



OS-Climate

Report: OS-Climate Stakeholder Roundtable

May 2, 2019
San Francisco

Roundtable video stream link: <https://vimeo.com/337615091>

Roundtable video download link: <https://vimeo.com/user96212676/download/337615091/07af6b192a>

Executive Summary

The OS-Climate Stakeholder Roundtable on May 2, 2019 in San Francisco convened 42 leaders from across the climate, investing, and tech communities to gather input on the OS-Climate data modeling roadmap, as well as governance and organization of community collaboration, over the next two years and beyond.

OS-Climate (OS-C) <http://www.os-climate.org/> is a breakthrough Open Source solution for climate-integrated investing. Using the Linux Foundation approach for community-driven projects, proven effective in solving large scale complex technical challenges, the OS-Climate Foundation will build a non-profit 501(c)(6) collaborative business association and data and modeling technical platform. This will enable investment decisionmakers to run scenario-based predictive analysis and accurately price risk and opportunity related to physical impacts and economic transition, as well as to understand the GHG impacts of portfolios. In 2019-2021, OS-C will focus on asset owner and asset manager (AOAM) use cases for portfolio construction, asset allocation, risk management, design of new strategies and products, and securities selection; the modeling and data for AOAM needs should also support certain use cases in banking, corporate strategy planning and investment, and policy design. The initial release, targeted for late 2019, will focus more narrowly on portfolio analysis for equities. Applying the governance, technical decision rules, and licensing evolved by the Linux Foundation through more than 120 global projects, and leveraging its network of more than 1,400 corporate and institutional members and more than 30,000 individual contributors, OS-Climate will enable users and technology providers to share cost, knowledge, intellectual property, and effort to jointly build the platform.

The Roundtable began with opening remarks from [TTS to fill in]

There were eight main themes in the presentations and discussion:

Transition risk. Existing climate risk assessment tools fail to adequately assess transition risk. Regulatory and policy responses to climate change within the next decade will cause significant financial disruption, Some participants called for a shift from temperature-centric scenarios to those capturing potential for rapid policy change. Some models being evaluated for inclusion in the Platform use temperature-based frameworks that also include numerous rapid and disruptive policy pathways. The OS-Climate architecture will include bottom-up modeling that enables users to assess a range of policy, technology, and other shocks.

Physical risk. Asset owner and asset manager priorities include asset classes highly exposed to physical risk. Some physical risk factors can be material even in the near term. Data, models, and analytics are improving in capability to assess these risks and could be incorporated in the Platform.

Coverage. There are major gaps in data, risk analytics, and information that institutions need for decisions at levels ranging from the portfolio level to individual investments, and across asset classes, sectors, and geographies. OS-C will scope the first release of the Platform on asset owner and asset manager needs, equities, and OECD coverage, but will expand according to a careful Community-governed decision process supported by expert advice. Emerging market data is a major gap.

Information integrity and usability. Investors need to be confident that the information they use for decisionmaking is trustworthy and accurate. This requires that source data is tracked, accurate, and

sufficiently complete, that it is curated carefully and expressed in decision-useful terms, and that assumptions used to transform data into useable information are transparent and rigorous.

Modeling, not just data. Most of the investment community lacks accurate, comprehensive models and tools for integrating climate in risk management and other investment processes. Aside from extremely large firms, most asset owners and asset managers cannot afford to develop and run such models and tools themselves.

User-driven, user-adaptable, understandable and practical for users. Processes and outputs need to be user-oriented, and user needs vary widely. Some users want everything rolled up to a recommendation, some want degrees of customizability, and some want full visibility and control of the data and logic. Tool outputs need to be understandable and actionable for a range of users. Linux Foundation open source projects typically draw numerous expert service and technology providers that help community members use properly and customize the shared code.

Evaluation and interoperability. There are many methodologies, models, tools, and datasets for climate and investing. In their current state, they vary in both quality and usability, and some are deeply embedded in user investment processes. A priority for OS-Climate is enabling interoperability of multiple methodologies, models, tools, and datasets. OS-C's technical governance needs to include capacity for rigorous evaluation of which models to incorporate in the Platform.

Open source. Open source dominates almost all forms of modern computing and is a quicker and cheaper way of getting platforms to market. The Linux Foundation approach OS-C has been proven effective at creating conditions where it is in the business interest competitive communities to share cost and IP in building a pre-competitive layer of data and software as a public good, accelerating a wide range of commercial offerings that use that code; however, embracing open source architecture may be a challenge for many stakeholders. Open source approaches have long been applied in the insurance industry and risk management, and is familiar to data scientists in financial services, but open source is less familiar to investment professionals.

Context of the Roundtable

Roundtable participants came to the discussion with knowledge of OS-Climate's context and background. All roundtable participants had either been briefed beforehand by our team or viewed our introductory webinar. We recommend that viewers of this recording first watch this webinar if they have not already done so.

