
AWS
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How Moody's uses serverless and microservices for ESG scores

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Agenda

- Introduction to Moody’s and ESG
- Product journey
- Technical architecture deep dive
- Outcomes and lessons learned

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Who is Moody's?

Moody's Investors Service

- Independent provider of credit rating opinions and related information for over 100 years
- Proven ratings accuracy and deeply experienced analysts
- Expanded sales and marketing activities in Commercial group

Moody's

Global integrated risk assessment firm providing credit rating opinions, analytical solutions and insights that empower organizations to make better, faster decisions

Revenue of $6.1 billion



Adjusted Operating Income[1] of $2.9 billion



Adjusted Operating Margin[1]

MIS 59.9% MA 26.1%

Moody's Analytics

- Provider of financial intelligence and analytical tools supporting our customers' growth, efficiency and risk management objectives
- Solutions address diverse needs and customers
- Extending brand into new markets and deepening customer relationships

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ESG encompasses a multitude of nonfinancial factors

Environmental

Conservation and protection of the natural environment

- Carbon emissions
- Water usage
- Waste management policies

Social

Relationships with employees, suppliers, clients, and communities

- Workforce diversity
- Equal pay policies
- Health and safety policies

Governance

Standards for company leadership, risk controls, and shareholder rights

- Board structure
- Executive compensation
- Tax strategy

Source: AWS ESG first call deck - https://aws.highspot.com/items/603d4dbe998ae477160652f4?lfrm=srp.0#5

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ESG priorities vary across market segments



Build new ESG products and services by integrating ESG data into lending, underwriting, and investment processes



Quantify financed emissions and integrate climate risk into a risk management framework



Report ESG metrics in line with evolving standards and regulations

Driving a need for granular ESG data and robust ESG data governance

Source: AWS ESG first call deck - https://aws.highspot.com/items/603d4dbe998ae477160652f4?lfrm=srp.0#5

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Collecting ESG data is challenging

- **No single standard for reporting ESG data**, resulting in diverse, incomplete, and uncorrelated datasets
- **Infrequent ESG reporting** makes it difficult to access quality and timely data
- **Uncovering investment insights from ESG data** as ESG scoring models require different weightings to be applied to ESG factors

Source: AWS ESG first call deck - https://aws.highspot.com/items/603d4dbe998ae477160652f4?lfrm=srp.0#5

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Significant value tied to ESG

40% **of the $110 trillion professionally managed global financial assets have an ESG consideration**

Gillian Tett, “Wall Street’s New Mantra,” https://on.ft.com/3XhVrD0

$288B **was invested in sustainable assets by investors in mutual funds and ETFs from January through November 2020, a 96% increase over 2019**

Larry Fink, “2021 Letter to CEOs,” https://www.blackrock.com/us/individual/2021-larry-fink-ceo-letter

81% **of a globally-representative selection of sustainable indexes outperformed their parent benchmarks during 2020**

Larry Fink, “2021 Letter to CEOs,” https://www.blackrock.com/us/individual/2021-larry-fink-ceo-letter

$550M **is what asset managers, the heaviest spenders on ESG data, are estimated to spend on ESG data in 2021**

Anne-Laure Foubert, “ESG Data Market,” https://www.opimas.com/research/547/detail/

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What are Moody's goals?

- Serve growing market demand for **rigorous and transparent ESG and climate solutions and data**, building on Moody's leadership and track record in risk management and assessments
- Publish **ESG data and SFDR[1] reports** with data lineage and transparency
- Introduce new revenue streams by **incorporating ESG data** into relevant Moody's risk models and platforms that serves core industries today

1. SFDR is a regulation set up by the European Commission; it stands for "Sustainable Finance Disclosure Regulation"

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Working backwards from our goals



