AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

AMZ202

Driving sustainable operations at Amazon and Climate Pledge Arena

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AWS

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Sustainable Building Program Manager
Amazon

Rob Johnson
VP, Sustainability & Transportation
Seattle Kraken

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Agenda

Building sustainability solutions on AWS

Sustainability at Amazon

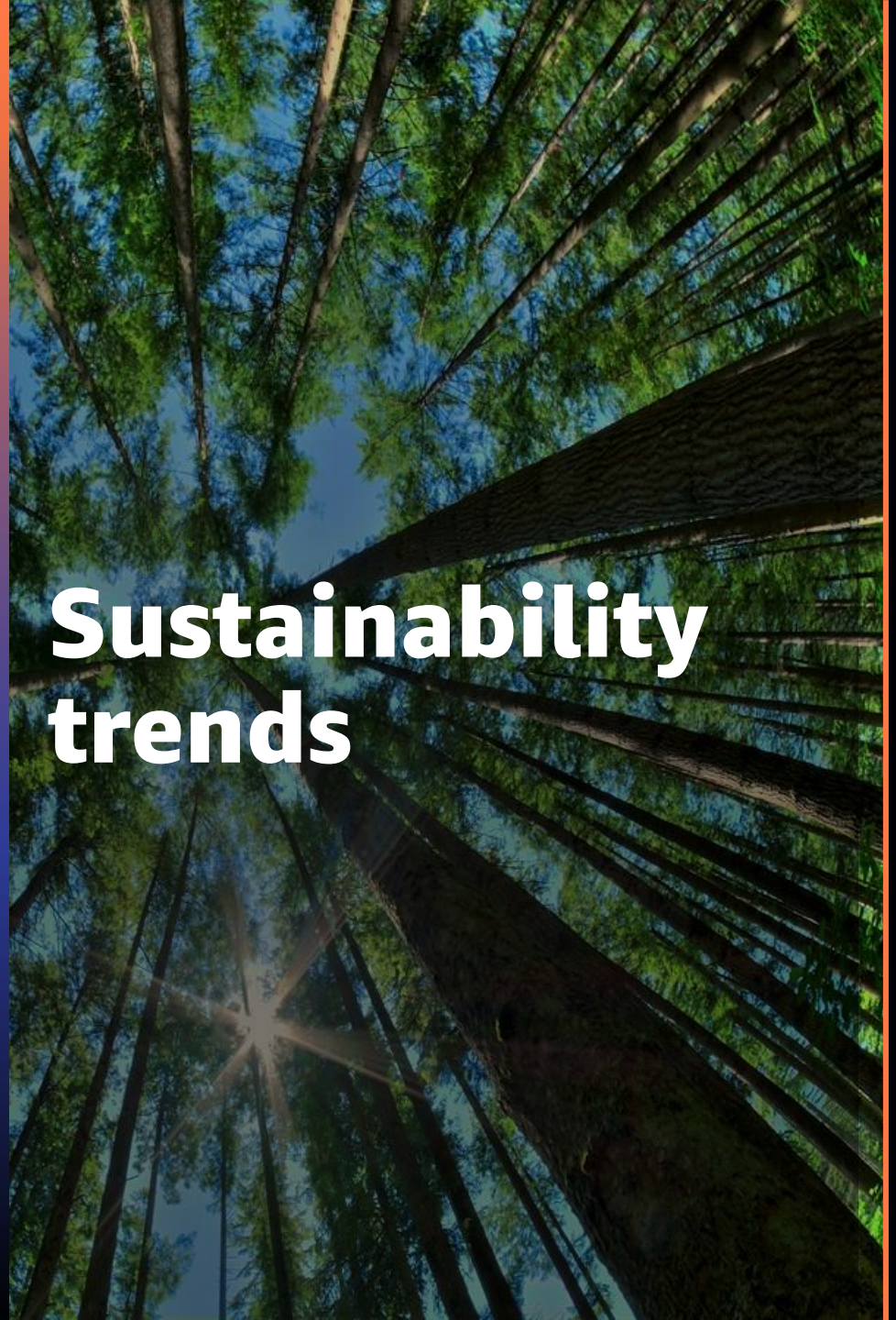
Amazon Sustainable Building Platform

Climate Pledge Arena

Climate Pledge Arena Carbon Footprint Platform

How to get started

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Sustainability trends

Customer demand

Government regulations

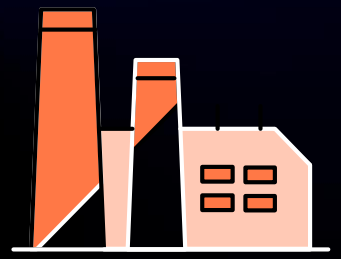
Employee demand

Impact investing

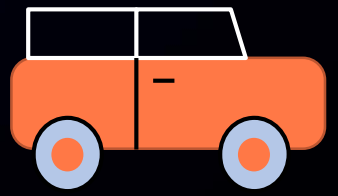
Sustainability as competitive positioning

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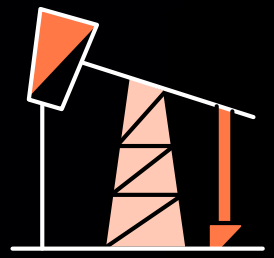
Sustainability goals across sectors