Introductory webinar stream <https://vimeo.com/324258096>

Introductory webinar download <https://vimeo.com/user96212676/download/324258096/9e754efcc7>

OS-Climate's data and modeling work over the next two years will focus mainly on use cases of asset owners and asset managers for the purposes of portfolio construction, asset allocation, and securities selection. The first release of the platform will focus even more narrowly on portfolio analysis, for listed equities, with bottom-up modeling of power, energy, and part of the transportation sector. OS-Climate's Asset Owner-Asset Manager Working Group, Planning and Technical Teams are in the process of further refining the scope, requirements, and specifications of that initial release of the platform. The Working Group members include Mellon, the investment management arm of BNY Mellon, Alberta Investment Management Company, and British Columbia Asset Management. The Group is reviewing detailed proposals for Version 1 execution from firms that have existing, proven models.

Information on the first platform project was not provided in this roundtable, except for very brief summaries of models that the Working Group and OS-C Technical Team has evaluated for integration in that release. For asset owners and asset managers that may be interested in joining the Working Group, we are happy to arrange full access to these materials regarding Version 1 and schedule presentations from the prospective developers.

Purpose of the Roundtable

The purpose was to gather input from important stakeholders about the OS-Climate data and modeling roadmap over the next two years and beyond.

- Clarify needs of Asset Owners and Asset Managers for the OS-Climate focus Years 1-2.
- Scope potential for asset management use cases modeling to also serve uses in insurance, banking, corporate planning and investment, and policy design.
- Explore opportunities to engage providers of existing datasets, models, enabling technologies, analytic tools, etc.
- Discuss roles for Linux Foundation and other networks in organizing community collaboration on the platform.

Agenda

- Welcome: Bob O'Connor of Wilson Sonsini Goodrich and Rosati, OS-Climate's counsel.
- Introduction: Truman Semans, OS-Climate CEO.
- Opening Speakers:
 - Bob Litterman, OS-Climate board member and chairman of the Risk Committee and a founding partner of Kepos Capital.

- Lionel Johnson, President of the Pacific Pension & Investment Institute.
- Deborah Spalding, Deputy CIO of The Common Fund.
- Jim Zemlin, Executive Director of The Linux Foundation.
- Round-the-table remarks:
 - Needs and priorities of asset owners and asset managers.
 - Needs and priorities of banks, insurance, corporates, and other users of the platform.
 - Presentations and demos from providers of data, model, and enabling technology.
 - Comments, feedback, and questions.
- Summary and closing.

Participants

There were 42 participants from across the climate & investing community representing asset owners, asset managers, think tanks, industry associations, NGOs, data and modeling providers, and technology firms.

Stephen Back Holm, Washington State Investment Board
Christine Cappabianca, Mellon
Alex Clark, CPI
Jennifer Coulson, British Columbia Investment Management
Michele Demers, Boundless Impact
Martin Doyle, Duke University
William Dumas, University of California Office of the President
Stan Dupre, 2 Degrees Investing Initiative
Lisa Eichler, Ortec Finance
Anne Maria (Mia) Eikeset, Norges Bank Investment Management
Lisa Eichler, Ortec Finance
Peter Ellsworth, Ceres
Chelsea Goddard, Mapbox
Adam Goehner, British Columbia Investment Management
Maryam Golnaraghi, Geneva Association
Ilmi Granoff, ClimateWorks
Maria Hancock, OS-Climate
Dan Hochman, Bridgewater Associates
Henrik Jeppeson, Carbon Tracker
Lionel Johnson, Pacific Pension & Investment Institute
Laura Kunkemueller, Mellon
Bob Litterman, Kepos Capital
Ken Locklin, Impax
Madhu Mathew, SASB
Samantha McCafferty, Harvard Management Company
Ilana Mayid, OS-Climate
Scott Nicholas, The Linux Foundation
Bob O'Connor, Wilson Sonsini Goodrich & Rosati
Janet Peace, C2ES
Ana Pinheiro Privette, Amazon Web Services
Benjamin Preston, RAND



Julie Pullen, Jupiter Intelligence
Alison Schneider, AIMCO
Dan Saccardi, Ceres
Truman Semans, OS-Climate
Rich Sorkin, Jupiter Intelligence
Peer Stein, International Finance Corporation
Tim Stumhofer, ClimateWorks
Dave Thau, WWF
Stéphane Villemain, PSP Investments
Marilyn Waite, Hewlett Foundation
Jim Zemlin, The Linux Foundation

REMARKS DURING THE ROUNDTABLE

Opening Remarks

Bob Litterman, OS-Climate board member and chairman of the Risk Committee and a founding partner of Kepos Capital.