2. Documents collected for companies from websites and stored in the data factory

1. ESG reference data to support methodology and required data elements







3. AI/ML used to extract key paragraphs and data points from stored documents

5. Data and scores delivered internally and externally



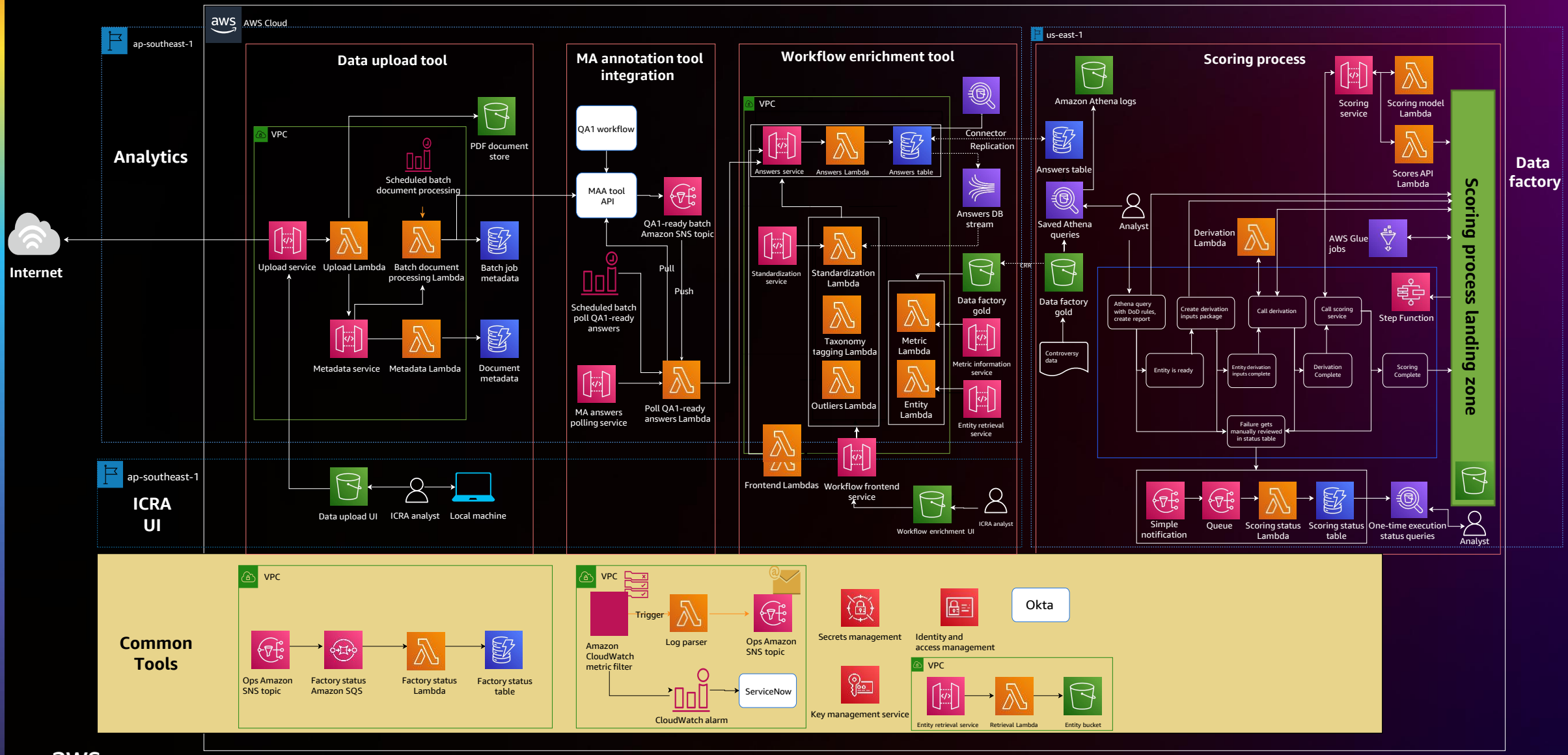


4. Enriched data points output used to support data analyst review and enrichment

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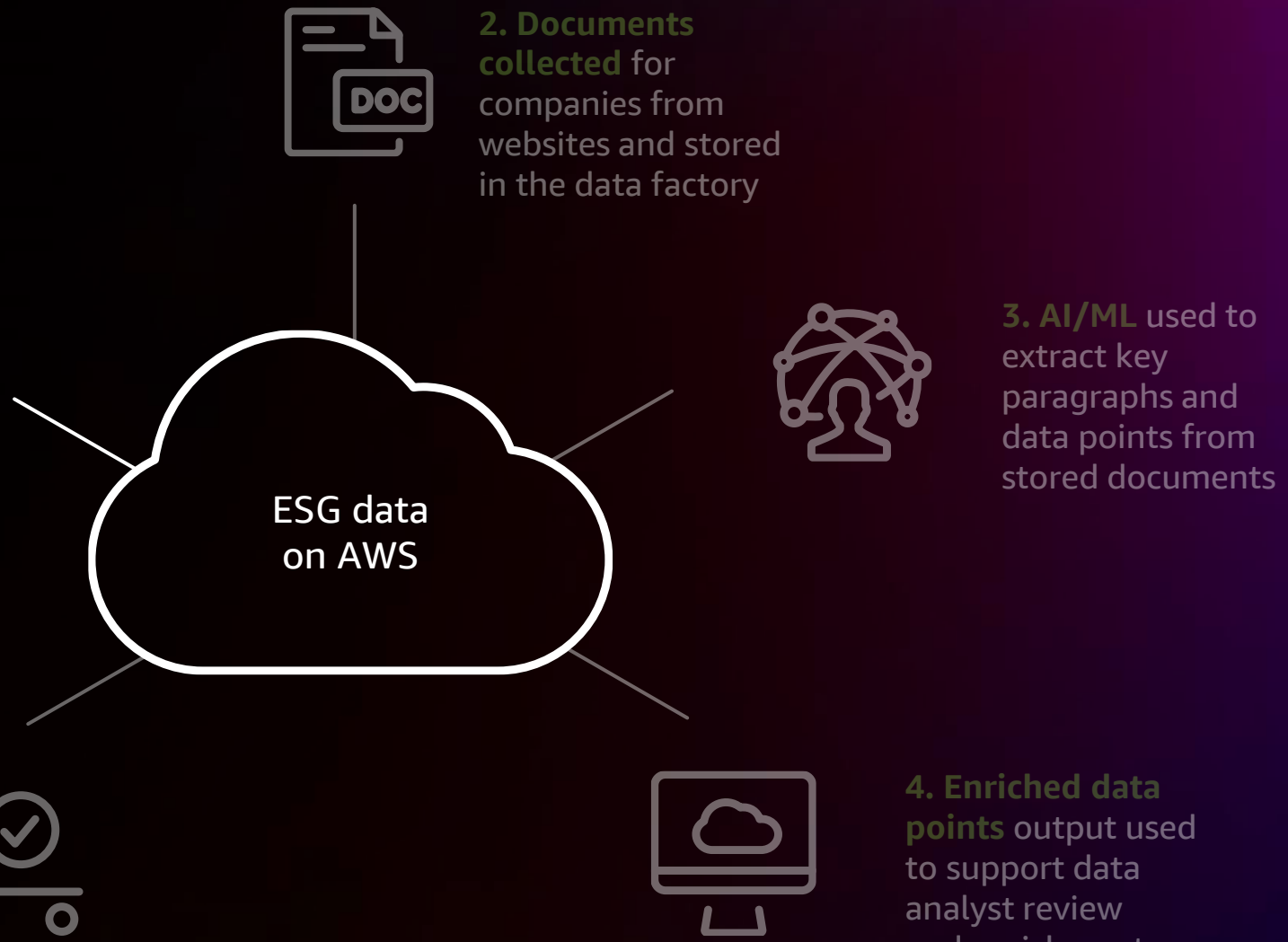
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Our journey