Manufacturing



Automotive



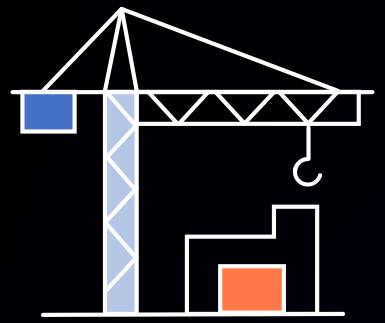
Energy



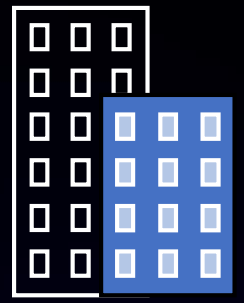
CPG/retail



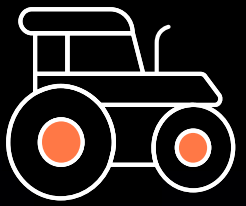
Life sciences



Construction



Real estate/logistics



Agriculture

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Sustainability leaders have many challenges

Business



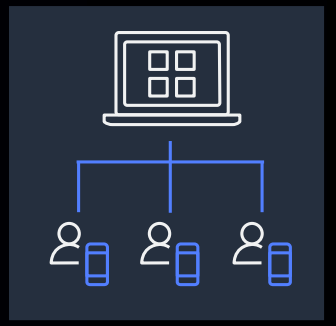
Funding



Project



Compliance



Operational impact



Stakeholder outreach



Employee outreach

Technical



Building infrastructure data access



Internal system access



Emissions, utility data



Reporting



Management tools

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Sustainability transformation on AWS





1 – MEASURE

Set organization-wide sustainability benchmarks and record in scalable data store

2 – MONITOR

Implement automated real-time monitoring across operations and report sustainability data securely

3 – MANAGE

Reduce resource usage and turn data-driven insights into action

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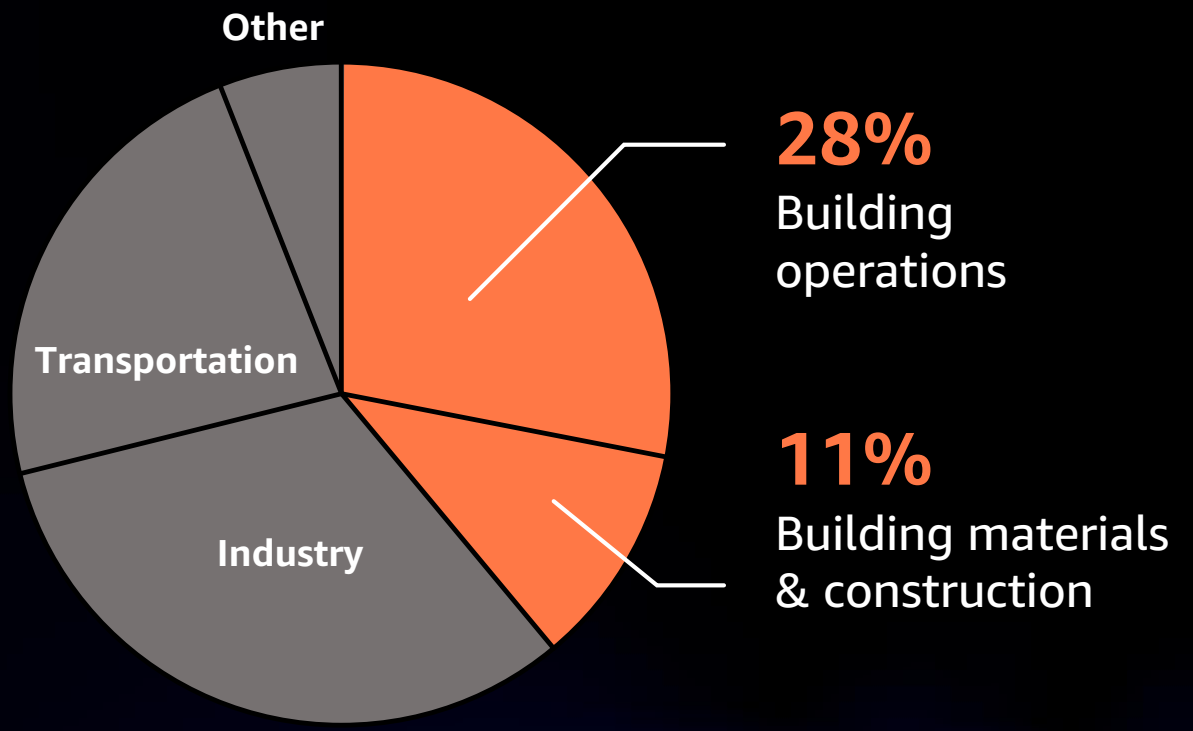
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Sustainable buildings

A hotspot across sectors is buildings

Buildings generate nearly 40% of annual global CO_2 emissions

Annual global CO_2 emissions



https://architecture2030.org/why-the-building-sector/

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Sustainability at Amazon, further and faster together

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THE Paris...
CLIMATE 10 years
PLEDGE Early
Amazon and Global Optimism co-founded The Climate Pledge,
a commitment to meet the goals of the Paris Agreement
10 years early and achieve net-zero carbon by 2040

