

P I M C O

Rotterdam, June 2019

Craig Dawson

Innovation in Investment Management

For professional investors use only

A company of **Allianz** 



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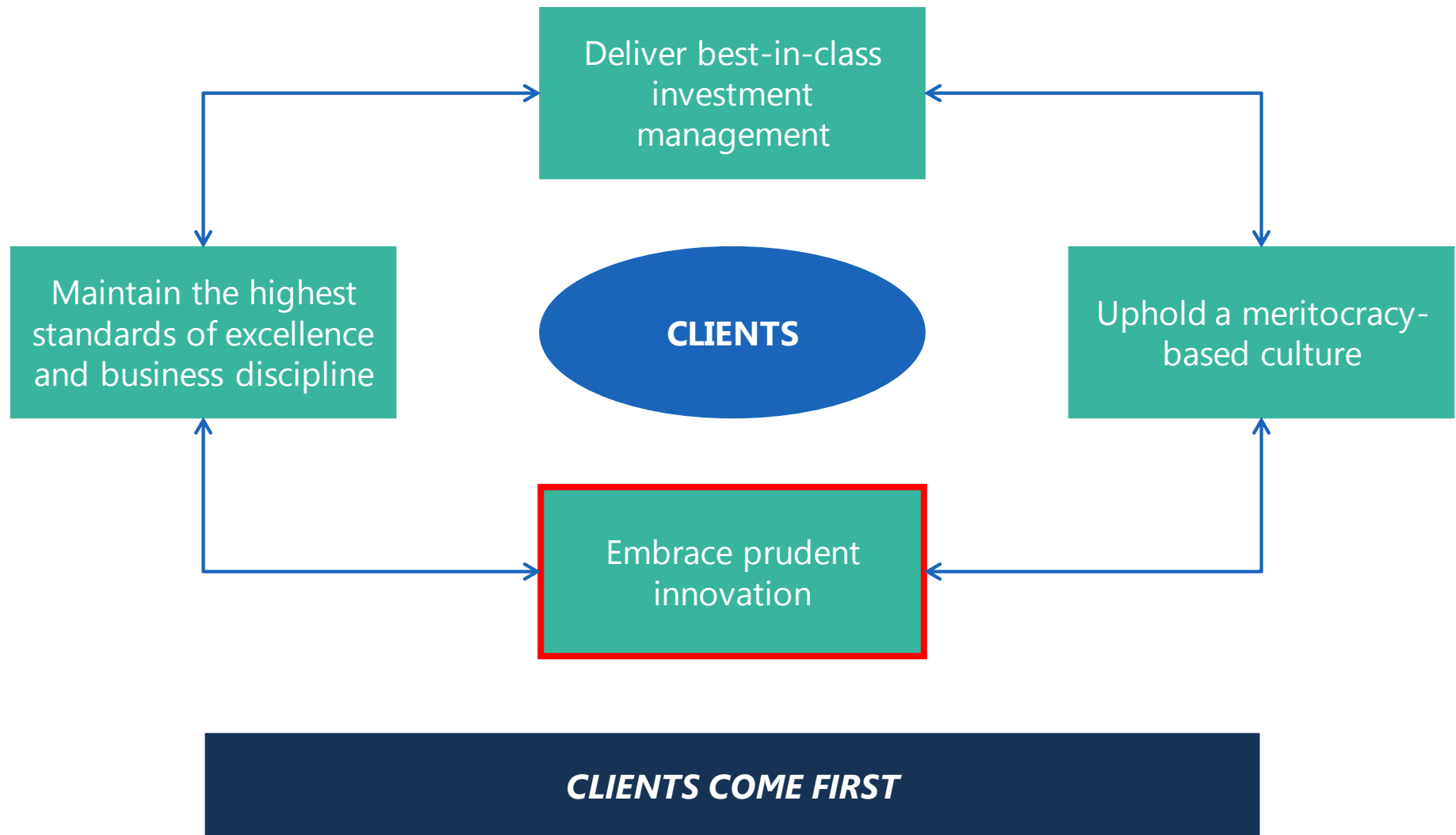
Presented in the Netherlands.

Agenda

- **Evolution of innovation at PIMCO**
- Current themes of innovation at PIMCO
- Conclusion

PIMCO evolution

Founding principles



PIMCO evolution

Summary of 45+ years of history

PIMCO

1971	1982	1994	2000
Founded as subsidiary of Pacific Mutual	Established autonomy from Pacific Mutual	Became public company through merger	Purchased by Allianz

GLOBAL OFFICES AND EMPLOYEES

1971	1980	2000	2008	2018
1 global office	1 global office 30 employees	6 global offices 412 employees	10 global offices 1,217 employees	14 global offices 2,500+ employees

PRODUCTS

1970's	1980's	1990's	2000's
<ul style="list-style-type: none"> Core 	<ul style="list-style-type: none"> Long Duration Enhanced Cash 	<ul style="list-style-type: none"> Credit Emerging Markets 	<ul style="list-style-type: none"> Absolute Return Asset Allocation Commodities Global Municipals Securitized Enhanced Equity ESG Hedge Funds Income Distressed/Private Credit Quantitative Strategies Real Estate

ASSETS*

1975	1980	1985	1990	1995	2000	2008	2012	2013	2014	2015	2016	2017	2018	2019 YTD ¹
\$40 M	\$1.5 B	\$10.0 B	\$28.9 B	\$76.4 B	\$220.0 B	\$930.0 B	\$2,003.8 B	\$1,919.6 B	\$1,680.4 B	\$1,435.0 B	\$1,467.0 B	\$1,755.7 B	\$1,664.6 B	\$1,758.1 B

As of 31 March 2019. **Past performance is not a guarantee or a reliable indicator of future results.**

* Third party and affiliated assets

¹ Assets include \$14.3 billion in assets of clients contracted with Gurtin Fixed Income Management, LLC, an affiliate and wholly-owned subsidiary of PIMCO.