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1. ESG reference data



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1. ESG reference data



Reference data tables

Establish a list of reference tables required for ESG data collection, such as companies to be scored, pillars, criteria, indicators, and relationships across all of these entities

Amazon S3 AWS Glue

Reference data sourcing

Design various trusted data sources required to establish this reference data; in addition, build them using Deequ, AWS Glue, and Amazon S3

Amazon S3 AWS Glue AWS Step Functions

Reference data management

Effectively review and manage reference data by building a UI and endpoints that enable users to access and update reference data (with clear, automated data dependencies in place)

Amazon API Gateway AWS Lambda Amazon OpenSearch Service Amazon S3

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1. ESG reference data: Challenges



- **Establishing reference data governance and management** to ensure the system of record is in a single place and data is used properly downstream
- **Creating an enterprise taxonomy** used across enterprise products and services (including credit rating and risk assessment products)
- **Building a platform** to manage reference data and its dependencies

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1. ESG reference data: Architecture



AWS Cloud

Region 1

Reference Data Universe Mgmt. Tool

VPC

Reference Service

Reference Service

Amazon OpenSearch Service

Metadata Service

Metadata Service

PostgreSQL

Reference Data Amazon RDS

EM Push

CRUD Service

CRUD Service

Research Line Service

FactSet Data ETL

ISIN/CUSIP AWS Glue

Issuer AWS Glue

Subsidiary AWS Glue

Index Data ETL

Index AWS Glue

External Infrastructure Third Party – Index Data

EDI FX Currency ETL

EDI FX AWS Glue

External Infrastructure Third Party – EDI Data

ORBIS

Region 1

Reference data UI

Reference Data UI

Local Machine

Universe Mgmt. Analyst

AP-EU-Central

Tools: Scoring/Doc. Collection/ Enrichment

AP-EU-Central

Data Factory

Common tools

VPC

Amazon SNS Topic

Entity Coverage Status Amazon SQS

Entity Coverage Status Lambda

PostgreSQL

Reference Data Amazon RDS

VPC

CloudWatch Filter

Log Parser

Ops Amazon SNS Topic

CloudWatch Alarm

ServiceNow

Secrets Management

Identity Access Management

Okta

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2. Document collection



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2. Document collection



Analysts to collect public disclosures

Global ESG analysts in Asia and EMEA collect hundreds of thousands of publicly available ESG-related reports/disclosures; these documents are stored using a UI

Amazon S3

Collect document metadata

Capture metadata and tie it to the company that the document belongs to and save the document into a bucket tagged with metadata

Amazon API Gateway

AWS Lambda

Amazon DynamoDB

Prepare batches of data for ML processing

Tag the documents based on portfolios that are logically ready for ML processing and schedule batches

AWS Lambda

Amazon DynamoDB

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2. Document collection: Challenges



- **Data inconsistency and manual collection** as a result of nonstandard ESG reporting
- **Maintaining data lineage** and versioning of documentation
- **Automation** as links update without much notice, resulting in an increase in analyst hours

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2. Document collection: Architecture