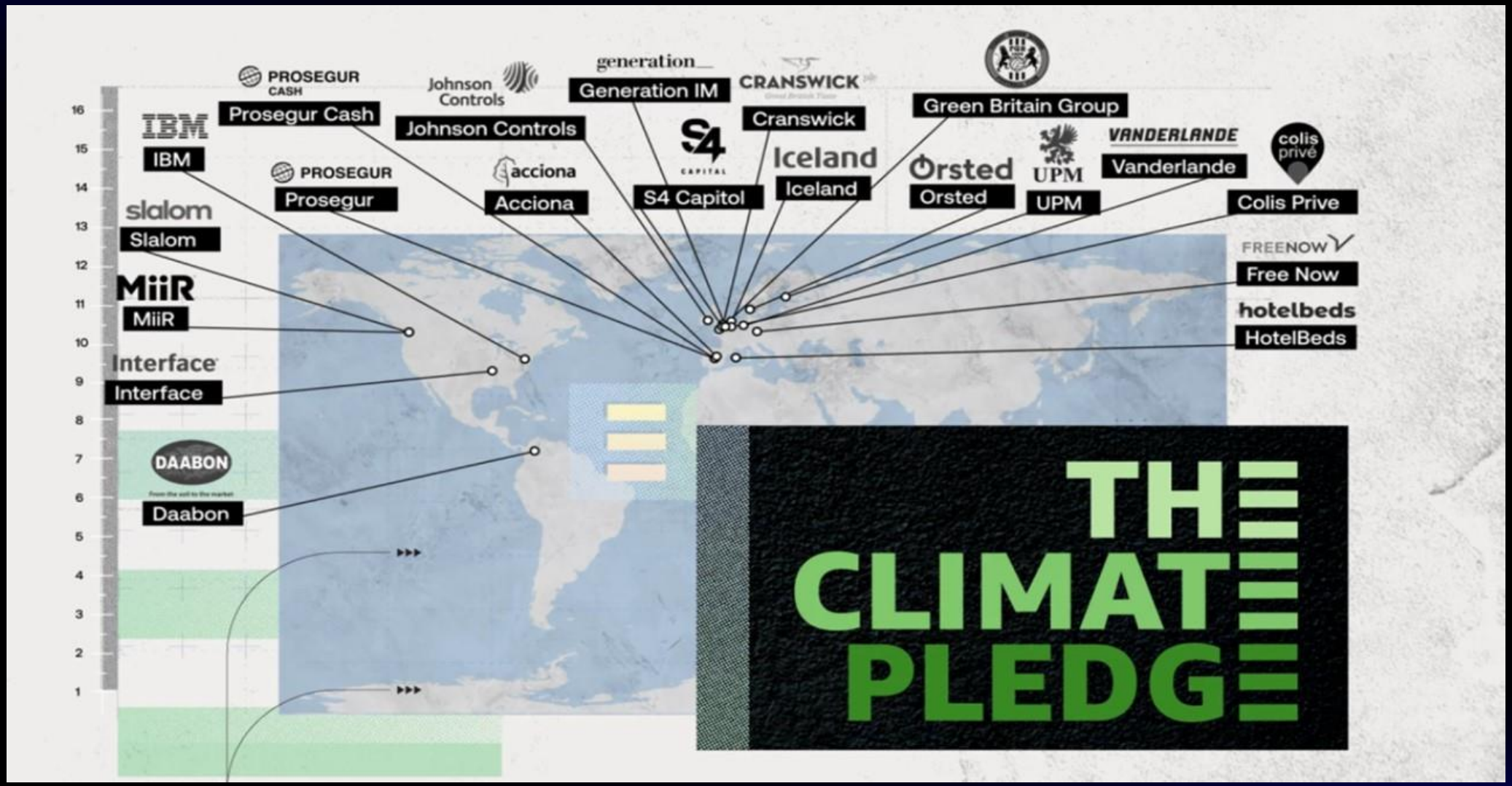
The Climate Pledge

Bold steps by big companies will make a huge difference in the development of **new technologies** and industries to support a **low-carbon economy**

Christiana Figueres
Former Executive Secretary of the United Nations Framework Conventions on Climate Change



201 businesses have accepted the commitment



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The Climate Pledge: Three principles

