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AI & Bonds

BNY MELLON

AI & Bonds

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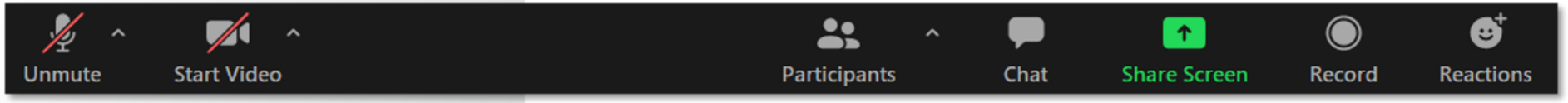

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AI & Bonds

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AI & Bonds

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Artificial Intelligence and the Municipal Bond Market:

Opportunities For Economic Development Finance Agencies

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May 8, 2024

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What is AI?

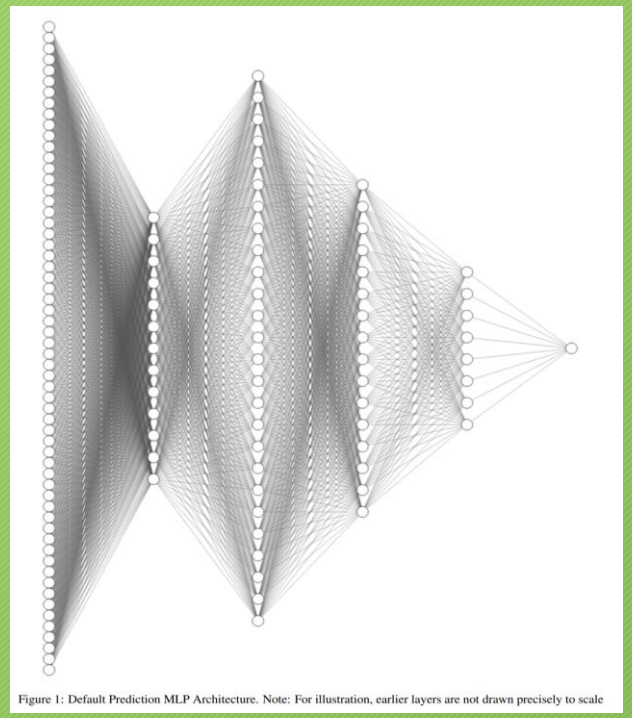

Figure 1: Default Prediction MLP Architecture. Note: For illustration, earlier layers are not drawn precisely to scale

- AI is a set of various quantitative methods to analyze data and generate outcomes.

Source: Luke Jordon, MIT GOV/LAB, October 15, 2021: *Bond Fault Prediction with Text Embeddings Undersampling and Deep Learning*

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The Municipal Bond Market Now
Three Trends Affecting Economic Development Bond Issuers

- A Shifting and Concentrated Institutional Bond Buyer Landscape
- Fee and Margin Pressures on Money Management and Broker/Dealers
- Increased Alternative Trading Systems and Algorithmic Trading

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The Municipal Bond Market Buyer Landscape
Shifts and Concentrations

- **Muni Separately Managed Account AUM** More **Concentrated…and Increasing**
  Top 10 Muni SMA Managers held ***84%*** of AUM
  AUM Total -- 2023: $494.6 B vs. 2021: $332.9 B (***up*** *48.5%*)
- **Muni Exchange Traded Fund AUM Highly Concentrated…and Increasing**
  Top 10 Muni ETF held ***98%*** of AUM
  AUM Total – 2023: $122.3 B vs. 2021 $83.2 B (***up*** *46.9%*)
- **Muni Mutual Fund AUM More Concentrated…and Declining**
  Top 10 Muni Mutual Funds held ***72%*** of AUM
  AUM Total -- 2023: $846.8 B vs. 2021: $1,089 B (*down 22.2%*)

Sources: Federal Reserve, Cerulli & Associates, Morningstar

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Fee Pressure

- iShares National Muni Bond ETF (Blackrock)
  - Tracks ~2,000 Investment-Grade U.S. municipal bond index
  - Expense Ratio: 0.05%
- AUM 2022: $29.5 B
- AUM Q1-24: $36.9 B

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ATS and Algorithmic Trading

- ATS Trading

  Customer Trades on ATS Platforms:

  2015: 2.9%

  2023: 15.0%

- Broker/Dealers buying Algorithmic Trading Platforms

Source: Municipal Securities Rulemaking Board

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Implications for the Economic Development Bond Issuer

- Larger Asset Managers have an Approved List of bond issuers.
- Less focus on credit.
- Rate likely *not* to reflect true creditworthiness.
- More likely the end-buyer for <10-year maturity will be Muni SMA or Retail Surrogate.
- Less likely to be in an index-based Muni ETF.
- Less likely to be in a top bracket mutual fund.
- More likely the end buyer for >10-year maturity will be a smaller mutual fund or Retail Surrogate.

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How to Use AI to Your Advantage

Use AI to Your Advantage

- Know your ultimate Bond Buyer
- Target Market vs. Broad Distribution
- Track new issue and trading levels of peers
  (MSRB, Bloomberg)
- Consider a Competitive or Blockchain New Issuance
- Digitize everything
- Identify, Track, and Post Credit Metrics
  (Financial, Non-Financial, Sector)
- Identify, Track, and Post Impact Metrics
  (Employment, Income, Home Value, Vehicle Sales, Commute Time, Childcare, Tax Revenues, Demographics)
- Retain a CTO/CDO or Firm
- Standardize Disclosure with Structured Data
- Develop a Success Probability: 0% to 100%
  (Municipal CE 5-year Default Probability Rate: 0.37%)
- Demand Rating Justification

Source: Moody's Ratings *US municipal bond defaults and recoveries, 1970-2022*

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Muniland 2030: A Glimpse Into The AI-Driven Future

"Predictions are very difficult, particularly about the future."
Niels Bohr, Nobel Laureate (or Yogi Berra, Baseball Hall of Fame)

1. Digitized Official Statements
2. 144A-type Shelf Financings
3. ATS Trades >50% of the Market
4. More liquidity for Retail/Odd-Lot Block size trades
5. More accurate pricing driven by aggregated Retail/Odd-Lot Block size trades
6. XBRL Standardized Disclosure with automated, real-time updates
7. Credit Ratings quantified and linked to default probabilities