PIMCO evolution

PIMCO's traditional structural alpha toolkit (examples)

**VOLATILITY
SELLING**
Provide insurance

**TERM
PREMIUMS**
*5th Eurodollar
contract*

RATINGS
Fallen angles, CCC's

**AMORTIZING VS.
BULLETS**

**CARRY
CURRENCIES**

**COMPLEX VS.
SIMPLE**

**FRONT END VS.
LONG END
CREDIT**

PROVEN THEMES ALSO APPLIED TO NEWER MARKETS

Agenda

- Evolution of innovation at PIMCO
- **Current themes of innovation at PIMCO**
 - **Artificial Intelligence**
 - **Behavioral Science**
 - **ESG/SRI**
- Conclusion

Artificial Intelligence / Machine Learning

Academic partnership with Caltech

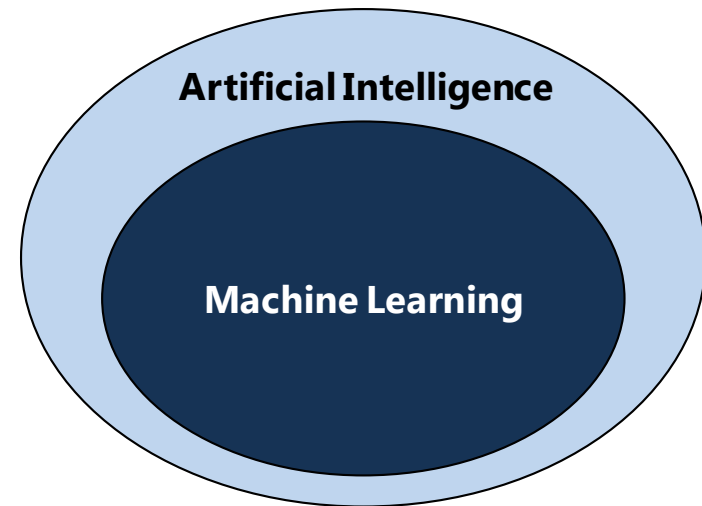
Caltech

JULY 2018

Established the PIMCO Postdoctoral Fellowship in Computing and Mathematical Sciences and the PIMCO Graduate Fellowship in Computing and Mathematical Sciences

Objectives

- An edge in the rapidly developing field of quantitative analysis
- A link between PIMCO and researchers on data science, machine learning and economics
- Collaboration with researchers interested in AI/Machine Learning application to finance and economics



Artificial Intelligence

Umbrella term for the broader concept of machines being able to carry out tasks in a “smart” way.

Machine Learning:

Build a system to learn and infer rules (instead of defining a fixed set of rules). A common machine learning approach is to have the algorithm learn the rules using training data and then apply these rules to a different set of data to determine effectiveness.

Source: PIMCO [press release](#) on 27 September 2018. University of Chicago’s **Center for Decision Research (CDR)** and PIMCO announce partnership to guide wiser decision-making. In recognition of this investment in research, Chicago Booth’s CDR laboratories will be renamed the PIMCO Decision Research Laboratories and will include a new “storefront” behavioral science research lab to foster greater engagement with the public and to broaden the reach and increase diversity of participants in the research studies.

Machine Learning applications at PIMCO

Practical examples

Sample applications at PIMCO

Macroeconomic analysis

Central Bank Sentiment Analysis

Estimating Recession Probability

Fundamental analysis

Predicting MBS Loan Level Default and Prepayment Behavior

Mining Changes in Corporate Filings

Trade execution

Decide Pace, Venue and Counterparty for Trade Execution

Behavioral Science

An Innovative Partnership of Academic and Investment Excellence

At PIMCO, we have long believed that cultivating diverse perspectives and challenging our own thinking can lead to stronger investment outcomes.



Through our partnership with The Center for Decision Research (CDR) at The University of Chicago Booth School of Business, we support research to gain:



"Understanding how we behave and the decisions we make are critical to building on PIMCO's strong culture of investing excellence and creating a diverse, engaging workplace, so we are excited to partner on this groundbreaking approach with Nick Epley and his incredible team at CDR".

Emmanuel Roman, PIMCO's Chief Executive Officer

Behavioral Science

Step #1: Build awareness for (cognitive) biases

Experience effects



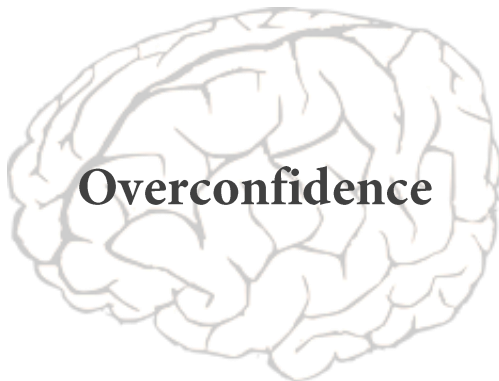
“Long-term effects of exposure to economic and political environments, macroeconomic shocks, and institutions affect even smart, successful, well-trained professional investors and decision-makers.”