1
Regular reporting

Measure and report greenhouse gas emissions on a regular basis

2
Carbon elimination

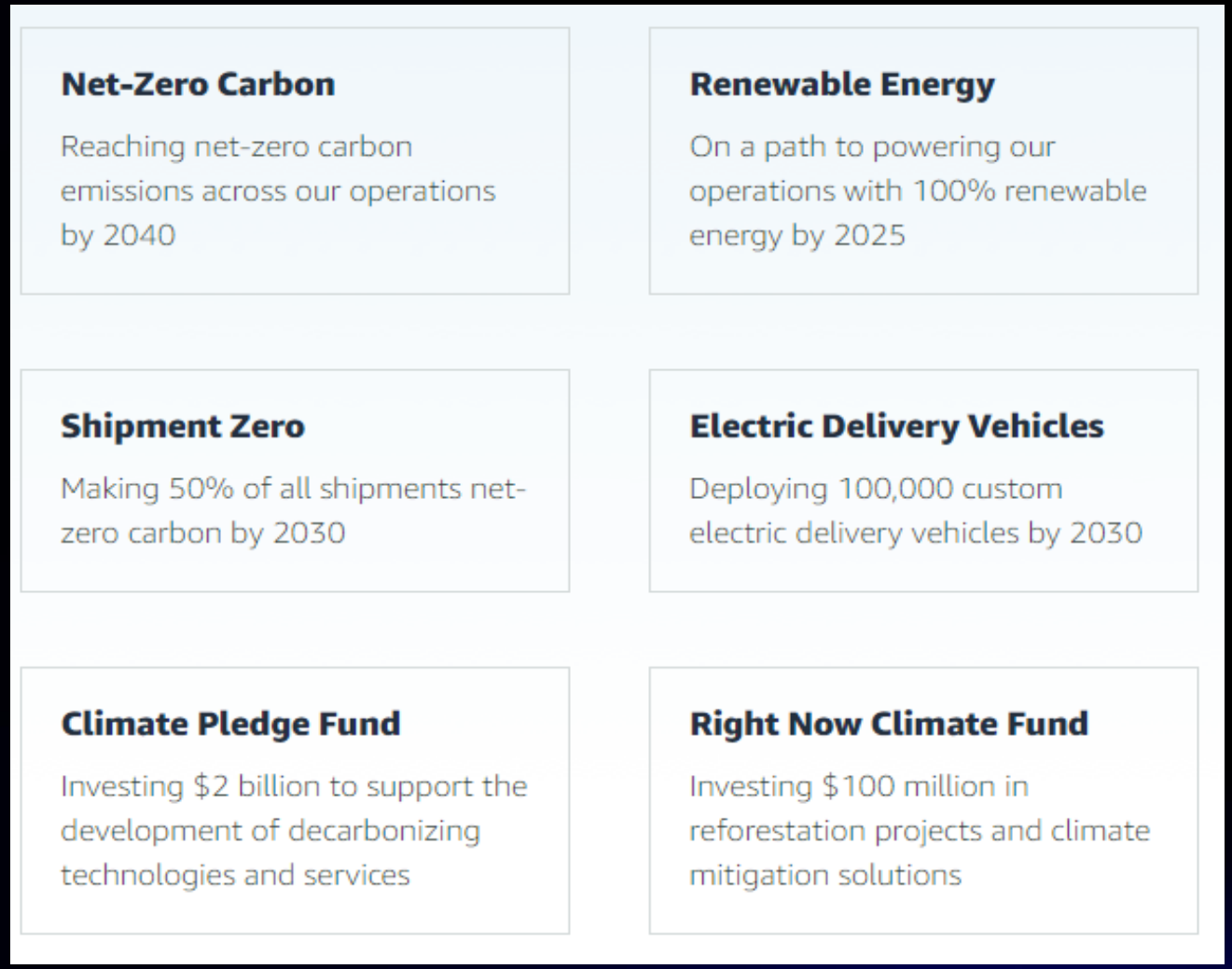
Implement decarbonization strategies in line with the Paris Agreement through real business changes and innovations, including efficiency improvements, renewable energy, materials reductions, and other carbon emission elimination strategies

3
Credible offsets

Neutralize any remaining emissions with additional, quantifiable, real, permanent, and socially beneficial offsets to achieve net-zero annual carbon emissions by 2040

The Climate Pledge: Our commitments

Amazon has made ambitious commitments to achieve net-zero carbon by 2040 as part of The Climate Pledge



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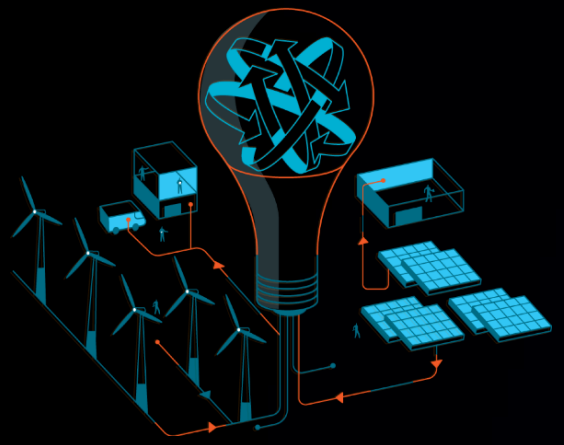
Energy and sustainable operations

Mission and objectives

We drive renewable energy and enable sustainable building solutions throughout Amazon's global operations

We scale our work by empowering teams across Amazon with expertise and data to develop real business changes in support of our environmental goals

