Linux Foundation
OS-Climate
open source breakthrough
for climate-smart investing

June 12th, 2021
The Problem

• There is a gap of at least $1.2 trillion annually needed to achieve Paris Climate Accord goals and prevent catastrophic disruption of the global economy and the natural world.

• There is no way to close that gap without large-scale reallocation of capital by financial institutions (pension and sovereign wealth funds, banks, insurance companies, and asset managers), corporations, individuals, and governments.

• Most corporations are not acting quickly enough on their own in the absence of government regulation and incentives, carbon price signals, and market demand signals.

• Therefore, it is crucial for institutional investors and banks to lead, by aligning their entire portfolios as quickly as possible with Paris Accord Goals,
  ➢ while pressing the companies they finance and invest in to do the same with their capex, R&D, product development, supply chain management, etc.
CLIMATE DATA & ANALYTICS - THE SITUATION

Climate Change

Existing Solutions
Huge Gaps

Data and existing tools’ coverage of asset classes beyond listed large-cap equities is poor, especially for countries outside the OECD. Even where coverage is good, quality, comparability, and trust are often poor.
Investors are overexposed to climate-related risk, and underexposed to climate-related opportunity; therefore a climate change mitigation and resilience strategy is needed.

To do so sophisticated climate data and tools are a prerequisite.

However:

- Investors lack insights on climate risks and opportunities
- It is difficult to quantify the impact of many climate-related factors such as technology, resources, policies
- Existing climate tools and analysis lack of transparency and geographical coverage

Organizations need access to meaningful and reliable data, as well as climate expertise, effective management, academic, technological, and financial resources.

However, such a goal is difficult to achieve especially when efforts are fragmented and often competing against each other.

A joint effort between different players is needed to bring together and share expertise and knowledge.
Solution: Linux Foundation OS-Climate (OS-C)

Apply the Community-Based Open Source approach that has enabled breakthroughs in Life Sciences & Tech to solve data & analytics challenges required for investment to achieve Paris Climate Accord goals.

OPEN SOURCE COMMUNITY

- Governance, licensing, and collaboration structures enabling stakeholders to share cost, intellectual property, and effort.
- Joint projects for new data, modeling, standards, and supporting technology.

GLOBAL DATA COMMONS

- Curated library of public and private sources, for both transition and physical risk/opportunity.
- More accurate corporate historical and forward-looking climate & ESG metrics as a public good.

ANALYTIC TOOLS

- Integrate climate-related risk and opportunity into decisions by investors, financial institutions, regulators, etc.
- Top-down and bottom-up modeling.
- Scenario analysis tools.
- Alignment tools.
OS-C ORGANIZATION & STRUCTURE

OS-CLIMATE COLLABORATION COMMUNITY

- Climate models and academia
- Asset Managers
- Asset Owners
- Climate Analytics
- IT companies
- High emitting industries
- OS Climate Platform
- Banks

Facts

- Unique collaboration platform to solve one of the largest problems for investors
- Community-based Open Source governance hosted by Linux Foundation
- Already close to reach the necessary market relevance
- Member companies from different sectors
- First official release before COP 26

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An Open Source collaboration community to build a software platform that will dramatically boost global capital flows into climate change mitigation, adaptation, and resilience.

In collaboration with Academia, NGOs, Investors, and Commercial data providers, the aim is to aggregate the best available data, modeling, and data science to enable powerful applications for climate-integrated investing.

**VISION**

- Unique open source approach gathers main actors on a single platform – academia, financial institutions, NGOs, regulators, and emitting companies
- Transparent, accurate, and reliable data on non-commercial platform
- Only global collaboration leads to break-through innovations
- Consistency between climate models, scenarios, and analytical tools – no black boxes in between
- Transition & physical risk analytic tools on platform become global standard

**TECHNICAL SET-UP**

- All data and tools based on AWS Cloud technology (AWS S3 storage, Jupiter Notebook for data analysis, Quick Sight for BI-service etc.). Mid-term cloud-agnostic approach.
- Community-based Open Source governance hosted by Linux Foundation with additional technical support by Amazon, Microsoft & Red Hat
- Project and code management on GitHub
OS-Climate Community Leadership

The membership has more than tripled since September 2020. The number of individual subject matter experts, data scientists, software engineers, solutions architects, and other contributors to the initiative from the members has grown more than 500% over that period.