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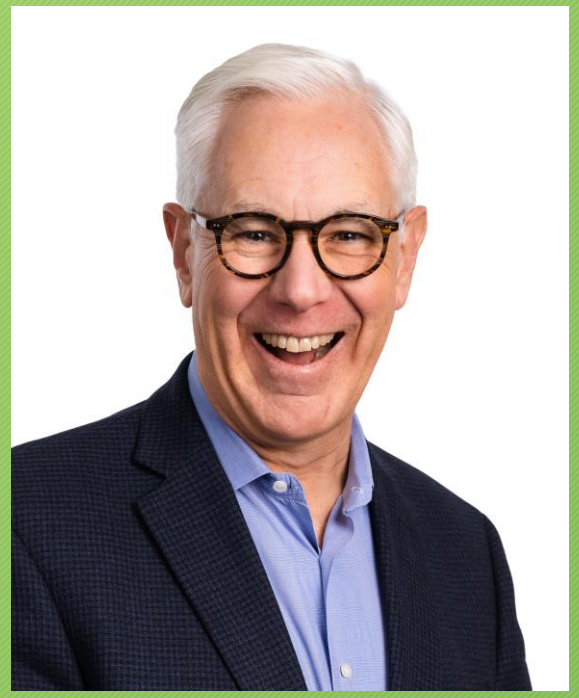
Barnet Sherman: BIO



- 30+ years Municipal Bond Market career managing multibillion dollar portfolios at Morgan Stanley and TIAA/Nuveen
- Economic Development Financing across the U.S. in Private Activity, Health Care, Senior Living, Senior Care, Higher Education
- Founder, The Tenbar Group. Consulting on financing, assessment, and performance for Economic Development projects.
- Senior Contributor, Forbes.com
- Professor, Boston University *Multinational Finance & Trade*, *Corporate Finance*
- Member of the Screen Actors Guild; Eagle Scout

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AI & Bonds

Gregory Sobel

US Public Finance Group
Moody's Investors Service

MOODY'S
RATINGS

AI can lower costs, but cyber risk, regulation and scalability issues present challenges
May 2024

Gregory Max Sobel
Assistant Vice President – Analyst, US Public Finance
May 2024

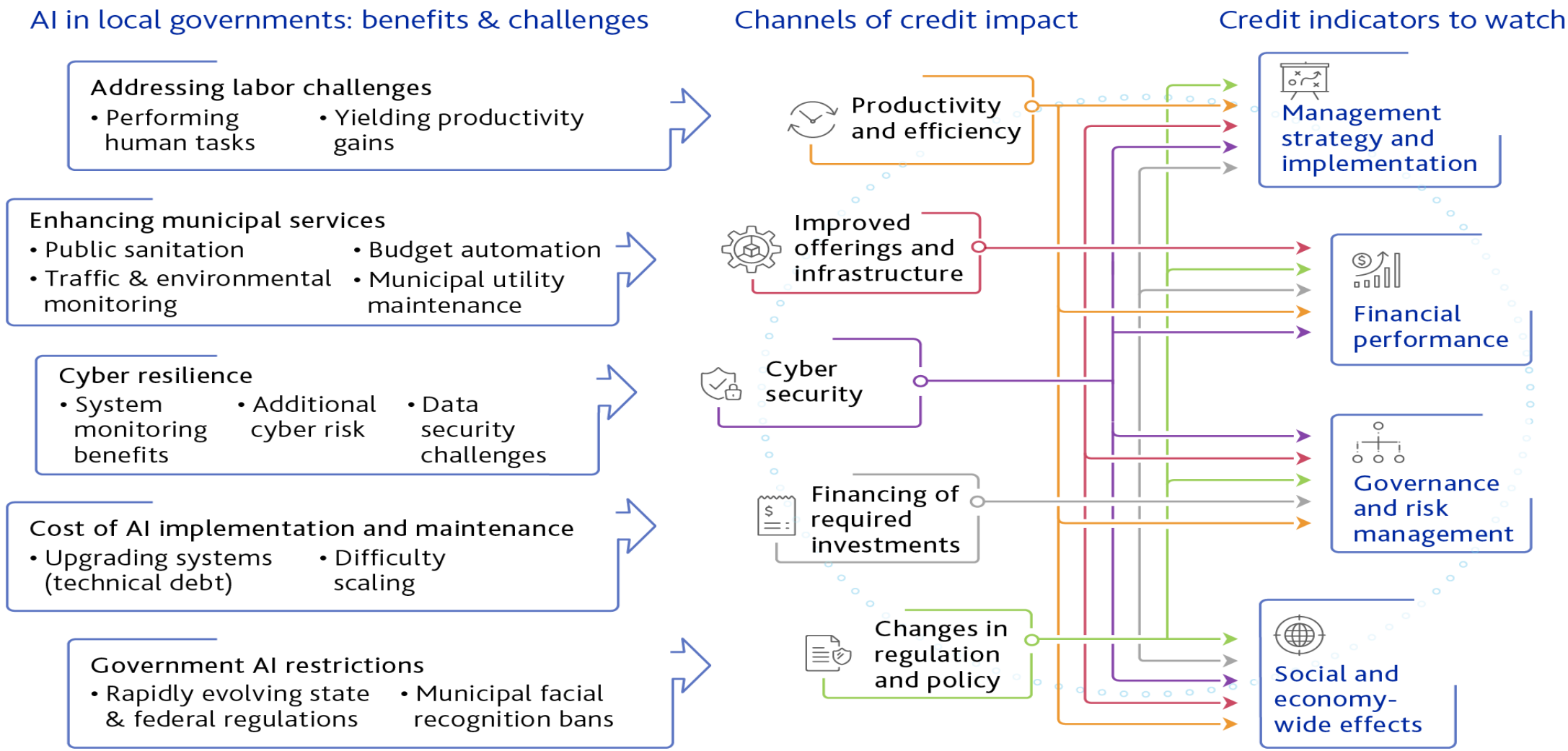
Agenda

1. Credit indicators to watch for local governments that use AI
2. Local governments are using AI to alleviate labor shortages
3. AI can create efficiencies and improve municipal services
4. AI use brings substantial cyber risk, but large municipalities could harness it to manage that risk
5. Resistance from taxpayers, evolving regulation and scalability challenges will hamper wider adoption