“Confirmation bias is the tendency to search for, interpret, favor, and recall information in a way that confirms one's preexisting beliefs”

Anchored to Belief



Overconfidence



“Overconfidence leads to the false assumption that someone is better than others, due to their own false sense of skill, talent, or self-belief”

Behavioral Science

Step #2: Take measures for optimal unbiased decision-making

Group Dynamic

"Credible Contrarians"

Broader Committee Representation

Portfolio Management Decisions

Trading Frequency

Winners vs. Losers?
Sell early or late?

Measuring More

Detailed attribution

Within Investment Committee
and Forums

Contests

Sustainable investing becoming mainstream

A \$30.7T global story, but at different chapters regionally

**AUM: \$21
trillion**



2014

**AUM: \$23
trillion**



2016

**AUM: \$31
trillion**

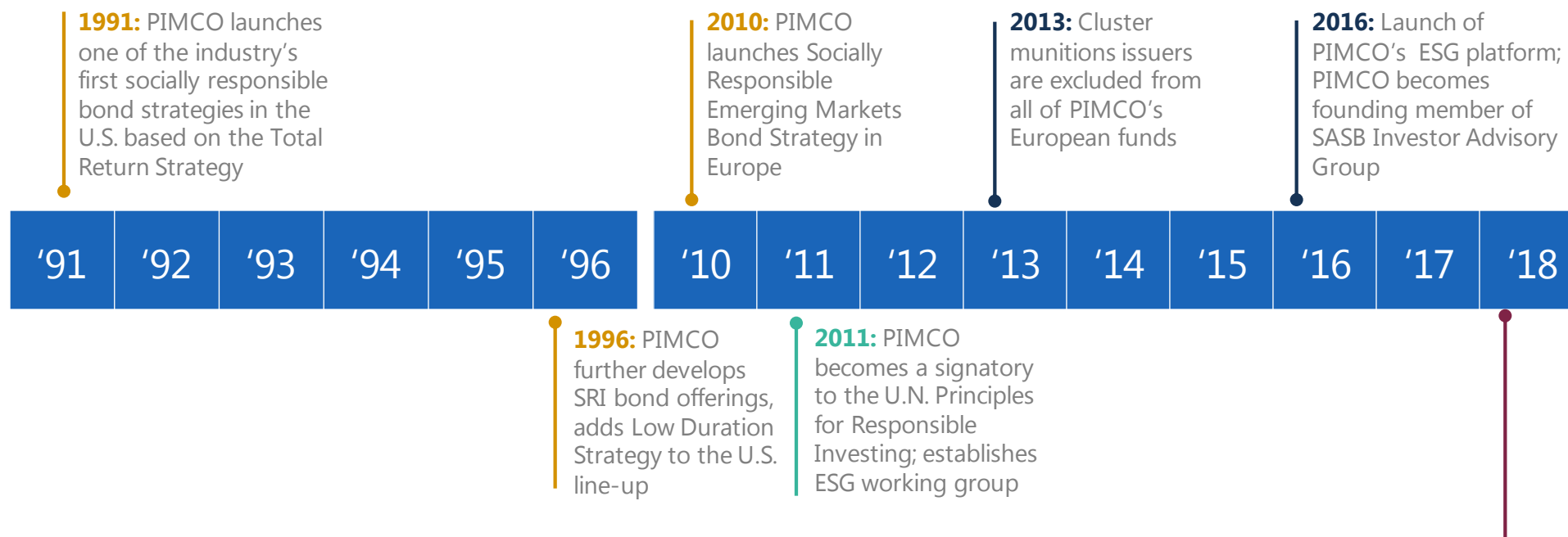


2018

As of 31 December 2018

Source: Global Sustainable Investment Alliance. All 2014 assets are converted to U.S. dollars at the exchange rates as of year-end 2013. All 2016 assets are converted to U.S. dollars at the exchange rates as of year-end 2015. All 2018 assets are converted to U.S. dollars at the exchange rates at the time of reporting.

The evolution of sustainable investing at PIMCO



2018:

PIMCO's ESG Integration:

UN PRI A+ Assessment Report on the quality of PIMCO's firm-wide ESG integration¹

PIMCO's SRI AUM: \$311B**

PIMCO's ESG-Oriented AUM: \$7.4B (3rd party assets)

Expanded our ESG analysis to securitized products and municipals

Improved proprietary ESG IT systems and capabilities

More than 250 engagements since 2017 used to accelerate the sustainable development agenda & issued first annual ESG and engagement report

* As of 31 March 2019. It includes ESG focused funds only.

** Values-based exclusion, including EMEA Fund complex with cluster munition exclusion

Past performance is not a guarantee or a reliable indicator of future results

¹ Source: UNPRI assessment report limited to asset managers signed up to the Principles for Responsible Investment (PRI) and based on how well ESG metrics are incorporated into their investment processes. UNPRI Transparency Reports 2018 are available at <https://www.unpri.org/signatories/transparency-reports-2018/3350.article>. For methodology, please refer to About PRI Assessment: <https://www.unpri.org/signatories/about-pri-assessment>.