- **Governing Board members:**
  - Remco Fischer, UNEP-FI as part of the Secretariat of the Net Zero Asset Owner Alliance.
  - Frank Manahan, KPMG
  - Udo Riese, Allianz
  - Truman Semans, OS-Climate Core Team
  - Rim Tehraoui, BNP Paribas
  - Jared Westheim, Goldman Sachs

- **Technical Advisory Council:**
  - Pierre de Belen, Goldman Sachs
  - Vincent Caldeira, Red Hat IBM
  - Robert Moroney, KPMG
  - Ludan Stoeckle

- **OS-C Core Team leaders:**
  - Hewson Baltzell, Product Leader
  - Truman Semans, CEO
  - Michael Tiemann, Project Leader

- **Senior Advisors include:**
  - Monique Barbut
  - Lionel Johnson
  - Bob Litterman
  - Deborah Spalding

- **Governing Board Observers:**
  - Adrian Cockcroft, Amazon
  - Lisa Eichler, Ortec Finance
  - Daniel Godfrey, Federated Hermes
  - David Harris, London Stock Exchange Group
  - James Salo, S&P Global
  - Nicholas Schifano, Microsoft
OS-Climate Focus Users & Use Cases in 2021

Asset Owners, Asset Managers, Banks & Regulators

### Scenario Analysis (Risk & Opportunity)

- Stress testing
- Risk management
- Asset allocation
- Portfolio construction
- Research (investment, banking, etc.)
- Manager selection

### Alignment (Portfolios, Investments/Loans)

- Analysis of securities & loans
- Design and execution of benchmarks, strategies & products
- Disclosure & reporting
- Engagement with companies & financial institutions

The OS-C Platform also will help Corporates efficiently disclose climate & ESG data while building a library of trustworthy data, available to the public at no cost.
OS-Climate Initial Platform Components

Data Commons

Corporate  Economic, Market  Sector & Industry  Policy & Technology  Physical  Linkage & Asset-Level  Scenarios

Tools for Scenario Analysis & Alignment

Stress Testing  Physical Risk  Top Down Portfolio Analysis  Bottom Up Company & Security Analysis  Target-Setting and Alignment
Platform components shown here and following pages are already in use by institutional investors:

- Top Down Model from Ortec Finance/Cambridge Econometrics.
- Physical Risk Extreme Event Data by Jupiter Intelligence (depicted in next schematic).

Microsoft and Allianz have prototyped UK CBES stress testing tools for Banking and Insurance that draw on Data Commons Data.
Functional Schematic of Data Commons / Tools Linkage

- **Ortec Finance contributed scenarios**
- **NGFS contributed scenarios**
- **Inevitable Policy Response contributed scenarios**
- **Scenario Contributor C**

**Data Commons**
- **Public & Private Un-Groomed Data**
- **Public & Private Groomed Data**
- **DB Snapshots, FTP, fileshare**
- **SOAP, REST API’s**

**Flat Files**
- **DB**

**Undigested Data**

**Alignment Module**
- **Physical risk by Jupiter Intelligence & ClimatePREDICT**

**Top Down**
- **Model A API**
- **Model B API**

**Bottom Up**
- **Model A API**
- **Model B API**

**Ortec Finance API**

**Top Down Scenario Analysis**

**Bottom Up Scenario Analysis**

**User Dials**

**Simulator**
- **Portfolio Upload**
- **Reporting Interface**
- **Reporting API**

**Tool A API**
- **Tool B API**
Data Commons – Focus on “Material” Climate Factors

V1.0 will focus on factors identified as top priorities by asset owners, asset managers, and regulators from among SASB, TCFD, CDSB, GRI, and CDP “highly material” factors. For example (not exhaustive):

- Carbon-related assets, with location/ownership – fuel reserves, plants, other large stationary sources/users, buildings, infrastructure, fleets, etc.
- At company-, division-, geographic-, and asset-level: breakdown of energy consumed by fuel type, water consumption, and Scope 1, 2, and 3 GHG emissions.
- Sales of, and investment in, CC-sensitive products by type & geography.
- Resource consumption, by type, asset-level, and geography.
- Capital planning and investment, R&D, and other forward-looking metrics.
- Climate-related targets, and progress against targets.

- Corporate Metrics (adding projections in future versions)

- Policy & Regulations by jurisdiction

- Technology, Resources, Physical Risk

- Scenarios & Other

- Carbon price – by carbon tax, or indirect though other policy.
- Regulations on emissions and other GHGs.
- Efficiency and clean energy mandates.
- Subsidies – direct and indirect.

- Fuel and other resource availability, production cost, and prices, by market and asset-level.
- Technology cost and performance curves.
- Probability of occurrence and severity, by geography and asset, for extreme climate and weather events – coastal and fluvial flood, heat, wind, fire, drought, freeze.

- NGFS as reference scenarios; also additional scenarios including Inevitable Policy Response.
- Transition pathways from multiple partners and sources (TPI, ADEME ACT, etc.)
- “Linkage” data, e.g., mapping climate-related data to corporate ownership and securities.
- Macroeconomic data and market trend data.