Focus areas



Renewable energy



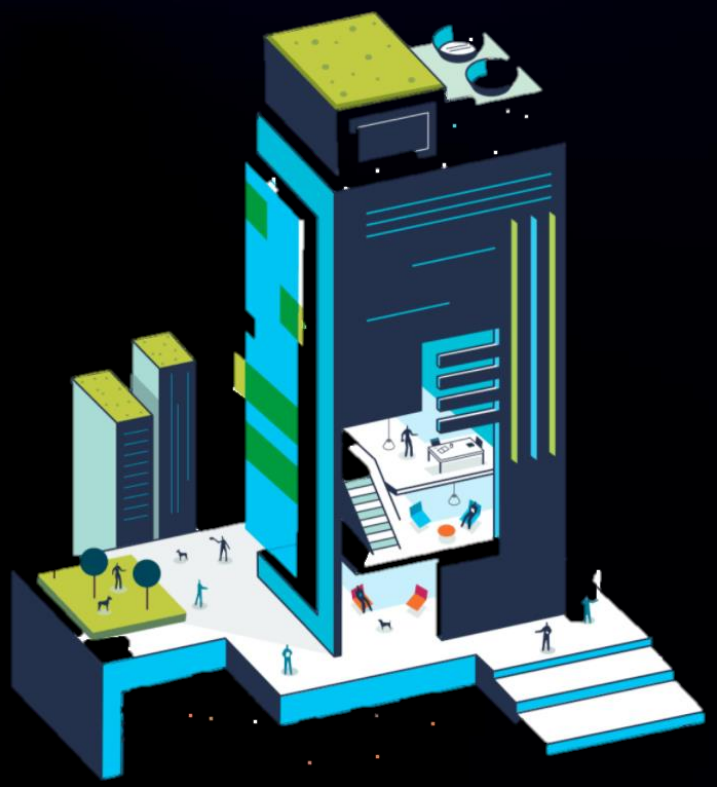
Sustainable buildings



Data & engagement

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Sustainable buildings: Focus areas



1. **Zero carbon**: Fully electric, use natural or ultra-low GWP refrigerants, use industry-leading energy efficiency technologies, be powered by renewable energy, and have a demonstrated reduction in embodied carbon in the building's construction materials
2. **Resource positive**: Positive contributors to the local environment through advanced water and waste strategies
3. **Health and wellness**: Create spaces that prioritize the health and wellbeing of our building occupants – employees, visitors, vendors, and customers

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Sustainable buildings

- Thousands of buildings worldwide
- Corporate offices
- Fulfillment network
- Data centers
- Physical stores



Diverse building footprint serving our employees, customers, vendors, visitors, and the local community

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Step 1: Measure + report

Amazon's Enterprise-Wide Carbon Footprint, 2018-2020

Carbon Intensity (grams of CO2e per $ of GMS)	2018	2019	2020	YOY%
	128.9	122.8	102.7	-16%

Emission Category (million metric tons CO_2e)	2018	2019	2020	YoY%
Emissions from Direct Operations (Scope 1)	**4.98**	**5.76**	**9.62**	**+67%**
Fossil fuels	4.70	5.57	9.37	+69%
Refrigerants	0.28	0.19	0.25	+32%
Emissions from Purchased Electricity (Scope 2)	**4.71**	**5.50**	**5.27**	**-4%**
Emissions from Indirect Sources (Scope 3)	**34.71**	**39.91**	**45.75**	**+15%**

1: Natural gas, diesel, and refrigerants

2: Electricity use and other purchased utilities, minus renewable energy purchases

3: Embodied carbon in building materials + construction

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Step 2: Carbon elimination

Where are we headed?

Net-zero carbon (NZC) buildings



Step 2: Carbon elimination

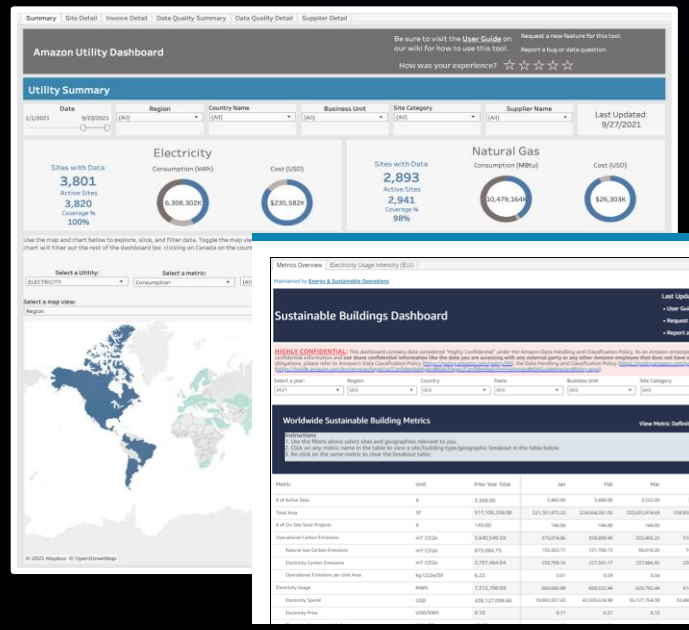
How do we define a NZC building?