² As of 31 March 2019. SRI AUM includes all exclusions based strategies (including European domiciled funds). ESG AUM includes dedicated ESG focused funds only.

Refer to Appendix for additional investment strategy, risk and strategy availability information.

PIMCO's ESG Process: "The Three Es"

Investing for performance and impact



EXCLUDE

Restrict investment in issuers fundamentally misaligned with sustainability practices

Examples of exclusions

- Controversial weapons
- Tobacco
- Adult entertainment
- Coal



EVALUATE

Emphasize best-in-class (BIC) ESG issuers and prime ESG engagement candidates in portfolio construction

Attributes of BIC issuers

- Good environmental practices
- Strong corporate governance
- Industry-leading social policies



ENGAGE

Engage collaboratively with issuers to change ESG-related business practices

Sample engagement questions

- Are you developing a framework for climate risk reporting?
- What is your policy on parental leave?
- Do you have a culture and conduct committee?

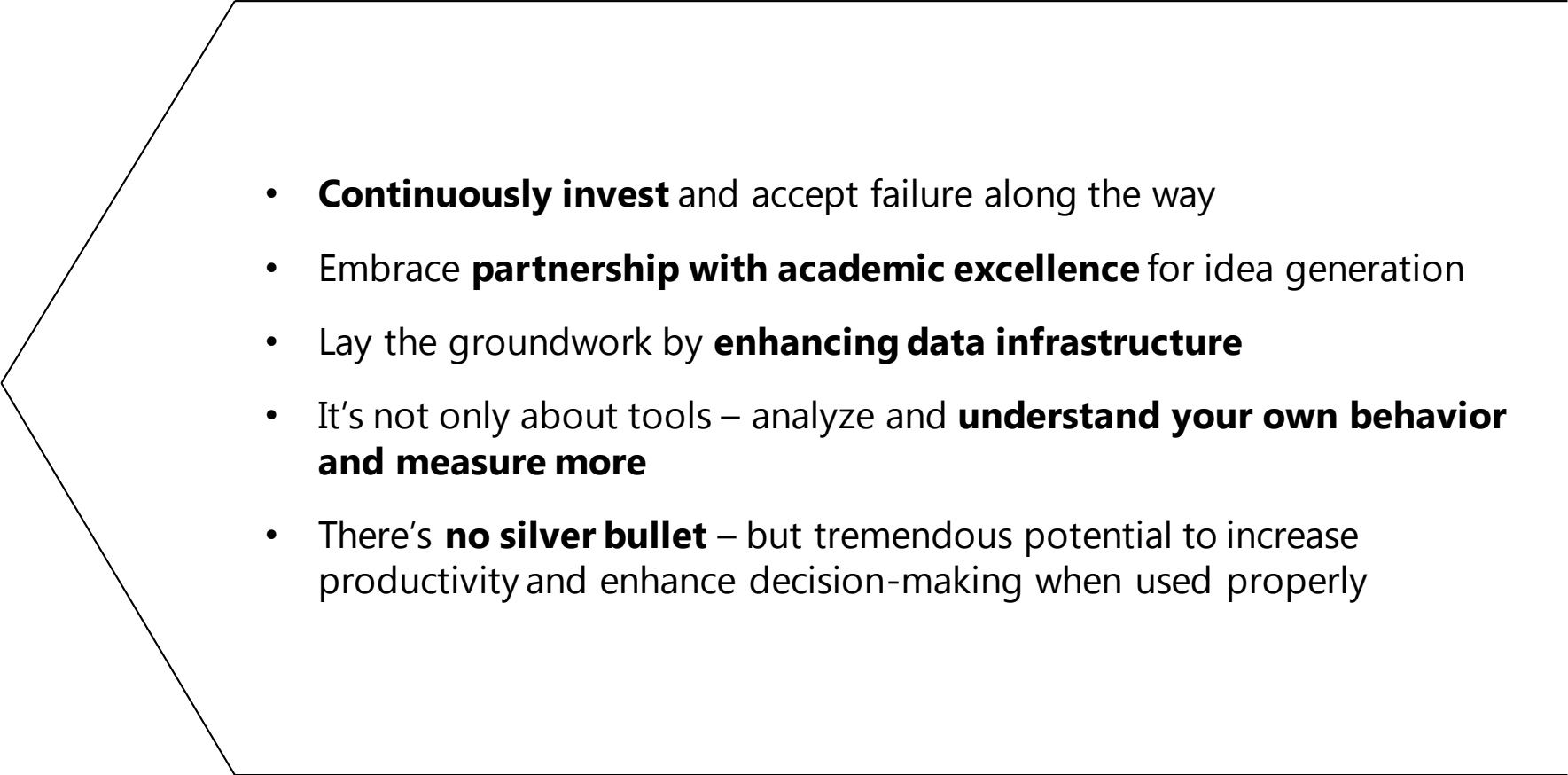
Source: PIMCO. For illustrative purposes only.
Refer to Appendix for additional investment strategy and risk information.