And derived metrics, e.g., rankings versus peers.
This visualization depicts Jupiter’s Commercial Product, with 1 meter$^2$ resolution. It shows probability of occurrence and severity of multiple perils, for 10-year intervals through 2050, 2075, 2100:

- Flood
- Wind
- Heat
- Drought
- Fire
- Hail

Jupiter Intelligence is contributing 30-km$^2$ Extreme Physical Risk Data.
Physical Risk Data Lineage

1. API visited
2. Use Golden Copy
3. three versions

1) gleif_lei2 (100)
2) gleif_repep_intra_day (10)
3) gleif_repeat_intra_day (64)
4) Weekly update

1. Data Loaded
2. ETL required

1. gleif_lei (Golden Copy)

3. EPA FRS National
   Linked by Lat, Lon
   1) Longituded
   2) Latitude, Longitude

4. GHG Emission
   Linied by FRS ID
   1) GHG (3000 total, 2500 overlap)
   2. WRI (5000 total, 2500 overlap)

5. WRI
   Power capacity
   Generation Est. Generation

6. OS-C
   Physical Risk Massive DataSet
   USA, Latitude, Longitude

4. Direct Emitters (10 year data)
   Error

5. Massive
   - 2500 - GHG, WRI
   - 500 - GHG
   - 1500 - WRI
HIGH EMITTING SECTORS

Example: NACE- Manufacturing
Carbon intensity

Motor vehicles
- Nissan Motor
  - 160 t CO2e/ m EUR invested
- Peugeot
  - 60 t CO2e/ m EUR invested
- Ford Motor
  - 35 t CO2e/ m EUR invested
- Volvo
  - 8 t CO2e/ m EUR invested

Industrial gases
- Air Liquide
  - 370 t CO2e/ m EUR invested
- Linde
  - 300 t CO2e/ m EUR invested

Oil & Gas
- Gazprom
  - 2,000 t CO2e/ m EUR invested
- Eni
  - 880 t CO2e/ m EUR invested
- Exxon Mobil
  - 620 t CO2e/ m EUR invested
- Royal Dutch Shell
  - 450 t CO2e/ m EUR invested
- Total
  - 350 t CO2e/ m EUR invested
- Equinor
  - 260 t CO2e/ m EUR invested

Steel
- ArcelorMittal
  - 6,600 t CO2e/ m EUR invested
- Thyssenkrupp
  - 4,500 t CO2e/ m EUR invested

Cement
- Lafarge Holcim
  - 3,400 t CO2e/ m EUR invested
- Heidelberg Cement
  - 3,200 t CO2e/ m EUR invested

Pharmaceuticals
- Astra Zeneca
  - 4 t CO2e/ m EUR invested
- Roche
  - 3 t CO2e/ m EUR invested

Sector average manufacturing
- 194 t CO2e/ m EUR invested
# SECTORAL ANALYSIS EXAMPLE – POWER GENERATION

## PUBLICLY AVAILABLE BACKWARD-LOOKING DATA

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Market Cap</th>
<th>Outstanding Debt</th>
<th>GICS Sub-Industry (MSCI)</th>
<th>2DS (Regions that are within the 2°)</th>
<th>Beyond 2° (Regions that have hit beyond the 2°)</th>
<th>Portfolio Mix</th>
<th>Carbon Emissions (Company Reported Data)</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

**Regional Exposure (% of revenue derived from)**

## PUBLICLY AVAILABLE FORWARD-LOOKING DATA

**Integration of the low-carbon economy in current and future business models (via screening of Annual - and Sustainability Reports)**

<table>
<thead>
<tr>
<th>Year X</th>
<th>(e.g. B2DS/2DS)</th>
<th>Fossil Fuels</th>
<th>Renewables</th>
<th>Year X</th>
<th>Year X-1</th>
<th>Year X</th>
<th>Year X-1</th>
<th>Year X-1</th>
<th>Commitment</th>
<th>Carbon Emission (Mt)</th>
<th>Carbon Emission Intensity t/EUR or in ton CO2e/KWh</th>
<th>Initiatives</th>
<th>Sovereigns</th>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Fossil Fuels</td>
<td>Renewables</td>
<td>Clean Technology</td>
<td>TPI Mgt.Level</td>
<td>SBTi Signatory</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Oil &amp; Gas, Coal etc.)</td>
<td></td>
<td></td>
<td>To what extent are Company commitments in line with Sovereign commitments.</td>
<td></td>
</tr>
</tbody>
</table>

**Specific KPIs need to be defined**
BUILDING ANALYTICAL TOOLS

Data Commons → Analytics → Output Layer

Investor Portfolio → Analytics

Data security
Temperature Scoring Tool Under Development

Investors and banks could aggregate temperature scores after separately assessing targets and emissions producing a ‘target’ and ‘emissions’ temperature score. This could be extended to integrate Capacity scoring.