MOODY'S
RATINGS

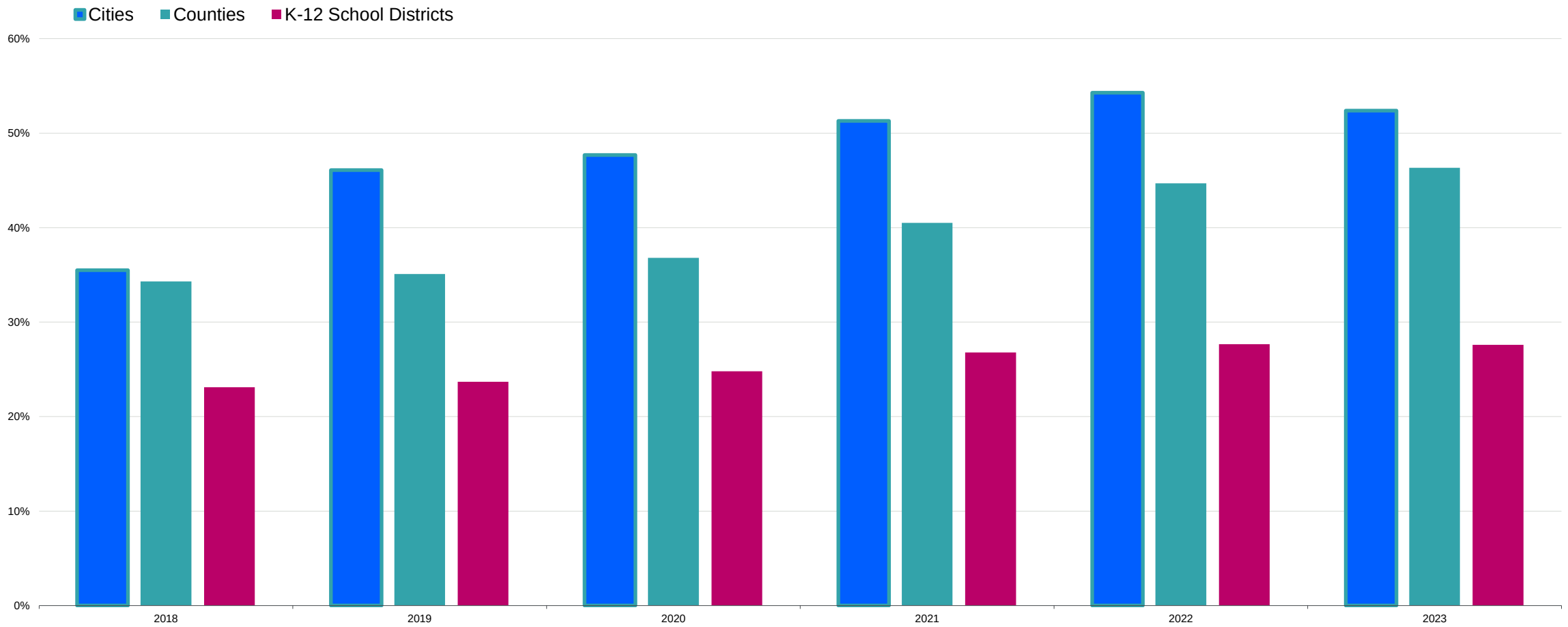
Credit indicators to watch

Benefits and challenges of AI and the credit indicators to watch for local governments



Municipalities are still flush with cash from federal coronavirus aid, which has enabled them to step up investment in the technology