Agenda

- Evolution of innovation at PIMCO
- Current themes of innovation at PIMCO
- **Conclusion**

Conclusion

Cutting through the hype

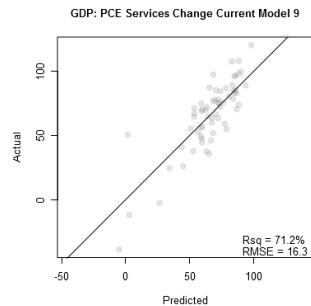
- 
- **Continuously invest** and accept failure along the way
 - Embrace **partnership with academic excellence** for idea generation
 - Lay the groundwork by **enhancing data infrastructure**
 - It's not only about tools – analyze and **understand your own behavior and measure more**
 - There's **no silver bullet** – but tremendous potential to increase productivity and enhance decision-making when used properly

Appendix

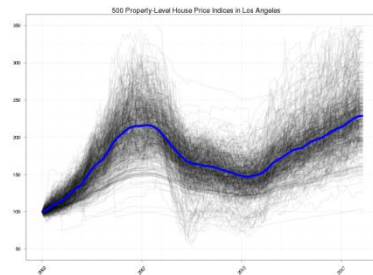
Common Economic and Financial Problems Recast into a Machine Learning Framework

Regression

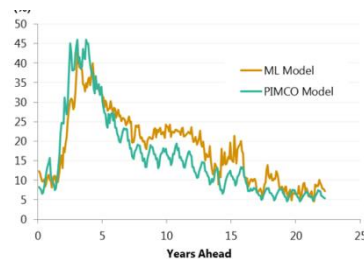
What's the next GDP number?



What is every house worth?



What will prepayments be?



Classification

Hawk or dove?

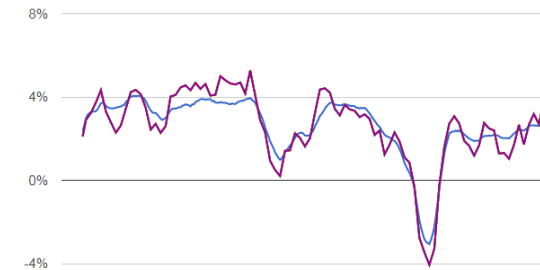


Buy or sell?



Unsupervised

What factors drive the economy?



What topics occur in FOMC Mins?

Real private expenditures for business equipment and intellectual property appeared to be rising further in the fourth quarter. Nominal shipments of residential capital goods excluding aircraft increased in October, and new orders of these goods continued to exceed shipments, which pointed to further gains in shipments in the near term. In addition, readings on business sentiment remained upbeat. Firms' nominal spending for nonresidential structures including drilling and mining rose in October, and the number of oil and gas rigs in operation—an indicator of spending for structures in the drilling and mining sector—started to edge up in late November after declining earlier in the fourth quarter.

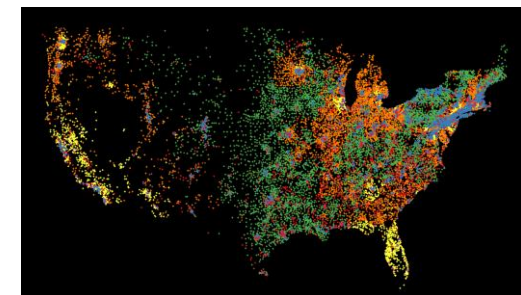
Total real government purchases looked to be rising in the fourth quarter. Nominal defense expenditures in October and November pointed to a flattening in real federal government purchases. However, real purchases by state and local governments appeared to be moving up, as those governments expanded their payrolls modestly over the two months ending in November and their nominal construction spending increased in October.

The nominal U.S. international trade deficit widened slightly in September and sharply in October. Exports picked up in September, led by exports of industrial supplies, but were flat in October. Imports grew significantly in both months, reflecting strength in both categories, although imports of automobiles declined. The available trade data suggested that the change in real net exports would make a neutral contribution to real U.S. GDP growth in the fourth quarter.

Total U.S. consumer prices, as measured by the PCE price index, increased slightly more than 1-1/2 percent over the 12 months ending in October. Core PCE price inflation, which excludes changes in consumer food and energy prices, was nearly 2-1/2 percent over that same period. The consumer price index (CPI) rose 2-1/4 percent over the 12 months ending in November, while core CPI inflation was 1-3/4 percent. Recent readings on survey-based measures of longer-run inflation expectations—including those from the Michigan survey, the Survey of Professional Forecasters, and the Bank's Survey of Primary Dealers and Survey of Market Participants—were little changed on balance.

Economic activity expanded at a solid pace in most foreign economies in the third quarter. In several advanced foreign economies (AFEs), economic growth slowed but remained firm. Economic activity in the emerging market economies (EMEs) continued to grow briskly for the most part, especially in Asia. However, the Mexican economy contracted in the third quarter, as hurricanes and earthquakes disrupted economic activity. Despite a boost from recent increases in oil prices, inflation remained relatively subdued in most AFEs and moderate in EMEs.

Which regions are similar?



For illustrative purposes only.