Emissions
- Emissions are projected forward to 2040 through line of best fit and divergence from benchmark is discounted to present

Targets
- Emissions are projected forward to 2050 based on company intentions and divergence from benchmark is discounted to present

Capacity
- Capacity is projected forward to 2025 and divergence from benchmark is discounted to present

Each company is scored in each module, then the modules are aggregated, defaulted to e.g. by historical sector probability of meeting target vs. benchmark.

Reporting and visualization
COLLABORATION ON ANALYTICS

Example – Portfolio Alignment Tools

**Linked to Data Commons**

1. **Data collection**
   - Secure and host company data

2. **Data loading**
   - Transform and match data to portfolio securities

3. **Benchmark selection**
   - Benchmarks from one or more climate scenarios are selected

4. **Emissions projection**
   - Company emissions are projected forward

5. **Temperature score**
   - Company score assigned based on cumulative benchmark divergence

6. **Portfolio reporting**
   - Results are reported to investors and visualized

**Potential owners**

- **Red Hat, ASDI, S&P, LSEG**
- **Red Hat, AZ**
- **GS, AZ, RMI, TPI**
- **TPI, GS, AZ**
- **Ortec**
- **Red Hat**

**POC focus**

- Utility emissions & targets only (LSEG/TPI, RMI, WRI)
- Red hat oversight
- Data brought in from data commons/vault and investor portfolio
- Matching flagging bad matches
- Red hat oversight
- Load of SBTI, IDEA 1.5 degree scenarios for utilities, autos, steel
- Convergence-based benchmark
- 10-year activity-based emissions projections
- Based on targets and emissions
- Cumulative divergence method with TORE calculation
- Ownership weights
- Simple metric reporting on underlying companies

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Example Visualization -- Alignment Tool

Portfolio Reporting

Temperature heat maps

Company reporting

Alignment trajectory analysis

Cumulative emissions overshoot

Peer benchmarking
Example ITR Tool Outputs: Company Temperature Scores

S1+2 GHG emissions and temperature score, per company

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Initial Top-Down Climate Scenario Analysis Tool: Ortec Finance – Cambridge Econometrics ClimateMAPS Model
Users Will Be Able To Dial Up Or Down Material Policy and Technology Factors

**POLICIES**

1) Promotion of renewables (e.g. % subsidy).
2) Limits on coal-fired power.
3) Nuclear (assumptions of capacity).

1) Incentives for purchase of clean fuel vehicles.
2) Biofuel blend mandates.

1) Support for energy efficiency investment (e.g. subsidies).

**TECHNOLOGIES**

1) CAPEX costs and learning rates.

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**Power Generation**

1) Promotion of renewables (e.g. % subsidy).
2) Limits on coal-fired power.
3) Nuclear (assumptions of capacity).

**Road Transport**

1) Incentives for purchase of clean fuel vehicles.
2) Biofuel blend mandates.

**Energy Efficiency**

1) Support for energy efficiency investment (e.g. subsidies).

**Carbon Price**

**Carbon Capture & Storage**

**Renewable Technologies**
Different climate pathways are expected to impact economic and financial risk drivers in their own way, per horizon and per region.
This also translates to differentiated impacts across all asset classes, regions, and sectors in turn.
Are expected returns for different climate paths still aligned with required return?

Example Visualization: Total Portfolio Impacts

<table>
<thead>
<tr>
<th>Investment portfolio</th>
<th>Cumulative return relative to climate-uninformed baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
</tr>
<tr>
<td>Paris orderly transition pathway</td>
<td>-3%</td>
</tr>
<tr>
<td>Paris disorderly transition pathway</td>
<td>-4%</td>
</tr>
<tr>
<td>Failed transition pathway</td>
<td>0%</td>
</tr>
</tbody>
</table>

Source: Ortec Finance
• **Business model:** non-profit 501(c)(6) business association under the Linux Foundation (largest organizer of open source tech initiatives globally); platform management and development funded by annual member fees plus philanthropic grants.

• **Governing Board** (fee-paying members + Academia, IGO, NGO): decides strategy, priorities, & budget. In Year 1, Asset Owners, Asset Managers, & Banks will be the majority and set direction.

• **Technical Advisory Council (TAC):** sets technical vision, facilitates collaboration among the Technical Projects, and recommends budget and technical decisions to Board.

• **Technical Steering Committees (TSCs):** are responsible for technical oversight of each technical project.