Median available fund balance by year and sector

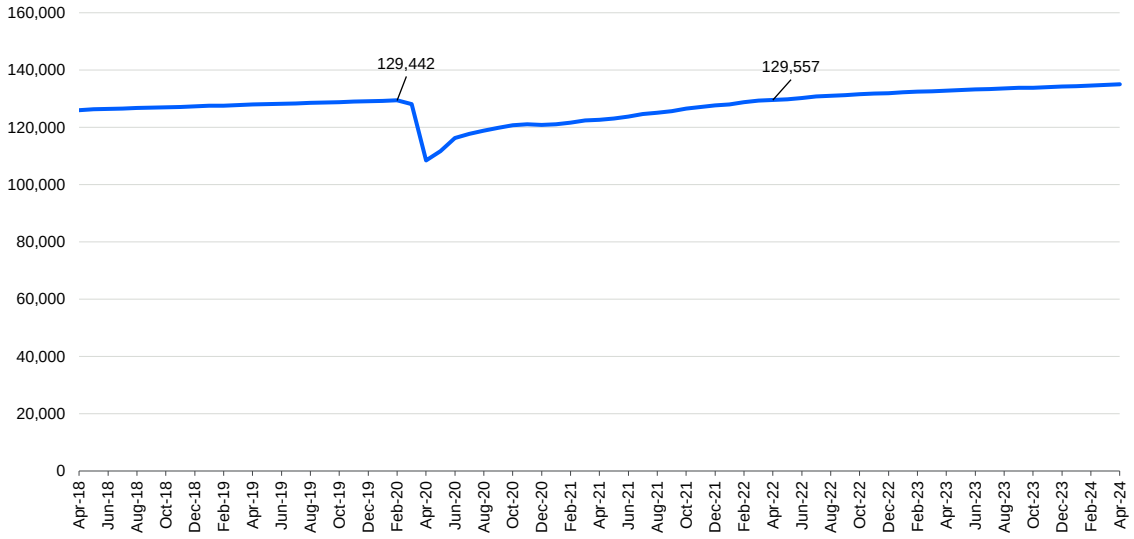


Local governments are using AI to alleviate labor shortages

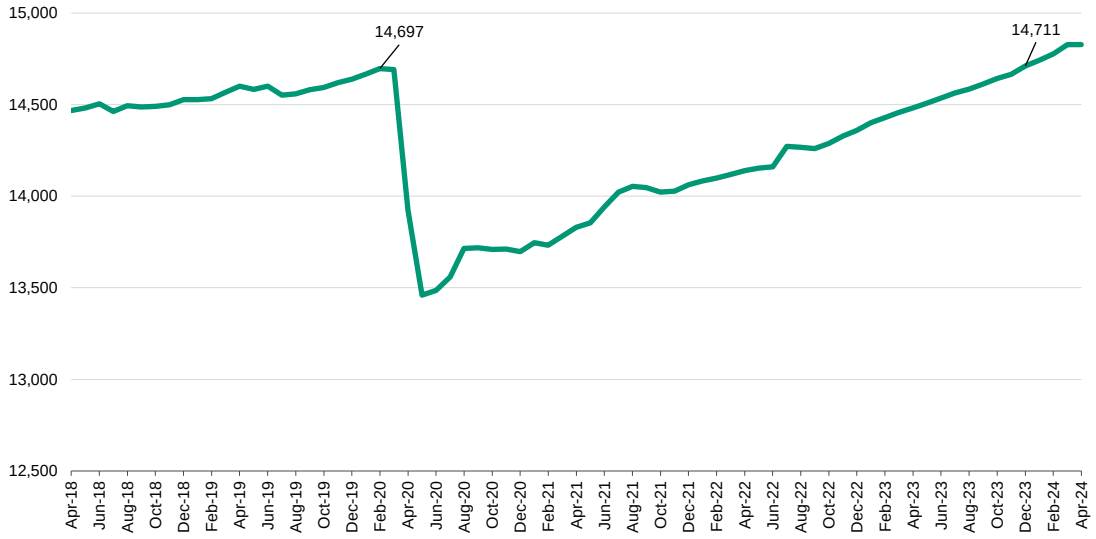
Local governments are using AI to alleviate labor shortages

The pandemic upended labor trends, creating an acute worker shortage across the public sector. The advent of AI technology, especially GenAI, has provided an opportunity for municipalities to alleviate their labor pressures while reducing costs. Specific roles that can be supplanted involve customer service and bookkeeping work.

→ **While private sector employment returned to pre-pandemic levels by April of 2022…**



→ **Local government employment was only restored by the end of December 2023**



Sources: Bureau of Labor Statistics and Moody's Ratings

Local governments are using AI to alleviate labor shortages

Examples are growing and span the nation

Customer service

- **IBM estimates that organizations can save up to 30% in their customer service budgets by using GenAI-powered chatbots – which municipalities across the nation have chosen to do.**

- **One example is Cabarrus County, NC (Aaa stable), which used the technology to filter applicants for $6.5 million in Emergency Rental Assistance Program (ERAP) funds.**
  - **A digital form gathered the applicant information required by the federal program. The county integrated the form with a GenAI-powered chatbot that asked additional questions to determine eligibility. This process directed ERAP-ineligible residents to other resources, lowered processing times for eligible applicants, and freed employee time for other tasks.**

- **Williamsburg, VA (Aa1) and Boston, MA (Aaa stable) have also implemented GenAI-powered chatbots, demonstrating the adaptability of the technology.**
  - **According to Citibot, Williamsburg's chatbot answers 79% of all resident inquiries without the need for referral to a human agent.**

Local governments are using AI to alleviate labor shortages

Examples are growing and span the nation

Improving labor productivity

- **Los Angeles Unified School District (A1 positive) announced its supervised AI-powered "Ed" student advisor in August 2023.**
  - **The tool is intended to immediately address student educational issues by following AI-generated recommendations.**
  - **The platform will initially cost only $4 million but there may be additional costs associated with rolling it out across the district. Moreover, the district was the victim of a ransomware attack in September of 2022, exemplifying the sector's exposure to cyber risk – a major concern associated with AI use by governmental entities.**

- **As part of New York City's (Aa2 stable) AI Strategy, its Department of Citywide Administrative Services is undertaking a process automation initiative for energy billing. DCAS's Division of Energy Management, which is responsible for paying all the city's electricity, gas, and steam bills, receives more than 15,000 bills to process each month.**
  - **Previously, the bill review team used an in-house software system, together with human review, to detect anomalies.**
  - **DCAS built a machine learning model, using Google's TensorFlow, trained on millions of historic billing records, weather data and facility information, including year built, square footage and usage type.**
  - **The system has saved millions of dollars, the city says, with DEM receiving $4.5 million in refunds in 2020 and 2021 from more than 100 detected billing anomalies from multiple utility companies.**

AI can create efficiencies and improve municipal services

AI can create efficiencies and improve municipal services

Municipalities are using the technology to supplement and enhance offerings

Budgeting and reporting

- **Administrative work is prime for the implementation of AI, and local governments facing increased competition for auditing services are turning to the technology.**

- **Many municipalities are giving GenAI applications access to historical financial information in order to improve their budgeting processes.**
  - **ClearGov, a municipal budget automation company launched in March 2023, uses ChatGPT technology and three years of data to build budgets with accompanying narratives to explain unique scenarios.**
  - **Clients have reported reductions of up to 25% in the time it takes to produce budgets, and the narratives enhance transparency and disclosures – a credit positive consideration from a governance perspective.**
  - **More than 1,000 municipalities are now using the platform for budgeting.**

AI can create efficiencies and improve municipal services

Municipalities are using the technology to supplement and enhance offerings

Sanitation

- **San Francisco (Aaa negative), for example, is piloting Nordsense machine learning sensor technology to improve public sanitation. The initiative began in 2019, predating the roll-out of more recent AI applications, with the installation of sensors on 48 of the city's 3,300 public trash cans.**
  - **As of 2023, the city has expanded the technology to over 950 cans. The sensors enable real-time monitoring of refuse, receptacle condition and temperature through a collection process involving 16 data points. The data is then translated into actionable insights, such as when to dispatch and how to best coordinate collection assets like garbage trucks, sanitation workers and transfer stations.**
  - **The city achieved an 80% drop in overflowing trash cans, a 66% decline in street cleaning service requests and a 64% reduction in illegal dumping**

- **Pittsburgh International Airport (Allegheny County Airport Authority, A2 stable) recently rolled out AI-powered trash bins manufactured by CleanRobotics. The receptacles automatically sort passenger waste, compost and recyclables with 96% accuracy.**