Machine Learning case study #1

Natural Language Processing for Mining Changes in Corporate Filings

1

Hypothesis

- Companies tend to keep the same language in their filings
- When they see potential large risk events, they mention them to avoid legal trouble



2

Big Data

- We downloaded historical 10-K and 10-Q filings of S&P1500 constituents and constructed similarity scores between each filing and the filing a year ago



3

Strategy

- We rank companies into quintiles based on similarity scores
- We find "changers" indeed underperform

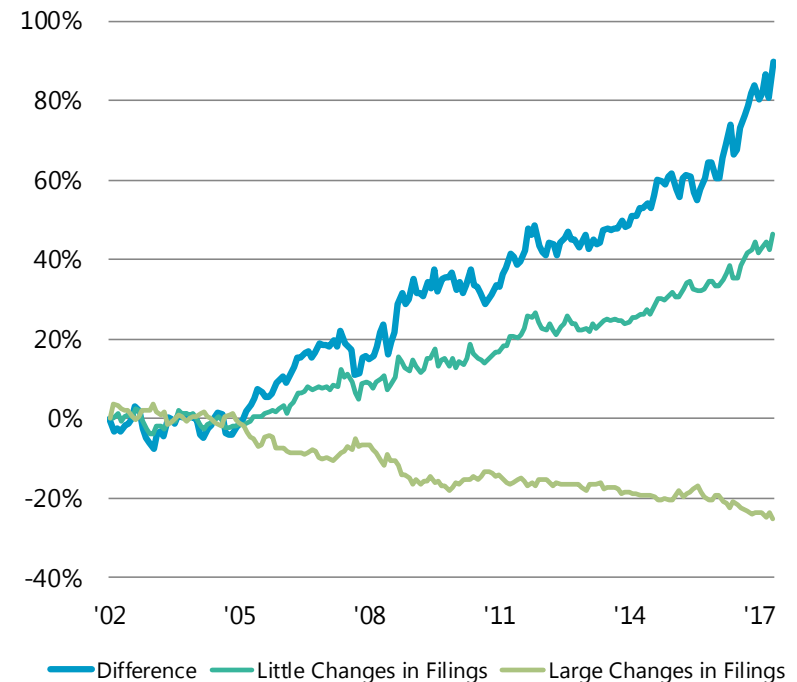


4

Results

- Long/short excess returns range between 20 to 40 bps per month
- Sharpe ratios range between 0.35 to 0.6
- The positive returns are quite robust

Cumulative Returns Excess to Market



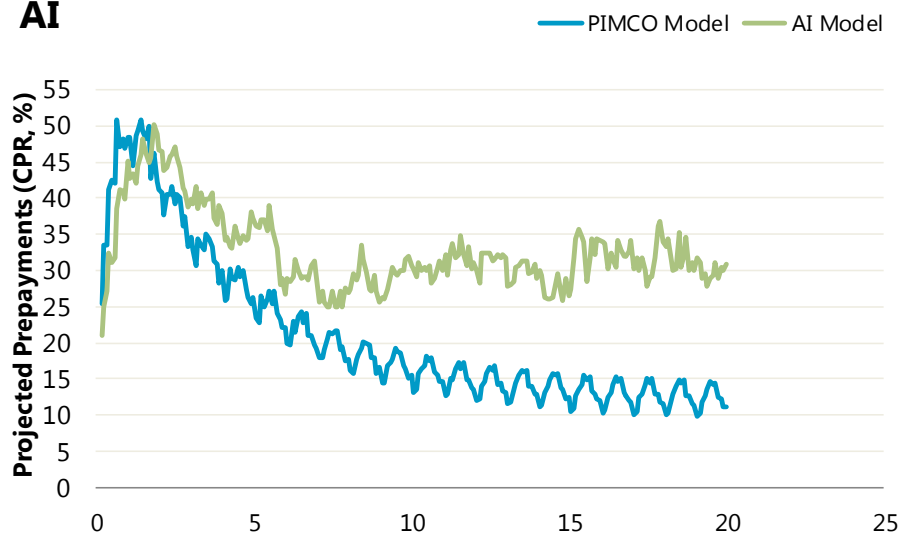
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*Market is S&P500