*Bio: Prior to joining Kepos Capital in 2010, Litterman enjoyed a 23-year career at Goldman, Sachs & Co., where he served in research, risk management, investments, and thought leadership roles. While at Goldman, Litterman also spent six years as one of three external advisors to Singapore's Government Investment Corporation (GIC). Bob was named a partner of Goldman Sachs in 1994 and became head of the firm-wide risk function; prior to that role, he was co-head of the Fixed Income Research and Model Development Group with Fischer Black. During his tenure at Goldman, Bob researched and published a number of groundbreaking papers in asset allocation and risk management. He is the co-developer of the Black-Litterman Global Asset Allocation Model, a key tool in investment management, and has co-authored books including *The Practice of Risk Management* and *Modern Investment Management: An Equilibrium Approach* (Wiley & Co.). Litterman earned a Ph.D. in economics from the University of Minnesota and a B.S. in human biology from Stanford University. He is also the inaugural recipient of the S. Donald Sussman Fellowship at MIT's Sloan School of Management and serves on a number of boards, including Global Institute of Sustainability at ASU, Resources For the Future, Climate Central, the Woods Institute for the Environment, the Robert Wood Johnson Foundation, the Sloan Foundation, and World Wildlife Fund.*

- There is massive misalignment and market failure – the market is not pricing climate risk.
- Many people think it will be a slow transition to a low carbon economy, but we're going to have a very rapid and dramatic transition.
- There are many government incentives promoting fossil fuels, but significant changes in incentives will occur soon.
- For example, see Climate Leadership Council, sponsor of Baker-Schultz Carbon Dividend Plan, which has gained very broad support for a carbon tax from business community including Shell, BP, Ford, GM, Microsoft as well as the environmental NGOs.
- If you're worried about risk management, you need to consider potential scenarios, not expected outcomes.
- In risk management of transition, if we have enough time, we can solve any problem; we don't know how much time we have, and if we run out of time, we will have a catastrophe.
- There's a lot of uncertainty about where to price risk. When you have uncertainty, you need to be cautious, and caution means you need to be at the high end of that curve for pricing that risk.
- To send an effective signal, the carbon price will need to get high quickly.
- Given the increasing urgency of stopping growth of greenhouse gases, and growing acceptance of the need for action, the policy response not going to be "easing on the brake," rather slamming on the break. That will result in tremendous change in the economy.
- For investors, the key is the re-valuation that will occur with respect to assets. The most dramatic impact will be on fuel assets, but it will affect assets across all sectors.

- WWF began addressing this 5 years ago, when Bob chaired their Investment Committee. Considered divestment of fossil fuels but decided a better approach would be to hedge them. We created a simple structure, a total return swap, short a basket of fossil fuels companies and long the S&P 500.
- A few years ago, Carbon Tracker came up with analysis that led us to add oil exploration and production to stranded assets, and the swap has continued to do very well.
- We've become more sophisticated about what we want to sell, and each year, we've updated that swap with weightings.
- After 5 years, that swap is up about 80%. In other words, the stranded assets that we define as coal and tar sands have underperformed the S&P by XX%.
- Today, Kepos Capital is developing a hedging instrument for use by investors. With energy, we look at underlying assets in the portfolio. When you think about what's going to impact the value of an oil company, you have to go to the underlying value of the projects they own and consider what's going to happen in a rapid transition to a low carbon economy. Long-term demand for oil is going to be less than had been anticipated. When there's lower demand for oil in the long run, the incentive is for oil companies to produce more now, even though it's going to reduce the price today.
- The economics that are going to bring down the forward curve are going to affect the valuation of various different projects. For projects producing in the next few years, it probably won't have much impact. If you have a tar sands project that's going to produce over a long period of time, it's going to have a big impact. You want to figure the breakeven for each of these projects, determine if it is sensitive or not so sensitive to the forward curve for oil, and assess how that affects the value of the underlying company. You might want to think about a relative value portfolio where you're long oil companies that are less exposed, short companies that are more exposed.
- But there are a lot of different ways to think about it, and a lot of complexity as you think about it for different sectors of the economy. For example, I'm sure all are familiar with PGE that went bankrupt due to the fires in California. It's an example of physical risk, not transition risk. These physical risks are much harder to predict, and you're not going to sell all utilities, but different utilities are going to have different exposure to physical risks.
- The problem is more urgent than most realize. We've increased about 1-degree Celsius. Even if we halt emissions growth today, given lags in the system, we have locked in an increase to 1.7-1.8 C in about 60 years, even if we capture and sequester some CO₂. Every 4 years of delay will lead to 0.1 degree increase in temp. If we wait 8 years, we're locked in to 2 degrees C. which means losing 90 % of coral reefs.
- To make the transition, we have to use the market. And the market won't do it unless climate is priced into valuation. We need to be able to look very carefully at valuations, which is the mission of OS-Climate.

Lionel Johnson, president of the Pacific Pension & Investment Institute

Bio: Lionel Johnson became president of the Pacific Pension & Investment Institute in July 2014. His career spans more than three decades during which he has been a leader in international business, public policy, and economic development. He has served as senior vice president of the Initiative for Global

Development, as vice president of Turkey, Middle East, and North Africa Affairs at the Chamber of Commerce of the United States, and as senior vice president of Public Affairs at Fleishman-Hillard.