ap-southeast-1

Data Upload Tool

Analytics

VPC

Scheduled Batch Document Processing

PDF Document Store

Internet

Upload Service

Upload Lambda

Batch Document Processing Lambda

Batch Job Metadata

Metadata Service

Metadata Lambda

Document Metadata

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ICRA UI

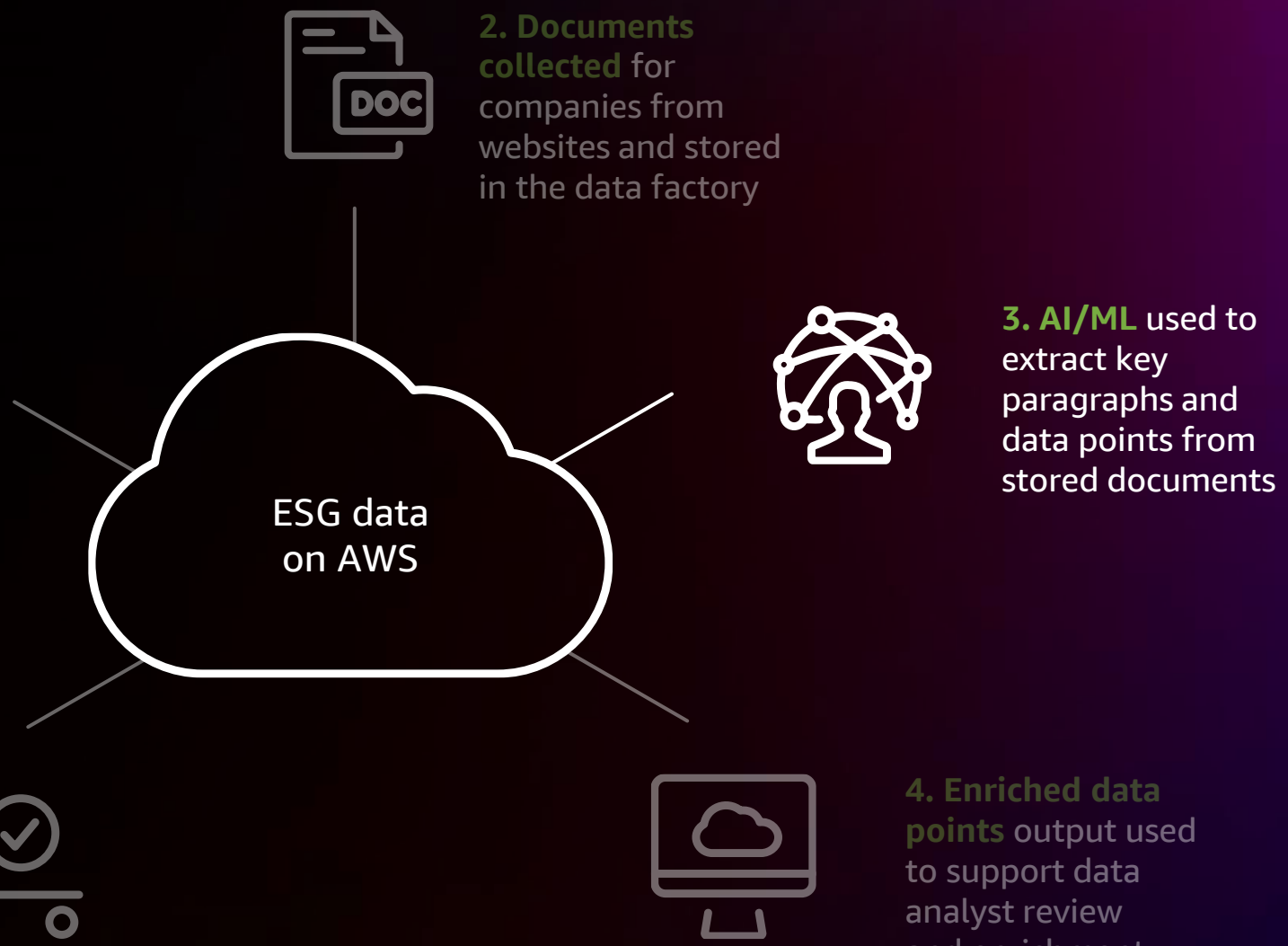
Data Upload UI

ICRA Analyst

Local Machine

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3. Extract data points from documents



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3. Extract data points from documents



Submit the portfolios to the ML API

Once the documents are collected, they are organized into portfolios based on the company sector and completeness; these portfolios are submitted to the AI/ML model to process and extract answers for predefined questions on ESG

Amazon API Gateway

Amazon Textract

Collect extracted data, collate, and store

Metadata is captured and tied to the company that the document belongs to; the document is saved into a bucket with metadata tagged to it

Amazon SNS

Amazon API Gateway

AWS Lambda

Amazon DynamoDB

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3. Extract data points: Challenges

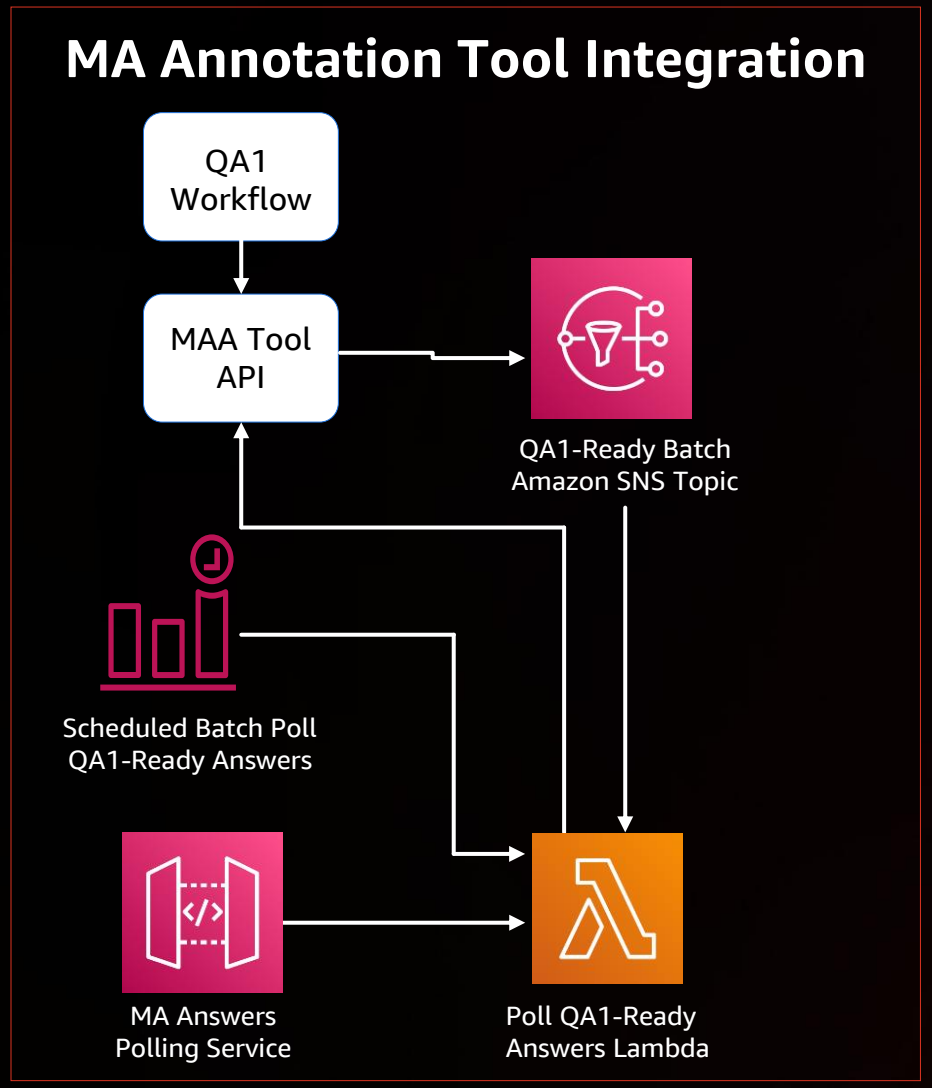


- **Redundant, duplicate, or empty** extracted data
- **Active learning** with ML model
- **Difficult to extract tables and complex data** into a consumable layout for downstream system consumption
- **Missing data lineage** (e.g., page numbers from the extracts)
- **Scaling** the ML model