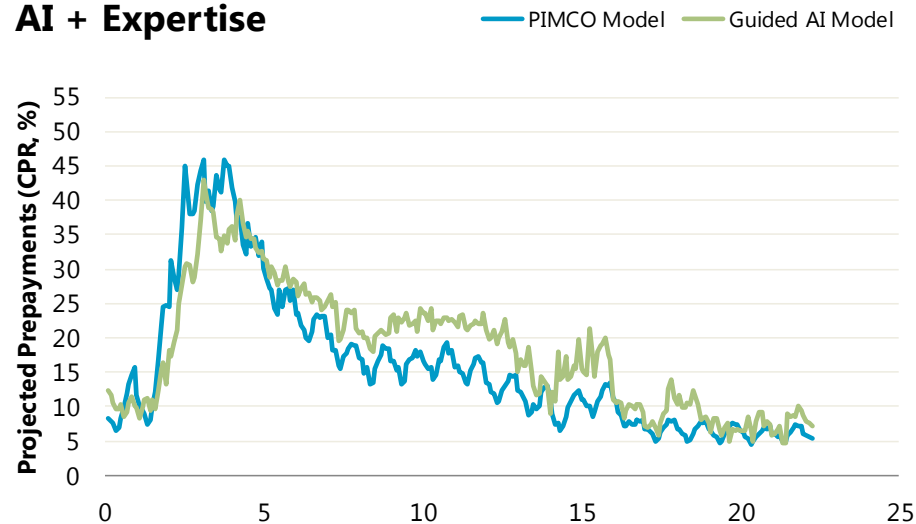
Machine Learning case study #2

Agency MBS Prepayment Modeling - AI Model benefits from economic intuition

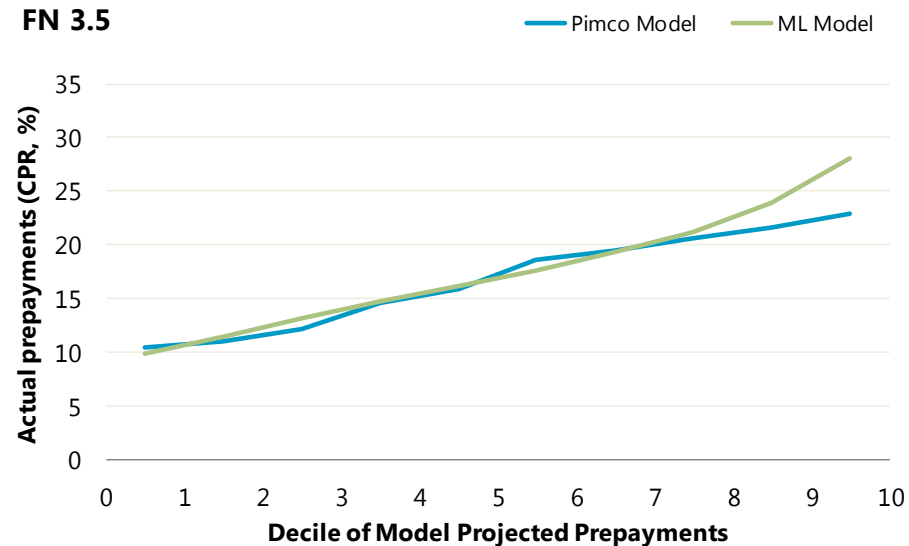
AI



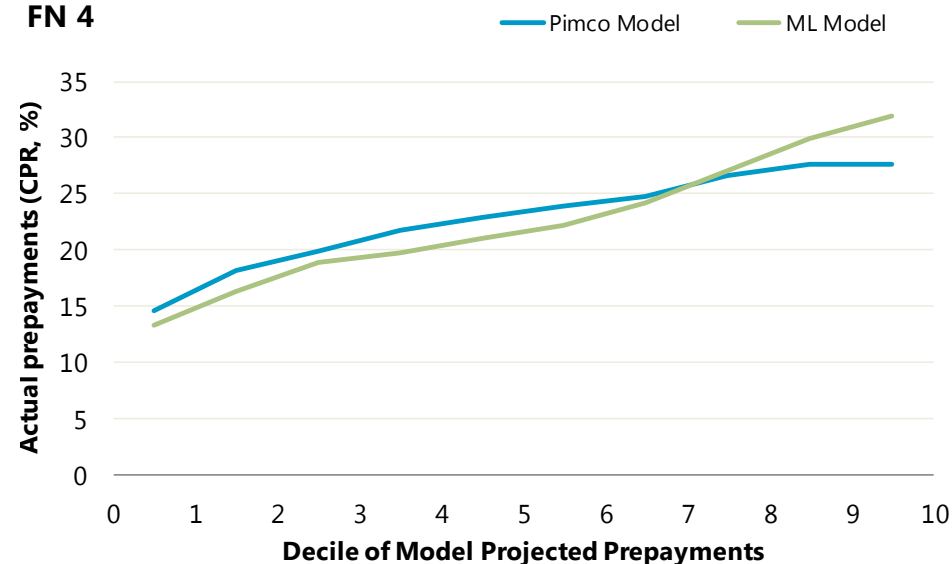
AI + Expertise



FN 3.5



FN 4



For illustrative purposes only.

Source: PIMCO, Fannie Mae

Behavioral science case study #1 - Analyzing corporate bond trading

Do we herd with the crowd when we sell corporate bonds? 2013 – 2018 evidence

- Compare our trading with the majority of market participants using TRACE data.
- We find that **we are 35% less likely to sell** when other customers display strong preference of selling
- This result is consistent across PMs: Investment Grade (IG) Credit dedicated vs. Generalist portfolios, indicative of an integrated process

Trades ranked by net customer flows per bond

	Total Return Fund		IG Credit Account	
	1 st quartile (more sellers)	4 th quartile (more buyers)	1 st quartile (more sellers)	4 th quartile (more buyers)
Likelihood of PIMCO selling	0.71	1	0.65	1
t-stat	-4	0	-5	0.2

References:

[1] Lakonishok, Josef, Andrei Shleifer, and Robert W. Vishny. "The impact of institutional trading on stock prices." Journal of financial economics 32.1 (1992): 23-43.

[2] Grinblatt, Mark, Sheridan Titman, and Russ Wermers. "Momentum investment strategies, portfolio performance, and herding: A study of mutual fund behavior." The American economic review (1995): 1088-1105.

[3] Wermers, Russ. "Mutual fund herding and the impact on stock prices." the Journal of Finance 54.2 (1999): 581-622.