Previously, Johnson was vice president and director of International Government Affairs at Citigroup and deputy assistant secretary of the Treasury for International Development, Debt and Environment Policy in the Clinton Administration. He was also a senior advisor for Resources, Plans, and Policy to Secretary of State Warren Christopher, and a member of the Department of State Policy Planning Staff. He served as deputy director of the Clinton/Gore transition team at the Department of State. As a member of the U.S. Foreign Service, Johnson held assignments in the U.S. Embassies in Haiti, the Philippines and Kenya. He also served as special assistant to Secretaries of State George P. Shultz and James A. Baker III. Johnson was a senior program officer at the National Democratic Institute for International Affairs. He was a graduate instructor of U.S. foreign policy and American politics at the City University of Manila, Philippines, and received his B.A. in political science from Rutgers University in 1982.

Johnson is a visiting scholar of the Program on International Relations of New York University. He is board chair of ID2020 and a member of the board of trustees of the RAND Corporation. Johnson also serves on the board of directors of Foreign Policy for America, the National Democratic Institute for International Affairs (NDI), the San Francisco General Hospital Foundation, and the U.S. Global Leadership Coalition. He has two children, Alicia and Christopher.

- PPI has been focusing on climate over the last five years since I've been president of this organization, which is a member organization of institutional investors from around the world. The geographic focus of our investments is the Pacific Rim.
- We've had distinguished speakers, including Bob a couple of years ago, who came and spoke to our members at the outset of our discussions about climate. Bob, you really put into everyone's mind, the issue of risk management as the principle issue here.
- We tried to get beyond some of the philosophical issues of climate change and go right to the financial issues, and that seems to have resonated.
- There was a mixed bag of reactions from our members as we started doing programming around how they are factoring in environmental and particularly climate risk issues into their investment decision making.
- EU, Canadian, and some Asian members were more forward leaning, and in some respects were perhaps more susceptible to political and environmental community pressures.
- I'm happy to say that the last several months, including at our most recent convening of the senior representatives of these institutions, we have seen that idea of looking at this as a risk management issue has really become more mainstream.
- What's still missing is a real base of information from which to make investment decisions at various levels within these major institutions.
- I am encouraged about the OS-Climate Platform as a potentially useful tool for those institutions, including those that are more forward-leaning like British Columbia Investment Management and the world's largest pension fund, GPIF of Japan, which have signed on to a lot of the international protocols and provided real leadership within our membership.
- I'm looking for an opportunity for us to continue to support this work.
- With the advice and consent of the phone people around this room, I think it would be enormously useful for PPI and for our membership.

Deborah Spalding, a founding member of OS-Climate's Planning Team and co-Deputy Chief Investment Officer of Commonfund.

Bio: At Commonfund, she is a Managing Director responsible for the design, tailoring, and implementation of custom investment solutions for Commonfund's investment advisory clients. She is primarily responsible for asset allocation recommendations, portfolio oversight and analysis, and tactical rebalancing of client portfolios. Prior to joining Commonfund, she was the Chief Investment Officer for the State of Connecticut's \$30 billion Retirement Plans and Trust Funds. Previously, she was a Managing Partner at Working Lands Investment Partners, LLC, an independent investment management firm that invests in rapidly growing environmental markets. Prior to that, she held a number of executive level positions including Executive Vice President and Head of International Investments for Schroders Investment Management N.A. and Managing Director and Head of International Institutional Investments at Scudder Kemper Investments. She began her career as an equity analyst at SKB & Associates in San Francisco. Deborah received a B.A. in International Relations and Asian Studies from Tufts University and holds graduate degrees from Harvard University, University of California Berkeley, and Yale University. She is a past Board Chair and a member of the investment committee of the National Wildlife Federation, and an advisory board member of the Center for Business and the environment at Yale and is a Lecturer in Forest and Ecosystem Finance at Yale.

- I'll give a quick summary of where OS-Climate is currently and frame the kind of input we'd appreciate when we go around the table.
- I assume you all have viewed the March webinar, so I won't go over the basics.
- What we have set out to do is massively ambitious:
 - We envision a platform of data, modeling, and predictive analytics that enables scenario-based predictive analysis covering all the material factors in every climate-sensitive sector, asset class, and geography.
 - In terms of factors, we want ultimately to cover all the financially material variables affecting performance of portfolios, sectors, industries, and companies. That means dozens of factors across policy, technology, resources, consumer trends, macro factors, weather and climate, technology, and company metrics.
 - That will take 10 years and cost \$50-75 million, with a lot of that cost around data collection outside the OECD.
- But we've worked with our Planning Team, technical partners, and Asset Owner-Asset Manager Working Group to define a focused, realistic near-term road map:
 - For the next two years, we'll focus on AOAM use cases for portfolio construction, asset allocation, and securities selection.
 - However, that data and modeling for AO and AM use cases should also be able to provide value for selected other uses in Banking, corporate planning, shareholder engagement, and policy design.
 - We'll be sharing detailed development plans with those user groups and their data and tool providers over coming months, so we take account of developments in those domains of methodologies, standards, models, and data sets.
 - The first Version of the OS-Climate platform will focus even more narrowly. The scope will be the portfolio analysis use cases for listed equities that we described in the