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3. Extract data points: Architecture





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4. Data points validation & certification



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4. Data points validation & certification



Receive and enrich data points

Data points received from the ML API go though metric standardization, reference data tagging, and indicating records that look like duplicates for ease of analysis

Amazon API Gateway | AWS Lambda | Amazon DynamoDB

Analyst validation process

Analysts with ESG domain expertise review the data in two phases to review, add missing data, and aggregate data where needed; every data point is reviewed by four different reviewers before it is certified; all of this is performed using a custom-built UI

Amazon S3 | Amazon API Gateway | AWS Lambda | Amazon DynamoDB

Vend data points

When the data is certified, the data is available for consumption globally, and the downstream process pulls this information for reporting and scoring

Amazon DynamoDB | Amazon Athena

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4. Data points certification: Challenges

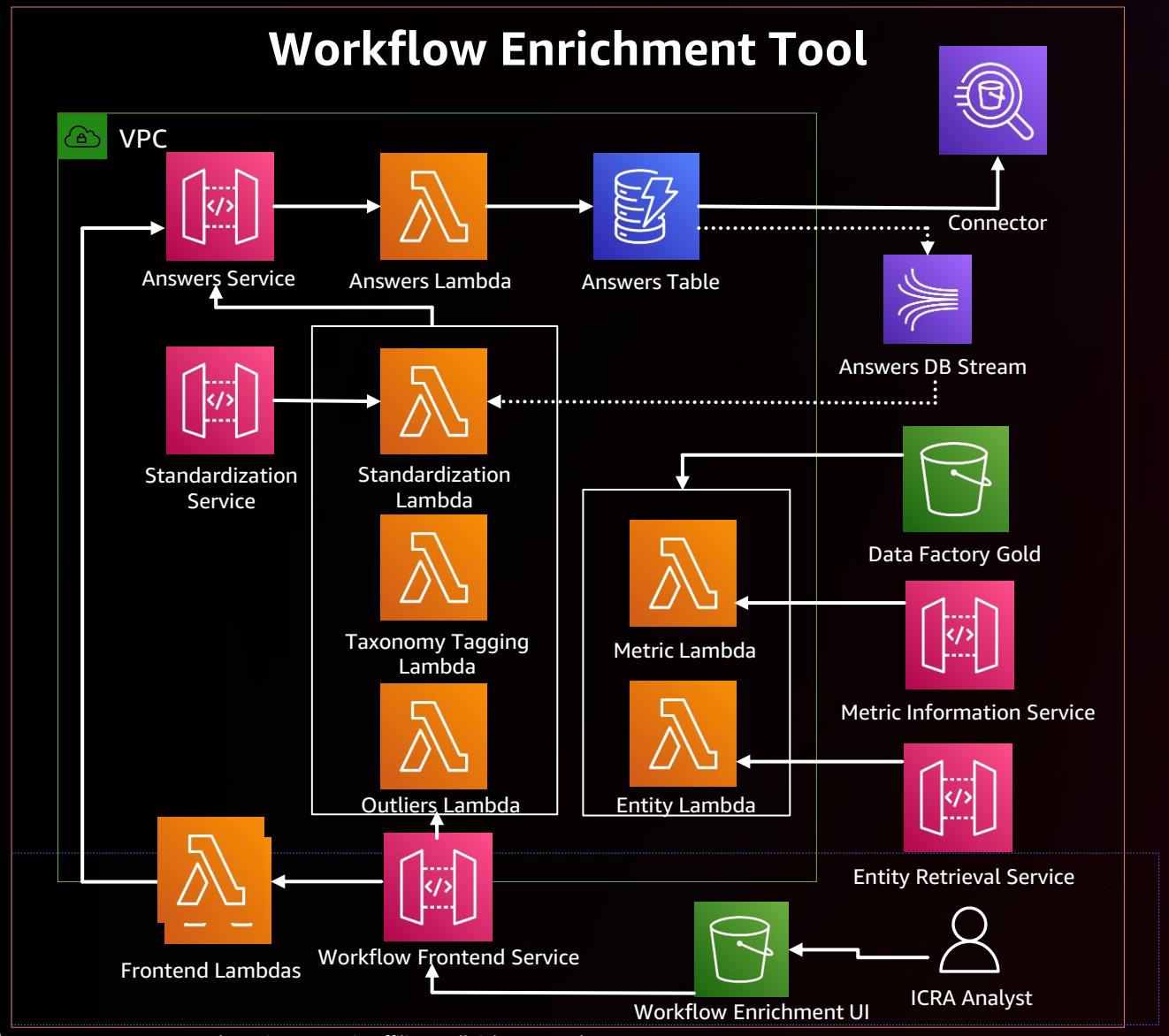


- **Scalable architecture** to support ~10 million data points
- **High availability** to optimize analysts' time across the globe
- **Evolving process and data requirements** testing the flexibility and nimbleness to correct data
- **Data validation integration** to ensure consistency