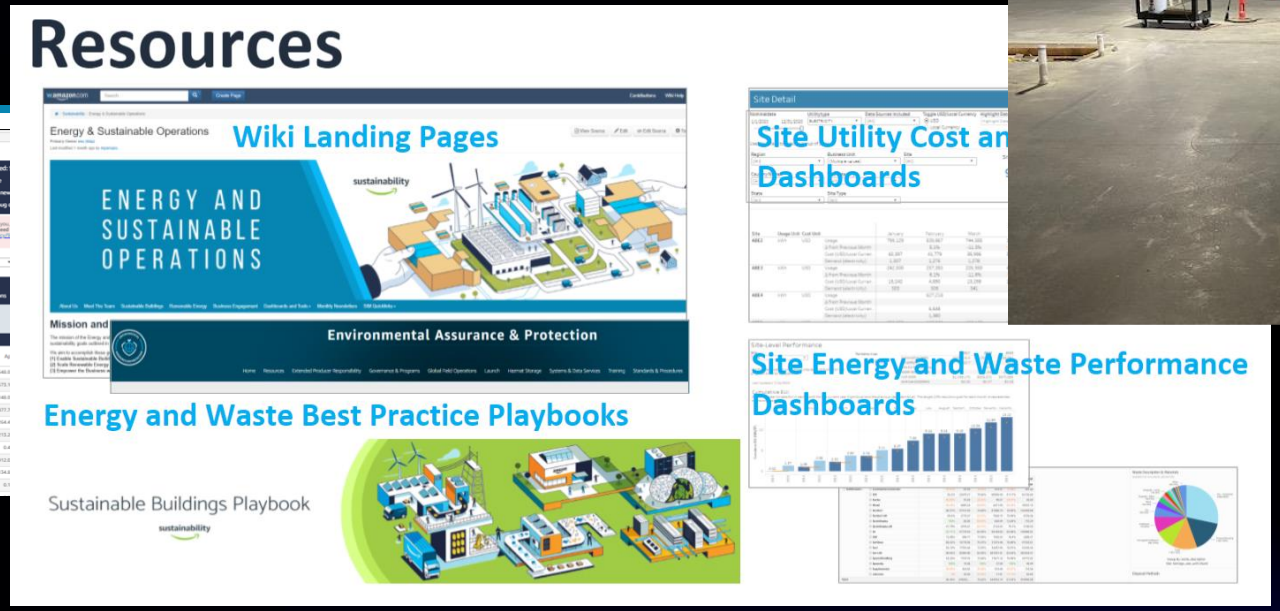
- Design for all electric, no combustion
- Use natural/low GWP refrigerants
- Drive energy consumption down
- Power with renewables
- Drive embodied carbon emissions down (offset the rest)

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Step 2: Carbon elimination

We have some wins and ambitious goals,
but we don’t have it all figured out!







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Step 2: Carbon elimination

Analytics

Deployed in over 300 buildings and quickly scaling

Implemented across all 4 major portfolios

New builds, retrofits, and right-sizing

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Sustainable building platform

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Moving to building system management

Building management systems
All building data

Emissions

Energy

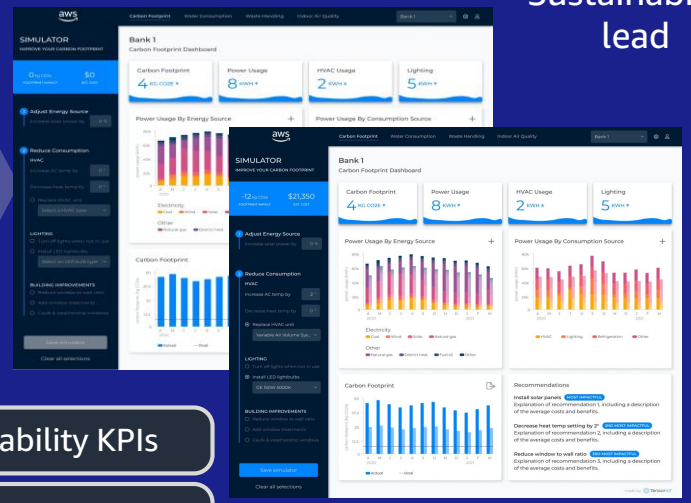
Air

Water

IT leads
Building leads
Sustainability leads

AWS foundation services

Building systems management
Some building data



Sustainability KPIs

Internal reporting

External reporting

Sustainability lead

Integration partners
AWS ProServe

Data acquisition

Data engineering and curation

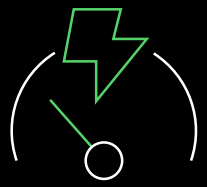
Analytics and reporting

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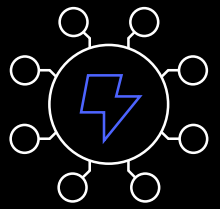
Energy management & operational efficiency