- webinar. The bottom-up modeling sectors we'll start with are power, road-based transportation, and probably also fossil energy.
- These sectors that are the best understood from an econometric standpoint and for which the data is relatively better than other sectors – at least for our starting focus core OECD coverage.
 - This first version, which we aim to release late this year or early 2020, will be what in open source lingo is called the Kernel. We will build it through a contracted software development project, but that Kernel will create the structure that enables the typical community-executed Linux Foundation approach that Scott Nicholas described in our webinar.
 - We're working with two prospective developers that have excellent existing intellectual property that could be incorporated in the platform.
 - We also exploring arrangements with outstanding innovators in data, modeling, and tool that could be incorporated into this first version or subsequent releases on an open source basis or interconnected with the platform. Some We look forward to hearing from some of them today.
 - Next steps in building out platform will ultimately be decided by the Governing Board of the Open Source Climate Foundation, which will be formed when we reach a critical mass of community members to launch. But the Asset Owner Asset Manager Working Group and OS-C Planning Team are precursors to that Board.
 - So, we're eager to hear from those of your representing asset owners and asset managers about your plans in the next couple of years, your needs, and your pain points.
 - And we're eager to hear from potential contributors of data, modeling, enabling technology, and tools we could help leverage and accelerate.
 - From all of you, we welcome advice on other initiatives with which we should coordinate or collaborate.
 - A key function of the Open Source Climate Foundation will be to provide the organizational and technical infrastructure for collaboration across the community of users and providers of data, modeling, and analytics represented in this room.
 - For those of us that are not experienced in the world of open source, and I suspect that is almost all of us in the room, it's probably not clear how exactly this works.
 - Jim's going to talk about how the business model and value proposition for community based open source projects works, from the standpoint of various type of community members.

Jim Zemlin, Executive Director of the Linux Foundation

Bio: Jim Zemlin's career spans three of the largest technology trends to rise over the last decade: mobile computing, cloud computing, and open source software. Today, as executive director of The Linux Foundation, he uses this experience to accelerate innovation in technology through the use of open source and Linux.

At The Linux Foundation, Jim works with the world's largest technology companies, including IBM, Intel, Google, Samsung, Qualcomm, and others to help define the future of computing on the server, in the

cloud, and on a variety of mobile computing devices. His work at the vendor-neutral Linux Foundation gives him a unique and aggregate perspective on the global technology industry.

Jim has been recognized for his insights on the changing economics of the technology industry, and he is a regular keynote speaker at industry events. He advises a variety of startups, including Splashtop, and sits on the boards of the Global Economic Symposium, Open Source For America, and Chinese Open Source Promotion Union.

- In almost any technology product or service today, open source represents about 90% of the actual source code in that product or service.
- Technology companies have realized
- That all of the underlying commodity of the structure that powers the platforms -- Google platform, or Amazon Web Services, or the New York Stock Exchange -- is not what their costumers actually care about.
- That it's expensive and tedious to build and maintain.
- That it is more efficient to build and maintain that underlying commodity infrastructure collectively, so individual companies can focus on what really matters to them in terms of capturing value in the market, which that maybe 3% or 4% of the code that in your case may be a propriety trading algorithm or the user experience in a Toyota automobile.
- Linux originally started as a pre-operating system shared as a competitive wedge against incumbents in the market, but it has come to dominate every modern form of computing -- 100% of the high-performance computing marketplace, 80% of the mobile marketplace, more than half of the server marketplace.
- What this shows is that open source in an effective way to get to market faster, cheaper.
- Recent examples include our Hyperledger project, not nearly as cool as crypto currencies, but being used by the healthcare sector to transact all of the suppliers in the healthcare industry, insurers, and providers of financial transactions in the billions.
- Another is a project with the Academy of Motion Pictures. The 150 most profitable movies ever are all computer graphics-driven (Mama Mia was 151). But they're storytellers. They're not technologists, but they need a lot of complex technology to explore things digitally and use computer generated graphics to create these stories. So, they created the open source Academy Software Foundation with us to accelerate development of the underlying infrastructure that will just make for a lot of better movies.
- We can leverage the collective sharing of intellectual property to create software to solve tough problems.
- In addition to that, many organizations are asking us to apply the open source software development model to the sharing of data. As a result, we've created open source licenses.

- It's something that we think can add value in this particular effort, as you're seeking to cocreate both data lakes and then the software to run predictive analytics on that data to solve this very big problem.
- Based on our experience working with hundreds of projects that are creating billions of dollars in value, we want to help you get to that outcome sooner by leveraging the governance structure that we've refined over a long period of time. It's going to take a lot more than just the technology to solve these tough problems.
- Finally, to give evidence of how much value gets created out of these open source projects and how unexpected innovation can help solve big global problems collectively.
- Last year, two technologies that were created by Linus Torvalds (creator of the Linux kernel) who works at the Foundation, were the basis for transactions totaling \$40 billion. Red Hat was acquired for 34 billion, and Github bought for \$5 billion by Microsoft. So, there's clearly something to this open source software stuff.
- The question here (with data and modeling for climate-integrated investing) is how the Linux Foundation help can to set up that sharing infrastructure to facilitate the development so that this problem can be solved as quickly as possible. My staff and I are committed to doing this.