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4. Data points certification: Architecture





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5. ESG data and scores



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5. ESG data and scores



Ready to roll

The analyst reviews the completeness of the data for entities and prepares a report of the companies that have the data ready; the outcome of this process triggers the subsequent process

Amazon DynamoDB

Amazon Athena

Validate and score the companies

Data points are again independently validated by automated scripts and scored, and eventually they continue into the data lake if the entities are successfully scored; if there are exceptions, this information is logged and flagged for further action

AWS Step Functions

Amazon API Gateway

AWS Lambda

Amazon SNS

Distribute the scores downstream

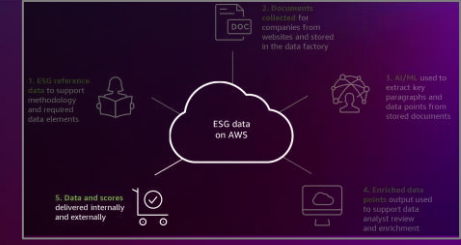
When the data is certified, the data is available for consumption globally, and the downstream process can pull this information for reporting and scoring purposes

Amazon S3

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5. ESG data and scores: Challenges



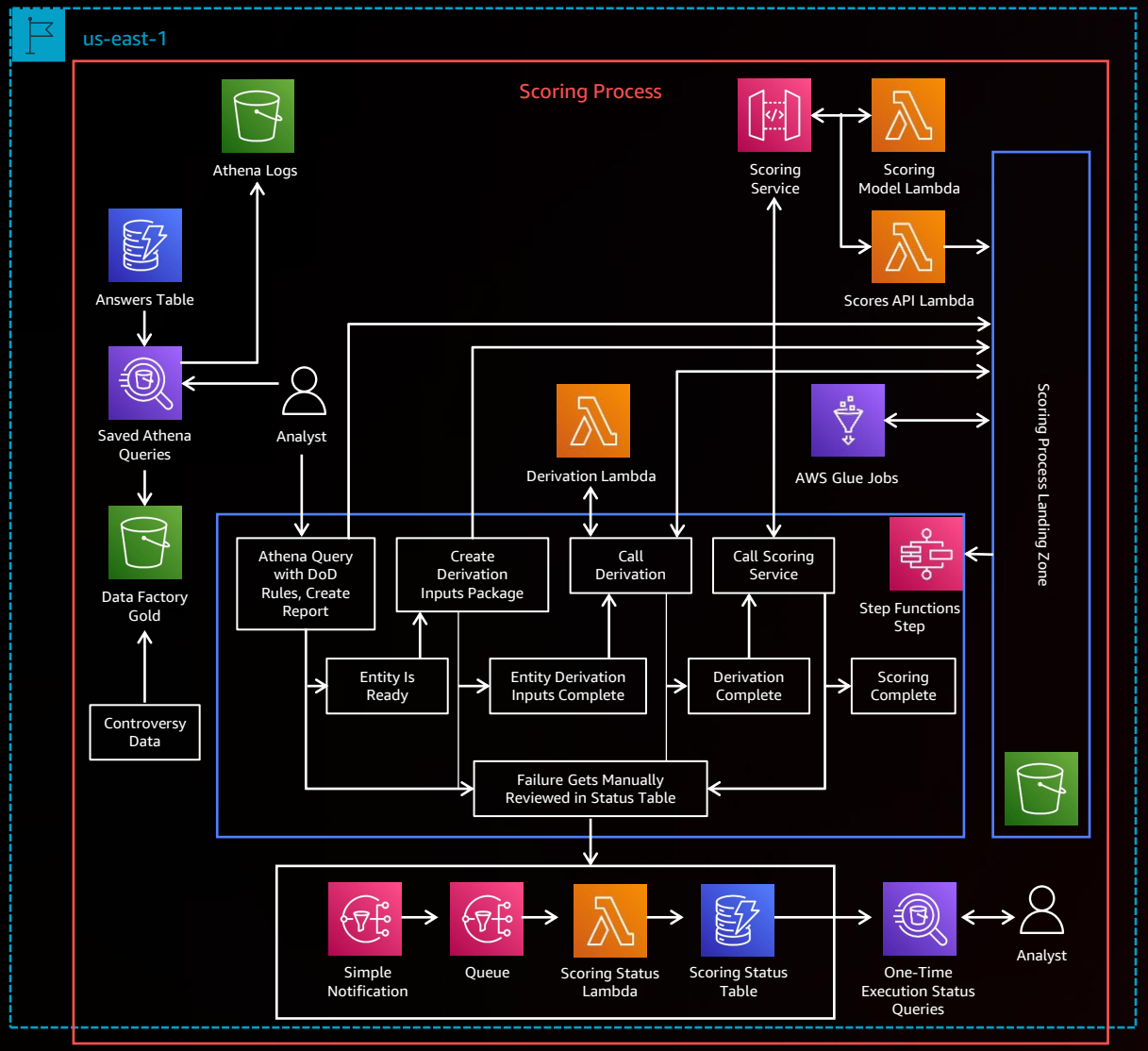
- **Alignment across different teams** to ensure the data requirements align with the scoring model
- **Adjusting to constant model changes**, resulting in data requirement changes
- **Flexibility** for real time or batch
- **Data lineage** pointing to the document where it is collected
- **Republishing scores** when the consumer requests