Behavioral science case study #2 - Selling winners early vs. holding on to losers

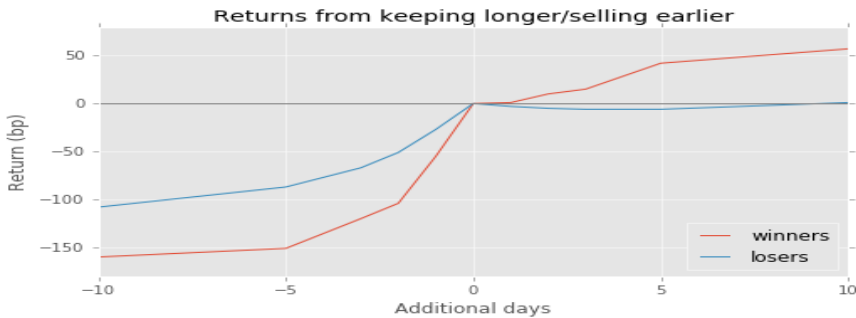
Analysis of disposition effect in commodity hedge fund (May '14 – Jun '18)

- We are 79% more likely to sell winners than the losers.

	Overall	Directional	Calendar	Substitution
Likelihood of selling winner vs loser	1.79	1.97	1.90	1.71
t-stat	17	5	14	9

- Holding on to winning positions for a bit (10 extra days) would have paid off.
- In contrast, we exit losing trades optimally

Additional days	1	2	3	5	10
Keeping winner longer	1	10	15	42	57
Keeping loser longer	-3	-5	-6	-6	1
Sell winner earlier	-55	-104	-120	-151	-160
Sell loser earlier	-27	-51	-67	-87	-108

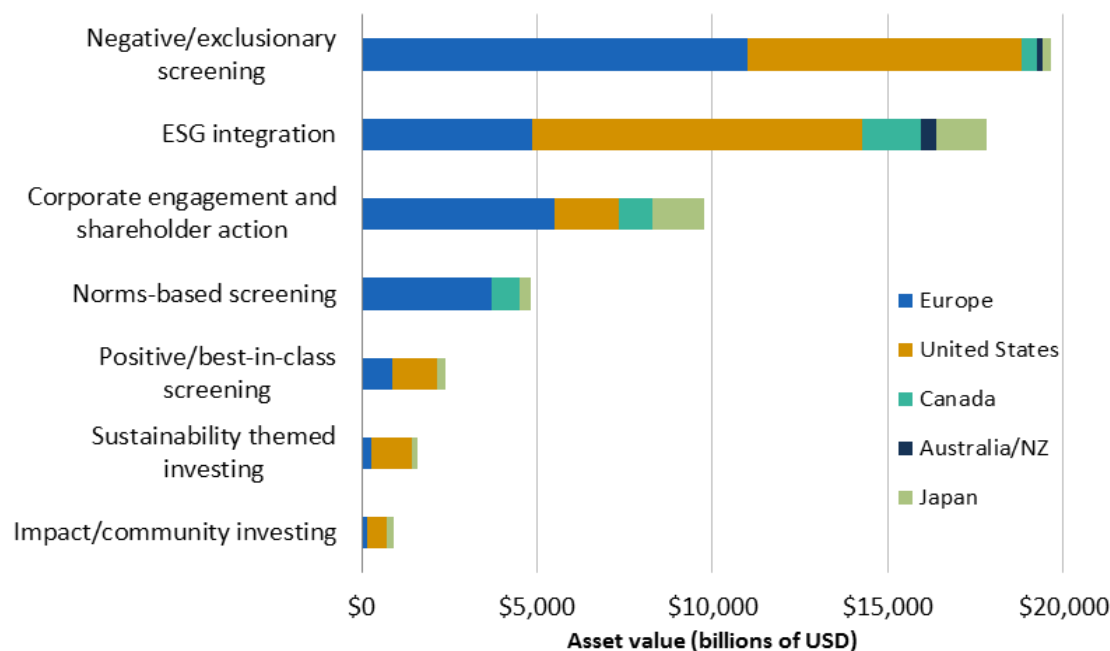


Sustainable investing becoming mainstream

A \$30.7T global story, but at different chapters regionally

Region	2016	2018	% Change*	% Total FI Market
Europe	\$12,040	\$14,075	11%	48.8%
United States	\$8,723	\$11,995	38%	25.7%
Japan	\$474	\$2,180	307%	18.3%
Canada	\$1,086	\$1,699	42%	50.6%
Australia/New Zealand	\$516	\$734	46%	63.2%
TOTAL	\$22,839	\$30,683		35.5%

Sustainable Investing Assets by Strategy and Region 2018



As of 31 December 2018

Bottom Chart Source: US SIF Foundation, UN PRI; Top Chart Source: Global Sustainable Investment Alliance. All 2016 assets are converted to U.S. dollars at the exchange rates as of year-end 2015. All 2018 assets are converted to U.S. dollars at the exchange rates at the time of reporting.

ESG/SRI case study #1 – Corporates

EM National Oil Company

Effective tool to encourage change in behavior

- **PIMCO successfully engaged with an EM National Oil Company** (NOC) on social issues, specifically a higher than-industry-average health & safety incident rate.
- Escalation of the issue (incl. credit, sovereign and ESG views), resulted in this **issuer agreeing to move towards international accreditation** (i.e. applying best practice standards) of its operations.



PIMCO contacts the NOC for information required to assess ESG risks, with spotlight on its Health & Safety

Dec '17

PIMCO escalates issues after insufficient response & dialogue

Aug '18

Written commitment by issuer to commence H&S certification

Oct '18

As of 31 January 2019
SOURCE: PIMCO, Bloomberg, IEA
Refer to Appendix for additional outlook and risk information.