Summary of remarks on priorities in addressing climate and needs for modeling, data, and analytics among asset owners, asset managers, and other users

“Asset owners and asset managers are having a very hard time understanding, at the portfolio level, climate and transition risk.”

“We need to go from separate proprietary models and datasets to Open Source. And it’s very important to look at standards.”

“Price discovery is the key: what is the actual price of risk in portfolio construction, actual assets, and asset allocation.”

“In the last couple of years, we’ve done much more intensive thinking about scenario analysis, physical risk, and transitional risk. We are trying to get a good overview of what data and methods are available.”

“We are relatively new in factoring environmental impact into our risk management. We are big users of BlackRock’s Aladdin, and there are some limitations in how we can tie ESG scores and signals into what they’re doing, and embracing an open architecture will probably be a challenge as well. We are very interested in OS-Climate and how we can use that with existing portfolios, which is our main interest right now.”

“Initial scenario analysis didn’t tell us a whole lot, to be frank. We’re looking for the OS-C initiative to give something more practical that can make sense to portfolio managers and be implemented by them.”

“We ask our analysts to consider anything that significantly influences the way a company or issuer behaves or impacts the context in which they operate. Climate is such a huge topic, cumbersome for individual analysts to break down and come up with meaningful models. Engaging in OS-C will be helpful in getting them to focus on and come up with coherent models they can apply.”

“Equities is our main focus currently.”

“Data on infrastructure and private equity are the biggest pain points for us.”

“Infrastructure is a very challenging area for modeling, but it’s the future if we ever want to transition to a low carbon economy.”

“This is not a one-time thing. We need to have dedicated people who are constantly advancing, improving, and verifying these models.”

“The big challenge is in the integration and utilization of the results. Too often people burn themselves not really understanding what’s in the model and what the assumptions are.”

“Having a tool that’s adaptable, so users can build their own scenarios, will be valuable for everyone. It will be really useful for users to be able to adjust the parameters. The issues are constantly changing.”

Questions, feedback, suggestions (OS-C comments inserted)

“The inevitable policy response that will emerge over the next 8-10 years means immense financial risk and financial disruption. We need models to reflect that regardless of which temperature we reach. We need these risks to be better integrated into a platform.”

OS-Climate Comment: We agree. Also, ironically, that financial disruption and resulting impacts on households and businesses could significantly undermine public support for the very policies that are necessary.

“The greatest need is better modeling, not data.”

OS-C Comment: The core of OS-C since the concept phase has been a platform to develop better modeling, both top-down and bottom-up, and to serve as a public organizational and technical infrastructure to enable alignment on the best methodologies and interoperability among the best models. However, we have heard from almost every asset owner and asset manager that data gaps, poor data quality, lack of transparency, and licensing restrictions and cost are significant barriers to fully integrating climate across investment processes. Responding to this, OS-Climate will develop a Data Commons including corporate climate metrics as a public good.

“The majority of climate risks and opportunities will play out in emerging markets, and emerging markets pose the greatest data challenges...” “We think about equity a lot on the transition risk side. What does it mean not only for investor risk but also for the community that was being invested in, especially in emerging markets?”

OS-C Comment: We agree fully. While the initial releases of the platform will mainly use OECD data, we believe based on feedback that there is appetite among AOAM for filling these gaps in future projects. We think that even the early releases of the Platform focused on AOAM portfolio analysis could have some usefulness for policymakers and international institutions. Later releases of the platform will certainly serve these use cases. We are also establishing a 501(c)(3) that will work very closely with the 501(c)(6) but focus on public benefit uses of the Platform. It will facilitate grants from foundations, intergovernmental institutions, and agencies for bringing data on local communities and emerging market to the OS-Climate platform and supporting Platform modeling for international development and public benefit uses in mitigation, adaptation, and resilience.

“There are many tools out there that exist to look at securities portfolios and how they maps to climate risk, but there are limitations in terms of coverage.”

OS-C Comment: Addressing coverage limitations is one core objective of OS-C. We see gaps in coverage of asset classes, sectors, and geographies, as well as gaps in the financially material factors modeled. In many cases, the cost of data collection, modeling, computing and storage, etc. mean that there is no commercial business case for filling these gaps, but sharing the cost of the precompetitive layer could work. As noted, a core purpose of OS-C is to make interoperable tools and models and to help innovative commercial tool developers to accelerate and scale.

“We are dramatically underestimating the importance of transition risk and using scenarios that aren’t designed properly, designed around temperature targets and not regulatory transition risk. They aren’t forecasts, they’re scenarios. The closest we have is the New Policy Scenario <https://www.iea.org/weo2018/scenarios/>.”