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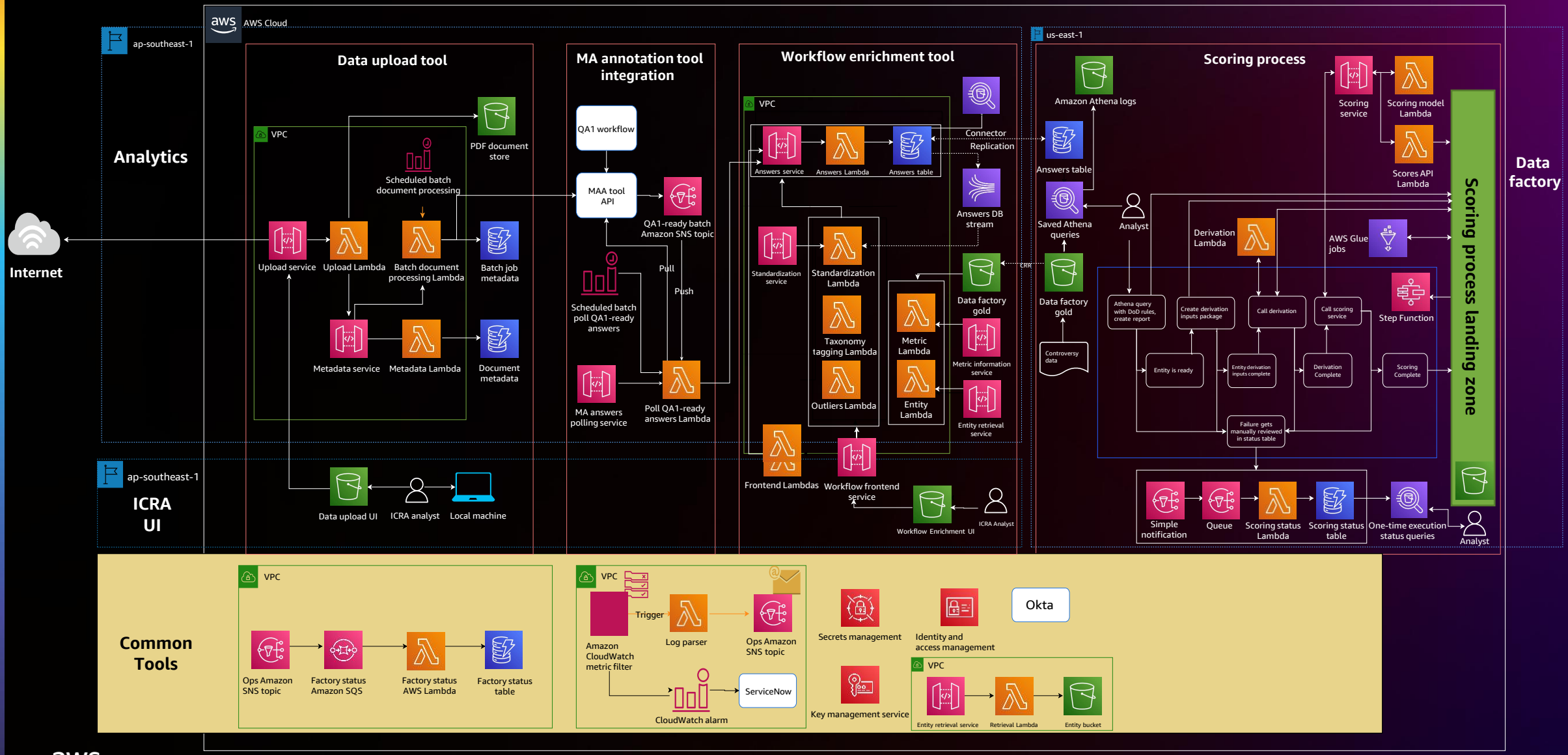
5. ESG data and scores: Architecture





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Recapping our journey



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Resiliency for serverless architecture