AI can create efficiencies and improve municipal services

Municipalities are using the technology to supplement and enhance offerings

Traffic Safety

- **In New Jersey (A1 stable), the Department of Transportation (NJDOT) partnered with Rutgers Center for Advanced Infrastructure and Transportation to deploy Velodyne's intelligent infrastructure solution in the city of New Brunswick (A2 stable). The technology uses AI to monitor traffic activity.**
  - **The technology is more cost-effective and easier to install than radar-based and camera-based systems. The lower price point is a result of requiring only a single lidar sensor installed on a traffic pole to cover an intersection or highway section. Radar- and camera-based systems would typically need multiple sensors to cover the same area.**

- **Austin, TX (Aa1 stable) is using AI to work toward what it calls a Vision Zero target, a holistic strategy to end traffic-related fatalities and serious injuries.**
  - **The initiative uses deep learning – a subset of machine learning that uses several neural networks with multiple layers to understand complex patterns – in order to recognize objects and learn how they interact.**
  - **The application was shown to be 95% successful in terms of identifying objects and can make recommendations to traffic engineers and officials.**

AI can create efficiencies and improve municipal services

Municipalities are using the technology to supplement and enhance offerings

Environmental issues

- **The City of Los Angeles's (Aa2 stable) Predicting What We Breathe project is an effort to tackle such risks by better understanding, predicting and mitigating issues related to air pollution.**
  - **The project is a partnership with the city, the National Aeronautics and Space Administration (NASA) and California State University (Aa2 stable) Los Angeles.**
  - **It combines satellite and ground data and applies machine learning to uncover patterns that may not be discernible to human analysts.**

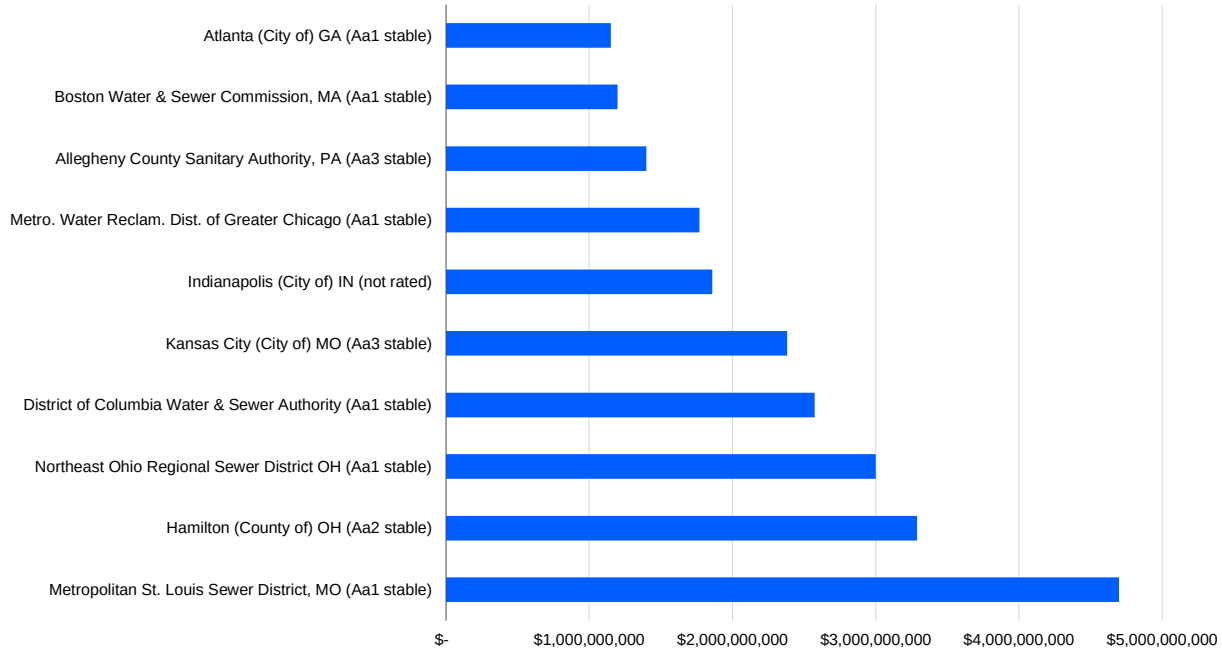
- **The City of Miami's (Aa2 stable) Miami Forever Climate Ready strategy seeks to monitor the effects of extreme heat including deteriorating air quality resulting from elevated temperatures.**
  - **As part of the initiative, PlanetWatch, a blockchain-based air quality monitoring company, rolled out its product in the city. Details of the partnership and how successful it has been are not yet known, but if Planetwatch's sensors - which are powered by the Algorand blockchain - can help a city such as Miami minimize the effects of pollution, it will help to demonstrate that AI can be leveraged to address environmental risks.**

AI can create efficiencies and improve municipal services

Municipalities are using the technology to supplement and enhance offerings

Water and sewer networks

- **The City of Akron Water Supply Bureau contracted with Fontus Blue, a company that creates AI-powered tools to improve water and sewer treatment plant performance and efficiency.**
  - **Akron saw a 25% reduction in chemical costs, worth approximately $1.2 million.**
  - **Before implementation, Akron Water based its chemical dosing on the performance of its filters, whereas the new tool uses alternative measures to arrive at an optimal treatment strategy.**
- **The City of Newark, NJ's (Baa2 positive) water and sewer system also engaged with Fontus Blue to improve water treatment and quality adjustments.**
  - **The city has also launched an internal compliance-focused machine learning AI application to assure compliance with all government standards.**
- **In Arizona (Aa1 stable), the City of Tucson Water Enterprise (Aa2 stable) has contracted with VodaAI, a company that uses machine learning to assess the condition of pipes and detect leaks.**
  - **The technology discovers patterns from previous pipe failures and assigns a "Likelihood of Failure (LoF)" score for each pipe segment alongside a "Consequence of Failure (CoF)" score. When combined, the application can eliminate anomalies and allows the enterprise to preemptively focus resources to minimize emergency repairs and reduce costs.**



Consent decrees for sewer overflow issues can be costly, with the largest 10 in the nation having estimated costs of between $1.1 billion and $4.7 billion. Preemptive use of AI to assure compliance could help to reduce such costs by identifying issues before they escalate.