OS-C Comment: We agree and believe that regulatory transition risk is among the least well priced-in risks associated with climate change. We also agree that to be valuable, scenario modeling must explore a range of regulatory pathways, including very disruptive regulatory scenarios. In assessing and selecting models for inclusion in the first version of the Platform, we aim to ensure the architecture is specifically well suited for using community-based open source development for rapidly advancing scenario modeling of significant policy shifts as well as better data on sub-national regional and local policies and regulations.

“To what extent is this intended to include the big banks, as they begin to invest their portfolios similarly to asset owners?”

OS-C Comment: We are confident that the same data and modeling for AOAM needs in the initial releases will also support certain use cases for banking, corporates, shareholder engagement, and policy design. In September or possibly earlier, we should be ready for a round of input from banking users to inform the OS-Climate roadmap by identifying possible adaptations of the models for their needs. In the meantime, in our collaboration with 2 Degrees Investing Initiative, we will be taking account the input they have received in their engagement with the banking community.

“Who is providing the data?” “What is the confidence that the data is consistent and dependable?”

OS-C Comment: We do not plan to use corporate climate metric data from for-profit commercial providers in the initial releases of the platform. In the initial releases, we will be subject to the same limitations of consistency and dependability as other platforms. As noted, we plan to develop a Data Commons that includes corporate climate data that is fully transparent, more consistent and dependable, and available as a public good. One key function of the quality control policies and processes for the Platform under the Linux Foundation Technical Charter will be to address data consistency and quality. As part of this function, OS-Climate will seek expert input from organizations including those that participated in this Roundtable, and other partners.

“How well do we actually understand the function and dynamic response between the scenario and what is actually happening at the asset/portfolio level? It works well in some situations, but not in others.”

OS-C Comment: This question points to the *raison d’être* for OS-C. The short answer is, “not very well... yet.” A guiding principle for OS-Climate is humility. A guiding principle for the Linux Foundation is that it doesn’t have the answer to any of these complex problems, rather the only way to solve them is through structured collaboration in the Community.

“What is the nature of the analytics, because ultimately there has to be some confidence that if you’re going to be selecting or blending analytic approaches, that you’re not taking someone else’s assumptions?”

OS-C Comment: This question gets to one of the deep problems we’re trying to address. Although it might be technically accurate that “nearly 400 investors with \$32 trillion in assets... are accelerating and scaling up the actions that are critical to tackling climate change and achieving the goals of the Paris Agreement,” the reality is that only a small fraction of these assets have been reallocated in light of risk and opportunity related to climate. Our interviews with dozens of asset owners and asset managers point to one of the reasons for this: the investment committees, CIOs, and PMs lack confidence in the available data, and in the available models and analytics to interpret the data. OS-Climate's decision to partner with the Linux Foundation was based largely on the conviction approach on Community organizational structure and technical governance is what the investment community needs to build sufficient trust and confidence in data and models for sustainable investing. A core principle of OS-C and of all Linux Foundation projects is complete transparency. A core *modus operandi* of community-based open source projects that rigorous evaluation and quality control “baked in” to governance, technical charters, etc. The initial “kernel” will mainly incorporate enhanced versions of existing IP that has been evaluated and tested by sophisticated users.

Two of the participating organizations described important initiatives underway to convene expert stakeholders to address needs of the sustainable investing community with respect to modeling and data -- methodologies, model quality, gaps, standards, etc.

OS-C Note: We are very keen to apply the insights and recommendations coming from these processes to the refinement of the OS-C roadmap and to specific technical decisions. Once the Open Source Climate Foundation is launched, its Technical Advisory Council (TAC) will manage the modeling and data roadmap, advise the Foundation’s Governing Board on technical

dimensions of all decisions, guide project-level Technical Steering Committees (TSCs) that are responsible for the execution of quality control, and establish technical partnerships with important initiatives such as these.

One participant described the potential for a climate impact measurement tool using quantitative science-based methods to measure the impact of emerging technologies, to facilitate better investment decisions, and to drive more investment capital toward the companies that are the most transformative.

OS-C Comment: Quantifying certain aspects of the environmental performance of companies' products, and quantifying their relative performance across policy scenarios that shape demand in product categories, will be central to OS-C models and is necessary for risk management and identifying potential for alpha. It is not yet clear what level of granularity the user community will want to achieve in the open source models; however, the kind of innovative third-party analytics OS-Climate aims to facilitate include, for example, life cycle assessment-level company analysis for alternative asset investing. We have also heard from a number of asset owners, asset managers, and other stakeholders that achieving measurable impact is an increasingly important criterion for their investors and that impact measurement, both global and local, and reporting are very important; so, we anticipate that the OS-C membership will decide to allocate community resources for building impact assessment into the open source models.