Energy-consuming assets
HVAC, electrical, lighting



Energy efficiency metrics
Energy usage intensity



Methods to improve
AI/ML analysis for improved analytics

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AI/ML for energy management

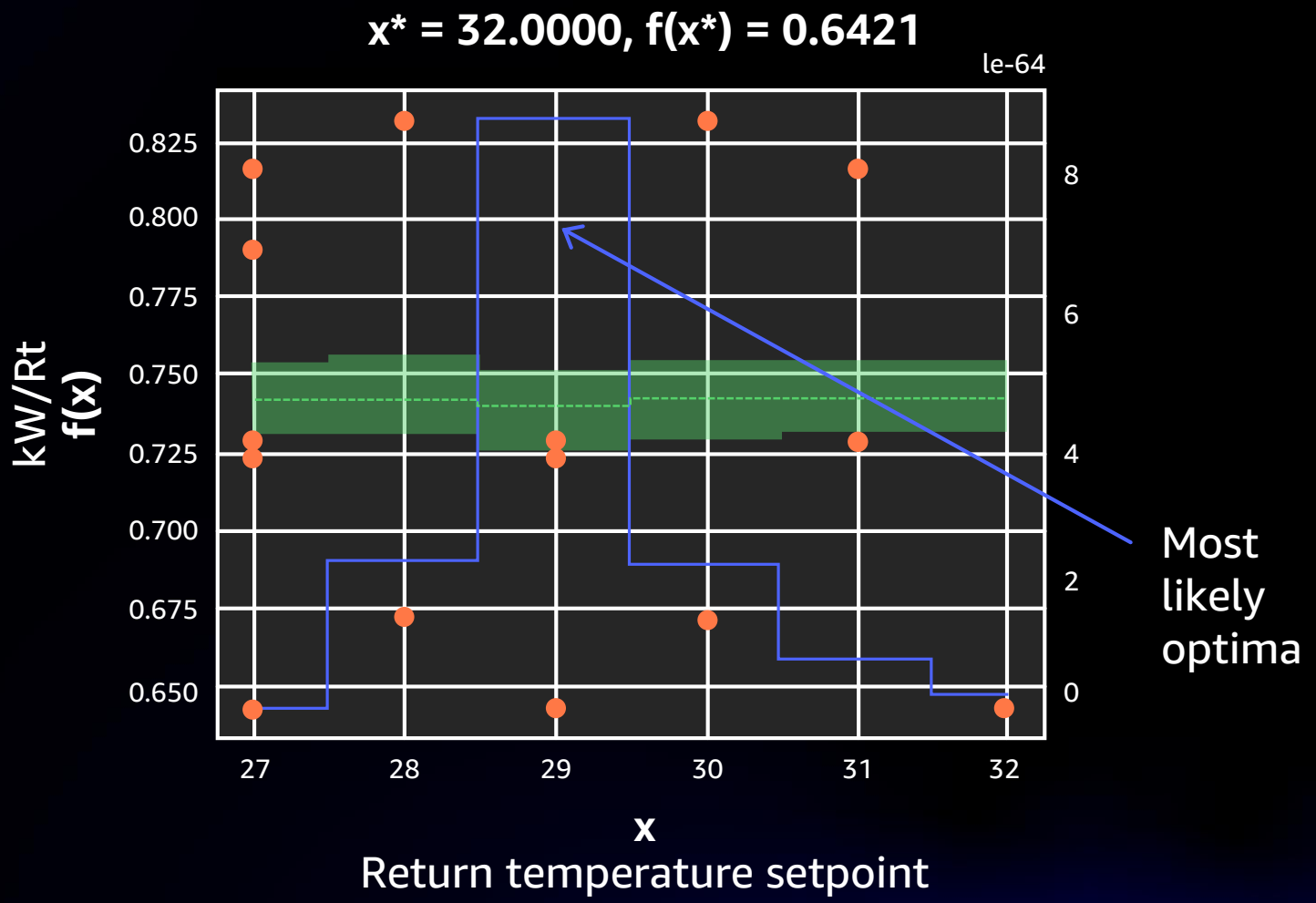
Business outcomes