AI use brings substantial cyber risk, but large municipalities could harness it to manage that risk

AI use brings substantial cyber risk, but large municipalities could harness it to manage that risk

Cyber risk exposure

- AI relies on massive amounts of data to succeed, but that data also represents a treasure trove for cybercriminals.
- Local governments, which have been struggling for years to keep up with a rapidly changing cybersecurity landscape, have generally not demonstrated great prowess in data stewardship. Housing the amount of data that enables the use of AI applications makes local governments even more attractive targets for hackers.
- The data most appealing to cybercriminals is personal information, which presents risks for AI use in virtual assistants and traffic monitoring.
- Integration of AI into municipal operations that do not collect personal information also brings cyber risk.
- AI can itself be harnessed to mount attacks.

AI use brings substantial cyber risk, but large municipalities could harness it to manage that risk

Cyber risk prevention

- Still, some local governments see an opening for AI to shore up their cybersecurity.
  - New York City's Cyber Command, a centralized organization created to lead the city's cyber defense efforts, works with about 150 city agencies and offices to prevent, detect, respond to and recover from cyber threats.
  - To do so, it uses machine learning systems – built in-house and hosted on Google Cloud Platform68 – to collect datasets on network activity that are used to flag anomalous behavior. The system was built using a vast amount of historical training data and processes more than 11 billion events every day, or hundreds of thousands of model predictions per second.

- For all but the most sophisticated and best funded local governments, however, the overall impact may well be net negative.
  - Firstly, leveraging AI-powered tools to enhance cybersecurity would require that vast amounts of sensitive information about municipalities' cyber posture be aggregated and shared across many jurisdictions and entities, something most governments are hesitant to do.
  - Moreover, AI models intended to thwart cybercriminals utilize the same methods that cybercriminals will harness to circumvent a local government's defenses. Municipalities would have to stay at the forefront of emergent technologies, attack trends, and best-practice defensive techniques to remain one step ahead of cybercriminals.
  - This would require substantial investments that will remain out of reach for most municipalities. Accordingly, while the largest local governments will have budgets large enough to keep their cyber defense in step, medium-size and small governments may be left with weaker protection.

Resistance from taxpayers, evolving regulation and scalability challenges will hamper wider adoption

Resistance from taxpayers, evolving regulation and scalability challenges will hamper wider adoption

AI use by municipalities raises fundamental societal and governance concerns

Taxpayer resistance

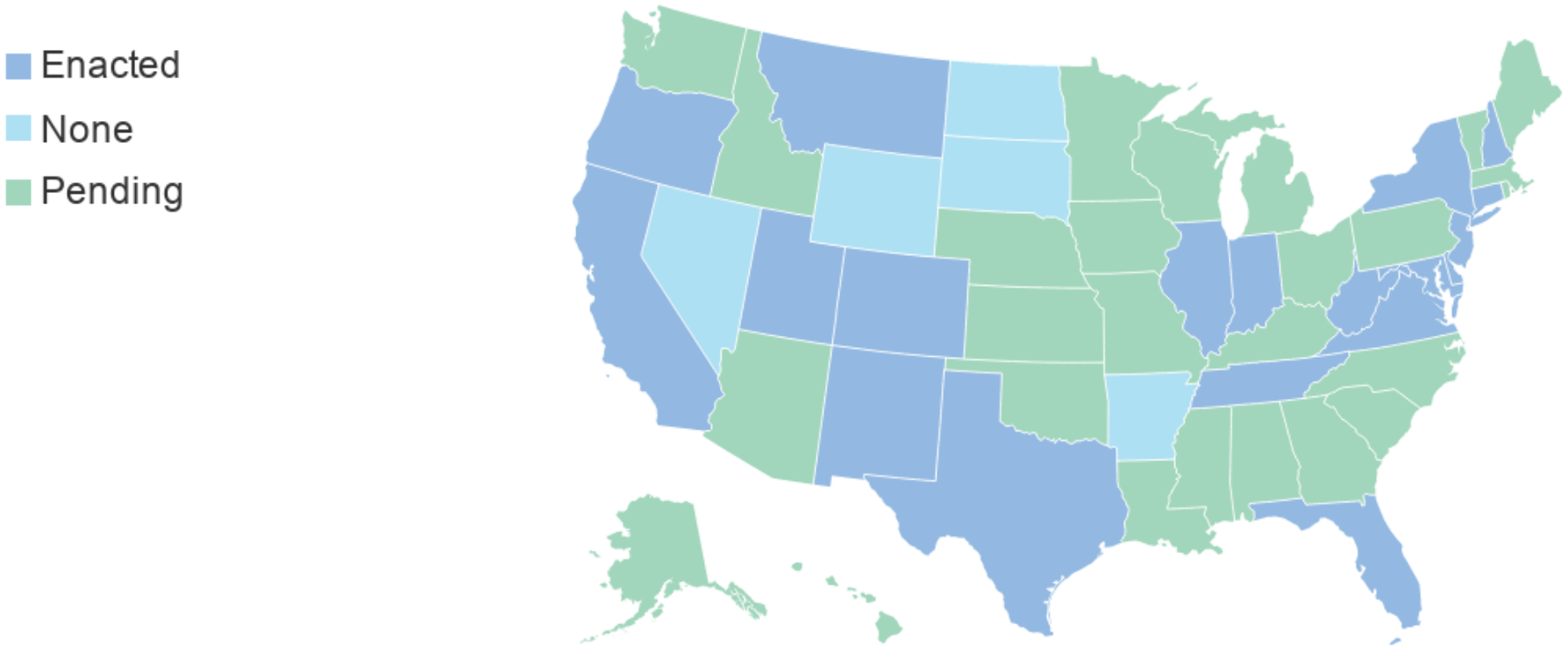
- **AI use by municipalities raises fundamental societal and governance concerns for municipal taxpayers, including the potential for bias in automated decision-making, the removal of the human element from consequential decisions, job displacement and the spread of disinformation.**
  - **Specific concerns include government reliance on algorithms to make decisions with real-life consequences for citizens, including privacy violations and inequities.**