One participant noted that in some of the large data platforms OS-C will want to draw on, "petabytes of data makes it difficult to distribute." It is important that OS-C "carefully curate the data and systems in a user driven way. It's also important to get the analyses from the tool making sure the output is in a form that asset owners and asset managers can understand and act on."

OS-C Comment: In the Concept Phase for OS-C, we heard this to be a priority from Ko Barrett, IPCC Vice Chair and Deputy Assistant Administrator for Research at the National Oceanic and Atmospheric Administration (NOAA), as well as from several other experts including Martin Doyle, co-founder of the Internet of Water and a member of the OS-C Planning Team. Martin, who -- due to a technical glitch -- wasn't able to speak to the group during the roundtable, has previously said, related to this challenge, that "our water world is data-rich, but information-poor."

Data & Solution Provider Presentations and Demonstrations:

OS-Climate Comment: OS-Climate invited presentations by four providers of models, tools, and enabling technologies that could potentially be incorporated into the OS-Climate platform, and that have demonstrated value through their use by large asset owners and asset managers in investment processes. The selection of presenters was not juried by the Community. There are many other excellent established and emerging firms with proven or promising models, tools, and technologies in use by the investment community that could participate in OS-Climate. The Linux Foundation organizational and governance structure, and its Technical Charter, are designed to implement transparent, meritocratic decisionmaking and will be used once the Open Source Climate Foundation is launched to enable the sustainable finance community to evaluate and decide which methodologies, models, datasets, and standards should be integrated in the OS-Climate Platform.

Presentations and demonstrations, which are included in the Roundtable recording on Vimeo, were given by:

- Lisa Eichler, Co-Head of Climate & ESG Solutions at Ortec Finance, describing the firm's top-down climate scenarios model for asset liability management.
- Stan Dupre, CEO of the 2 Degree Investing Initiative, describing the PACTA tool.
- Chelsea Goddard, Engineer from Mapbox, demonstrating the company's foundational technology for location-based information.
- And Rich Sorokin, CEO of Jupiter Intelligence, describing the company's predictive analytics for managing asset level risk from weather and climate events.

Ortec Finance is a provider of investment decision modeling and technology, not a data provider, with 500 clients worldwide, mainly asset owner and asset managers. Starting in 2018, they began integrating quantified climate risk and opportunity in their existing economic scenarios generator that drives software they provide for risk-return modeling. It has been developed together with Cambridge Econometrics, with input from European and Canadian pension funds and insurance companies to ensure to ensure it is immediately applicable their use cases. Ortec also has partnered with academic institutions to make sure it was academically sound. Ortec is discussing with OS-Climate how to offer it in context of the OS-C Platform. Pathways they model are 2 degrees, 1.5 degrees, and 4+ degree Celsius, capture both orderly and disorderly transition paths and capturing non-linear policy impacts, physical impact, etc. Existing economic scenario sets that all clients using on a daily basis for the risk-return modeling, make the existing scenario sets climate informed. They translate climate modeling as inputs to their Stochastic financial model. They capture risks and opportunities via the Cambridge Econometrics macroeconomic model, for example modeling how climate change metrics such as sea level rise of X cm in year Y in country B flows through to broader macroeconomic interaction worldwide. They feed those climate adjusted economic shocks per year per country into their Stochastic financial model. The outputs is climate risk-adjusted scenario sets, basically economic and financial outlooks near term up to 2100. Example uses are for strategic asset allocation, checking if you want to make adjustments given the different climate scenarios, or, asset liability management studies.

The 2° Investing Initiative's work matches physical assets to their owners and parent companies, up complex ownership trees, to the security or the loan issued. The result is a company energy transition profile today and in five years based on their capital expenditure plan, which can be combined at the portfolio level to compare the trajectory of the portfolio to that of the different scenarios. The initiative was funded in large part by the European Commission. 2Dii has partnered with UNPRI to offer the free online tool. Users may upload their portfolios and receive a report on each sector held.

Mapbox is a location data platform which has already helped a number of different communities, in both the private sector and public sector, to contextually visualize location data and economic indicators in order to empower those impacted by natural disasters. Mapbox builds developer tools for engineers and organizations to embed in location services, providing building blocks to answer questions that have a geographic dimension. With its powerful rendering engine and platform agnosticism, it can be used to surface insights to understand and combat climate risks.

Jupiter Intelligence offers an end-to-end, 100% cloud-based solution focusing on asset- and portfolio-level physical risk with more granularity than existing portfolio-level screening tools, which typically

offer higher resolutions at 30-meter for global or regional use cases. Their solution fills a gap that exists currently available asset-level analysis. For the New York Metro Area, for example, Jupiter Intelligence has one trillion data points that are the intersection of physical locations at 1m resolution, probability thresholds, risk impact thresholds, scenarios, and probabilities (at the typical 1% insurance sector threshold). On a map interface, users are able to pick assets of focus, then work with additional partners for physical impacts, economic costs, and various resilience strategies. Scenario inputs and variables are adjustable, and it produces outputs to platforms for visualization, such as Mapbox, APIs, and custom reports.