace of innovation in hydrocarbon recovery, allowing shale producers to operate profitably at lower prices.
Energy Price Volatility
NGP attempts to hedge production costs whenever possible in order to mitigate downside. Nevertheless, it is often difficult to completely hedge exposure over longer time frames. It is impossible to hedge the price of commodities in the ground that have not been brought into production. While this dynamic does boost the volatility of returns, it also allows NGP to serve as a meaningful hedge against long-term commodity price inflation, the core purpose of our investment.

PSERS History & Performance:

NGP XII will be PSERS third fund investment with the company. Additionally, PSERS has participated in two co-investments with the manager. In 2012 PSERS allocated $100M to NGP Natural Resources X. This proved to be a challenging vintage year with capital deployment occurring during a period of high oil prices; however, the fund has delivered a net IRR of 5.8% to date, substantially better than the 2.3% loss of the public market equivalent.[9] Moreover, the manager continues to strategically work to extract value from these investments and remains optimistic that Fund X can deliver a low double-digit return by the end of the fund's life. In June 2014 PSERS allocated $100M to NGP Natural Resources XI. The fund is off to an auspicious start with a net IRR of 24% and a TVPI of 1.3x. In 2015 PSERS allocated $15M to a natural gas development co-investment. Finally, early this year PSERS engaged in a second $15M co-investment which portends to be one of NGP's most successful.

NGP Natural Resources Performance (as of 3/31/2018)								
	Commitment	Vintage year	Contributions	Distributions	Valuation	IRR	TVPI	DPI
NGP Natural Resources X, L.P.	100,000,000	2012	99,323,661	67,837,087	48,926,388	5.8%	1.2	0.7
NGP Natural Resources XI, L.P.	100,000,000	2014	83,838,917	12,687,047	95,464,485	24.0%	1.3	0.2
2015 Co-Investment	15,000,000	2015	15,000,000		17,007,804	5.1%	1.1	0.0
Total	215,000,000		198,162,578	80,524,134	161,398,677	9.4%	1.2	0.4

Investment Committee Disclosure:

Relationship with Hamilton Lane:	None
Introduction Source:	Fund Sponsor
Placement Agent:	Not used
PA Political Contributions:	None Disclosed
PA Presence:	None currently
Potential Conflicts:	None Disclosed

[9] Hamilton Lane Private Market Equivalent Estimate

First Time Fund With PSERS:	No
PSERS AIC Approval:	July 24, 2018

Oversight Responsibility:

Investment Office:	Charles J. Spiller Thomas A. Bauer Ray Schleinkofer Michael Tyler	Deputy CIO, Non-Traditional Investments Deputy CIO, Traditional Investments Senior Portfolio Manager Portfolio Manager
External Consultant:	Hamilton Lane	

June 27, 2018

Board of Trustees
Commonwealth of Pennsylvania
Public School Employees' Retirement System
5 North 5th Street
Harrisburg, PA 17101

Re: NGP Natural Resources XII, L.P.

Dear Trustees:

NGP Energy Capital Management, L.L.C. ("NGP") was founded in 1988 by Ken Hersh, David Albin, John Foster and Gamble Baldwin; Messrs. Hersh and Albin transitioned to Advisory Partners in 2016, and the firm is currently led by Tony Weber and Chris Carter. In 2012, NGP formed a strategic relationship with The Carlyle Group when it acquired a 47.5% stake in NGP; the General Partner serves as Carlyle's investment platform for North American private equity energy exposure. The senior investment professionals have an average tenure of over nine years, which drives team cohesion and consistent decision-making. NGP employs 25 investment professionals, located in offices in Irving and Houston; the investment team is supported by 4 Advisory Partners and 32 back-office professionals. The General Partner maintains multiple committees to focus on various aspects of the investment and firm management processes: the Investment Process Committee completes an initial review of investment opportunities, the Investment Committee, requiring a majority decision, makes the ultimate decision on investment opportunities and the Executive Committee makes all of the decisions related to firm-wide management, strategy and compensation. NGP is targeting $5.325 billion in commitments from limited partners for its twelfth buyout fund, NGP Natural Resources XII, L.P. (the "Fund"). NGP has completed three closings with commitments totaling $2.8 billion, as of March 2, 2018. The General Partner will commit at least 2% of commitments to invest in or alongside the Fund.