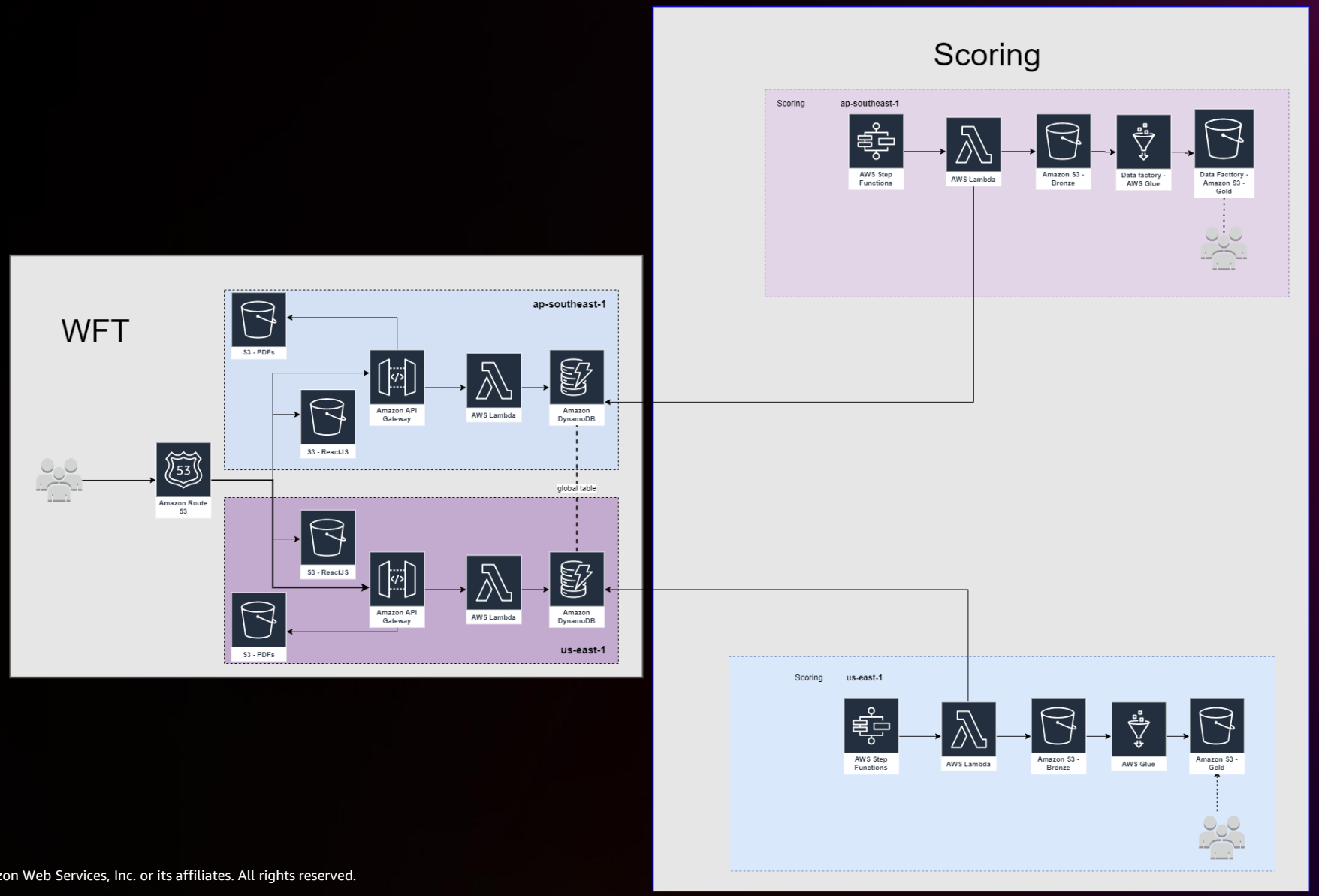
Goals

- Disaster recovery across multiple regions to ensure analyst productivity with an **RTO < 1 hour and RPO < 1 hour**
- Durability of data to ensure **data committed survives permanently** even when the system goes down
- Redundancy across regions to **maintain SLAs and automate cutovers** where possible
- Ability to **“nonfunctionally” test resiliency** to document and understand how the app behaves under stress

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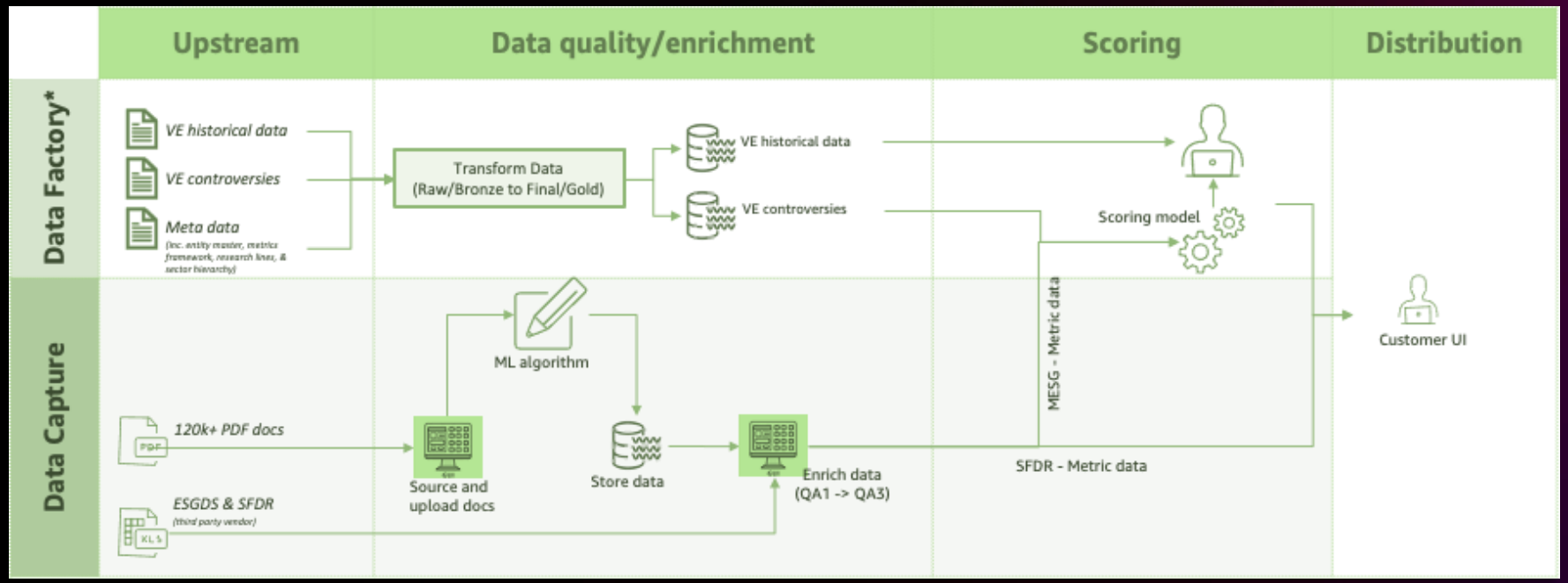
Resiliency for microservices



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Product outcomes

Data is sourced from VE, public disclosures, and third-party vendors to build out MESG and SFDR products



Business outcomes	Tens of thousands of companies	Hundreds of thousands in PDF documents processed	Hundreds of metrics collected
Technical outcomes	4 services; 20+ endpoints	40+ sources ingested	600+ DQ rules

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