- **AI use has also sparked concern over job displacement.**
  - **While local governments see the benefits of implementing GenAI and machine learning to fill vacant positions and reduce costs, taxpayers whose livelihoods are under threat in the wider economy may also oppose the supplanting of public sector positions with AI technology.**
  - **In July, the Organisation for Economic Co-operation and Development (OECD) reported that jobs with the highest risk of being automated make up 27% of the average labor force in OECD countries, though the number was somewhat lower for the U.S. at 21%.**

Resistance from taxpayers, evolving regulation and scalability challenges will hamper wider adoption

AI use by municipalities raises fundamental societal and governance concerns

Evolving regulation



Sources: National Conference of State Legislatures, BCLP, and Moody's Ratings

Resistance from taxpayers, evolving regulation and scalability challenges will hamper wider adoption

AI use by municipalities raises fundamental societal and governance concerns

Coronavirus cash is running out

- **While many GenAI applications are easy to implement and can be tailored to a wide range of uses, novel applications require heavier investment.**
  - **With local governments flush with cash, that may not be a problem in the immediate term, but federal coronavirus aid has concluded for cities and counties and will run out by the end of this year for school districts.**
  - **Local governments that have already invested in AI technology may find they do not have the funding to adopt or build out more recent AI-powered initiatives.**

- **Moreover, many local governments carry substantial technical debt, i.e. the cost of additional work required to enable information technology systems to operate in modern environments.**
  - **Upgrading those systems to accommodate novel AI initiatives may be too large a hurdle to overcome.**

Thank you

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AI & Bonds

Dr. Sean Stein Smith

Professor

City University of New York – Lehman College

AI, Blockchain & Implications for ESG Bonds

Dr. Sean Stein Smith

CDFA/BNY Mellon Webinar Series

May 21, 2024

About me

- Dr. Sean Stein Smith, CPA, CMA, CGMA, CFE
- Associate Professor, Lehman College, City University of New York
- Forbes Contributor – Crypto & Blockchain
- AICPA Outstanding CPA of the Year (2022)
- Accounting Today Top 100 Most Influential People in Accounting (2019 & 2023)
- E.C. Harwood Visiting Research Follow – American Institute of Economic Research
- Board of Advisors – Wall Street Blockchain Alliance (WSBA)
- Chair, Accounting Working Group, WSBA
- Strategic Advisor – Crescent City Capital
- 40 under 40 in Accounting (2017-2023)
- NJCPA Trustee (2022-2025 FY)

Agenda

- Market recap of
  - Blockchain
  - AI
  - Tokenized financial instruments
  - ESG trends and issuance
- Examples of how bonds combining these trends

Blockchain/tokenized assets

- Following a bear market in the aftermath of FTX the crypto market has recovered strongly
- Being led by institutions in the U.S. and internationally
- Bitcoin hit all-time-highs in March 2024
- Banks and governments are actively experimenting with blockchain/cryptoassets
  - Examples to come

AI market update

- AI has taken over the marketplace in terms of media coverage, investor interest, and regulatory scrutiny
  - U.S. Congress
  - United Nations
  - European Union
- ChatGPT and its iterations have made AI accessible to the mass market
- AI is also being implemented into financial instruments and markets