Consistent with prior funds, NGP intends to create a diversified portfolio of investments across all major basins in the United States and Canada, identifying opportunities within each basin based on market conditions. The General Partner intends to invest the majority of the Fund in upstream oil and gas; however, it retains the ability to invest opportunistically across the energy and power value chain. NGP generally invests in companies at various stages of their life cycle through a line of equity strategy, which enables it to make small initial commitments and subsequently scale its investment size to match each company's performance. The line of equity strategy limits downside risk by enabling the General Partner to limit funding to underperforming businesses and mitigates commodity risk as capital is staged in over multiple years. NGP's brand name as a preferred partner, deep network of relationships and its ability to invest in management teams on a repeat basis has driven bilateral deal flow. Additionally, NGP has focused on supporting young and technically-skilled teams, which is expected to drive direct sourcing capabilities in unconventional resource plays. Post-investment, NGP typically seeks to drive value by improving the management of assets, optimizing portfolio companies' capital structures and strategically repositioning companies for enhanced access to capital markets. The Fund will primarily target equity investments in the range of $10 million to $550 million; NGP estimates that the Fund will make 30 to 40 investments. The General Partner has generated consistent and attractive net performance across prior funds; additionally, NGP's focus on capital preservation has resulted in limited losses.

NGP Natural Resources XII's investment thesis can be summarized as follows:

- NGP has a cohesive team with significant energy investment experience that drives effective decision-making

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- The General Partner's sourcing is driven by partnering with repeat management teams and its reputation for supporting emerging management teams
- Conservative approach focused on downside protection; NGP has produced consistent, attractive performance with limited losses in prior funds

Hamilton Lane's recommendation is based upon the following analytical factors and is made within the context of Commonwealth of Pennsylvania, Public School Employees' Retirement System's ("PSERS") investment guidelines.

- Detailed due diligence, including interviews with industry peers and private equity professionals. The initial review was completed March 27, 2017; the on-site due diligence was conducted June 12, 2017; the Fund was approved by Hamilton Lane's Investment Committee on July 10, 2017; additional review was completed on behalf of PSERS June 15, 2018 and the recommendation to PSERS was issued June 27, 2018.

- Evaluation of the composition of the investment team, how they work together, compensation structure and other factors that help determine whether a group is likely to be able to replicate past successes as currently configured.

- Detailed Operational Due Diligence, including interviews with NGP's operations team to review the controls and processes surrounding the firm's finance, fund administration, tax, legal, compliance, IT, HR and accounting functions.

- Evaluation of the Fund's proposed investment strategy within the context of the current investment environment.

- The strategy proposed for the Fund is appropriate for the Commodities component of the portfolio.

The individuals at Hamilton Lane who were involved in the due diligence process for the Fund are:

Lars Pace – Principal, Bala Cynwyd Office
Charlotte Tant – Analyst, London Office
Roy Walker – Analyst, Bala Cynwyd Office

Based on the above, Hamilton Lane recommends that PSERS commit up to $225 million in NGP Natural Resources XII, L.P. Hamilton Lane makes this recommendation considering the General Partner's qualifications and PSERS' overall investment guidelines.

This recommendation is given solely for the benefit of PSERS and cannot be relied upon by other investors, considering an investment in the Fund, since their needs, objectives and circumstances may not be identical to those of PSERS. The scope of this recommendation is limited to the investment merits of the Fund. Hamilton Lane does not provide legal or other non-investment-related advice.

Sincerely,

Michael Koenig, Managing Director	Corina English, Principal