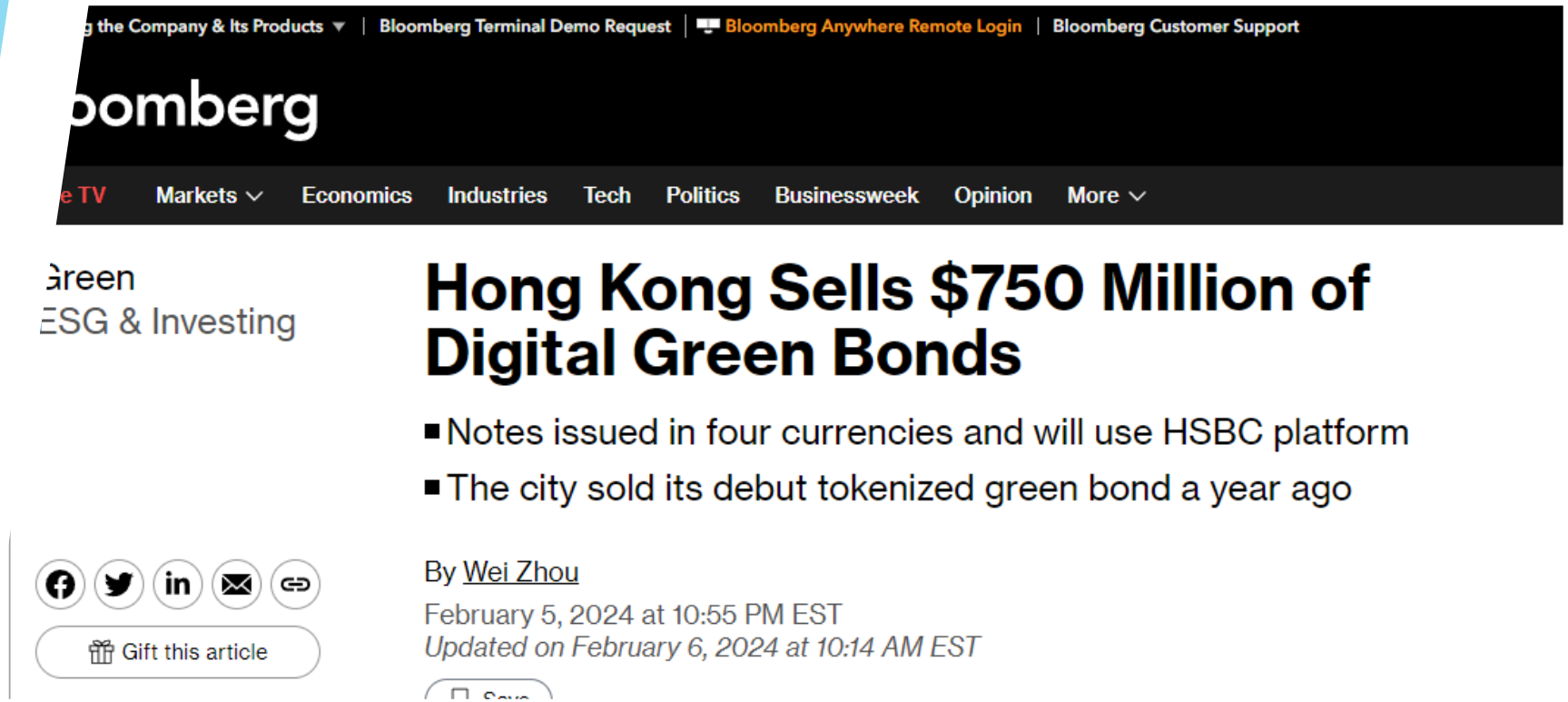
ESG market update

- Despite the political tensions around ESG and ESG related projects/investments the pivot toward these instruments continue to increase
- Inflation Reduction Act
- Sustainability Goals
- ESG metrics and benchmarks
- Trillions have been allocated to projects in this space, and have muni/governmental bonds are catching up

Let’s look at some examples

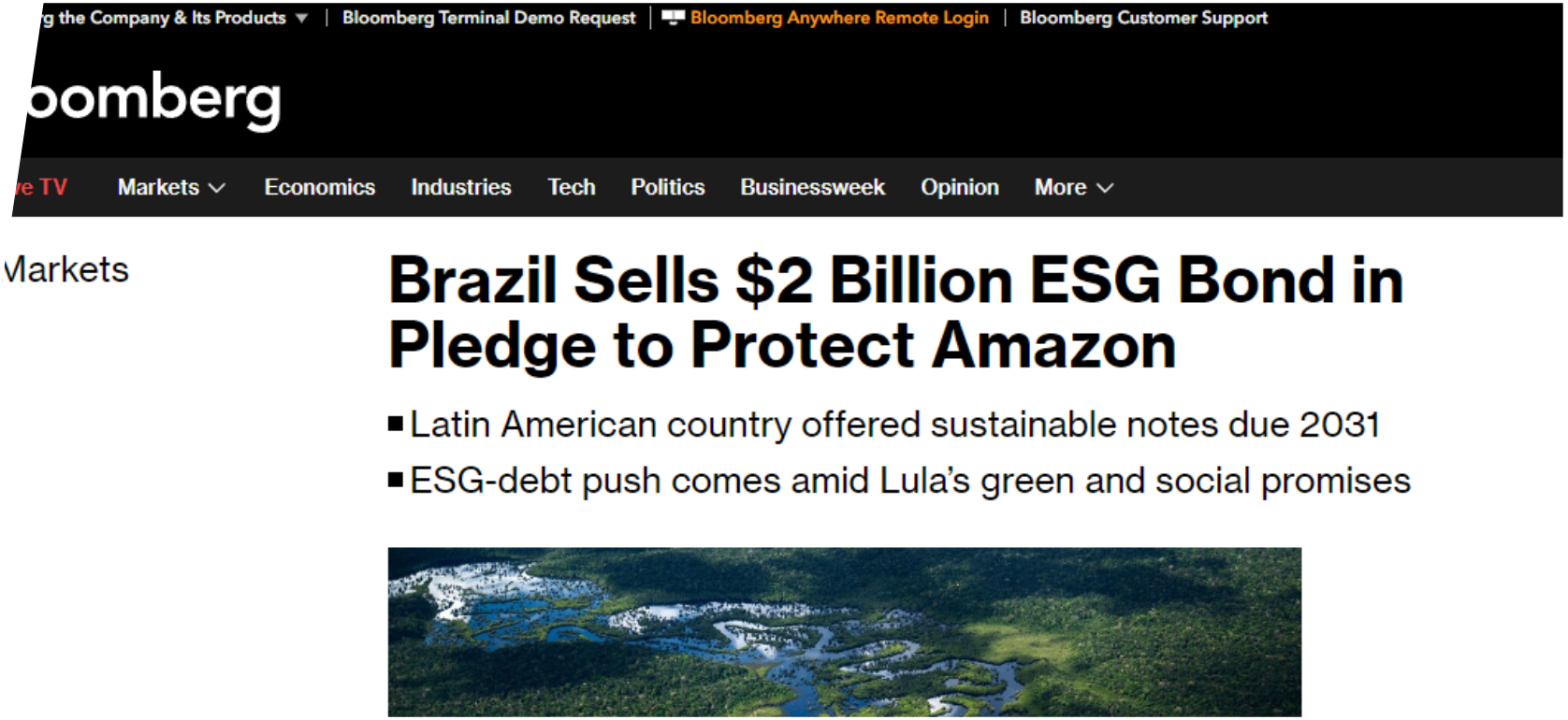
Quincy, MA

Read more here



Hong Kong

Full article here



Brazil

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World Business Markets Sustainability Legal Breakingviews More

Finance

SocGen issues 10-mln-euro digital green bond on a public blockchain

By **Reuters**

December 4, 2023 12:55 PM EST · Updated 5 months ago

Aa

SocGen

Full article here

Implications

- Technology trends are reshaping accounting and finance functions
- Raising capital will increasingly be technologically driven
- ESG themes and associated pressures will continue to exist
- Reporting and transparency will increase and hopefully improve as these trends continue
- Every aspect of the financial world will need to upskill/educate themselves on these topics

Thank you!

- Questions?
- Comments?
- Jokes?
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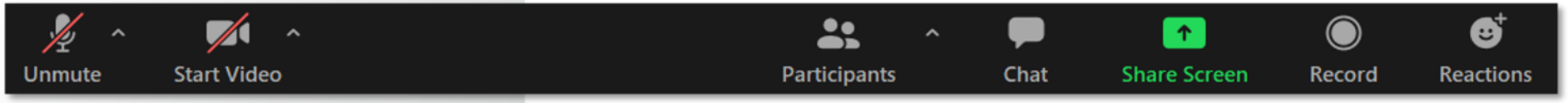
Audience Questions



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2024 CDFA Equitable Lending Learning Series: Strategic Partnerships for Sharing Financial Risk
July 23 // 1:00 – 3:00 PM Eastern

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