Reduce cost and energy consumption by optimizing equipment efficiency

Solution

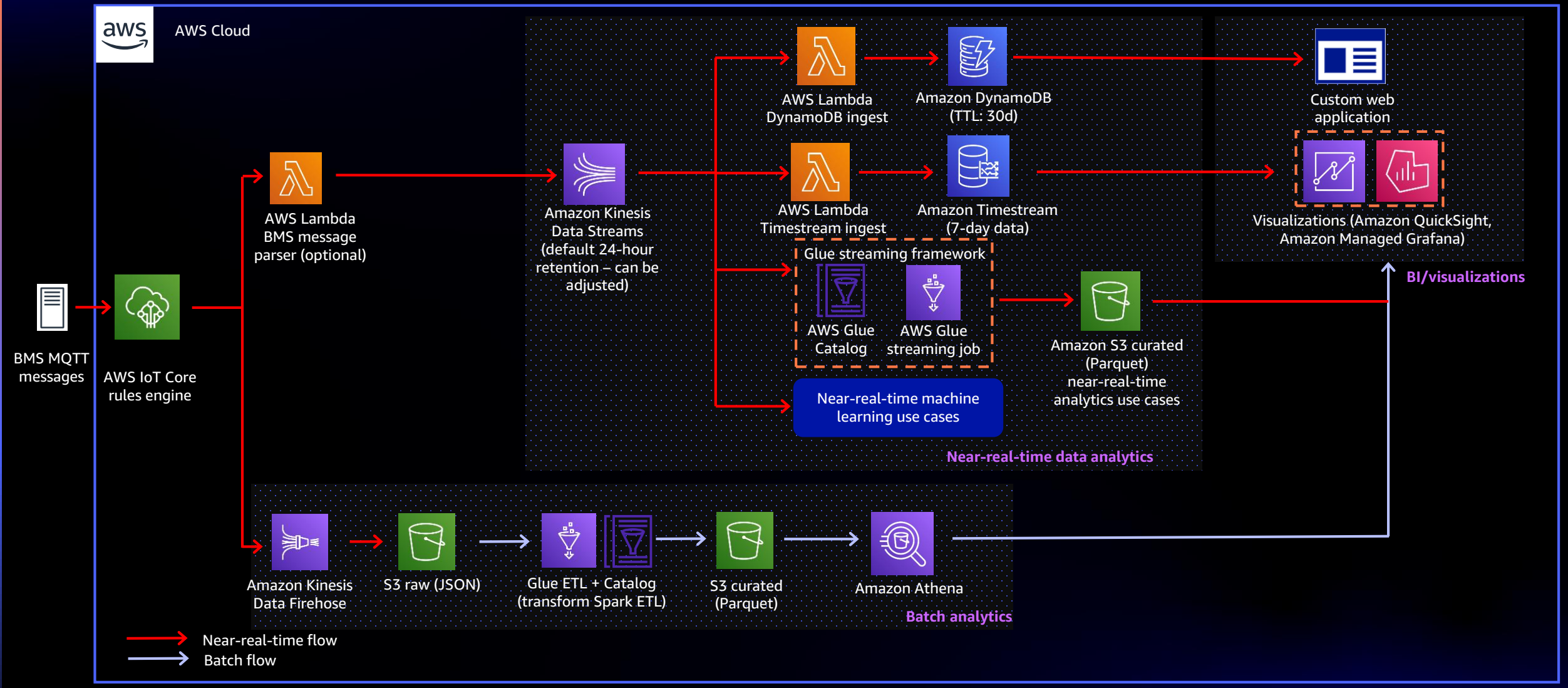
ML-based creation of Digital Twins

Prescribe optimal setpoints based on Digital Twin simulations



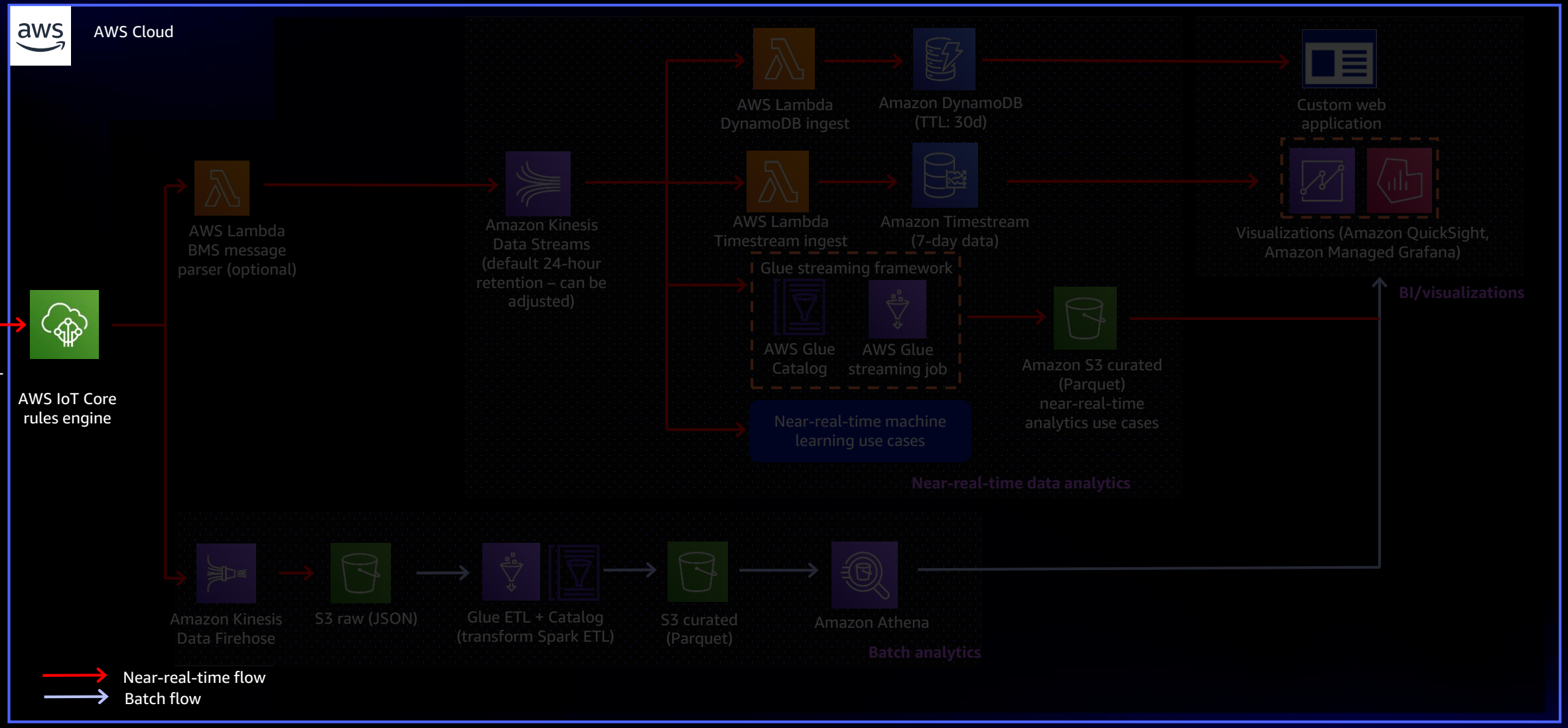
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Data flow (streaming BMS data)



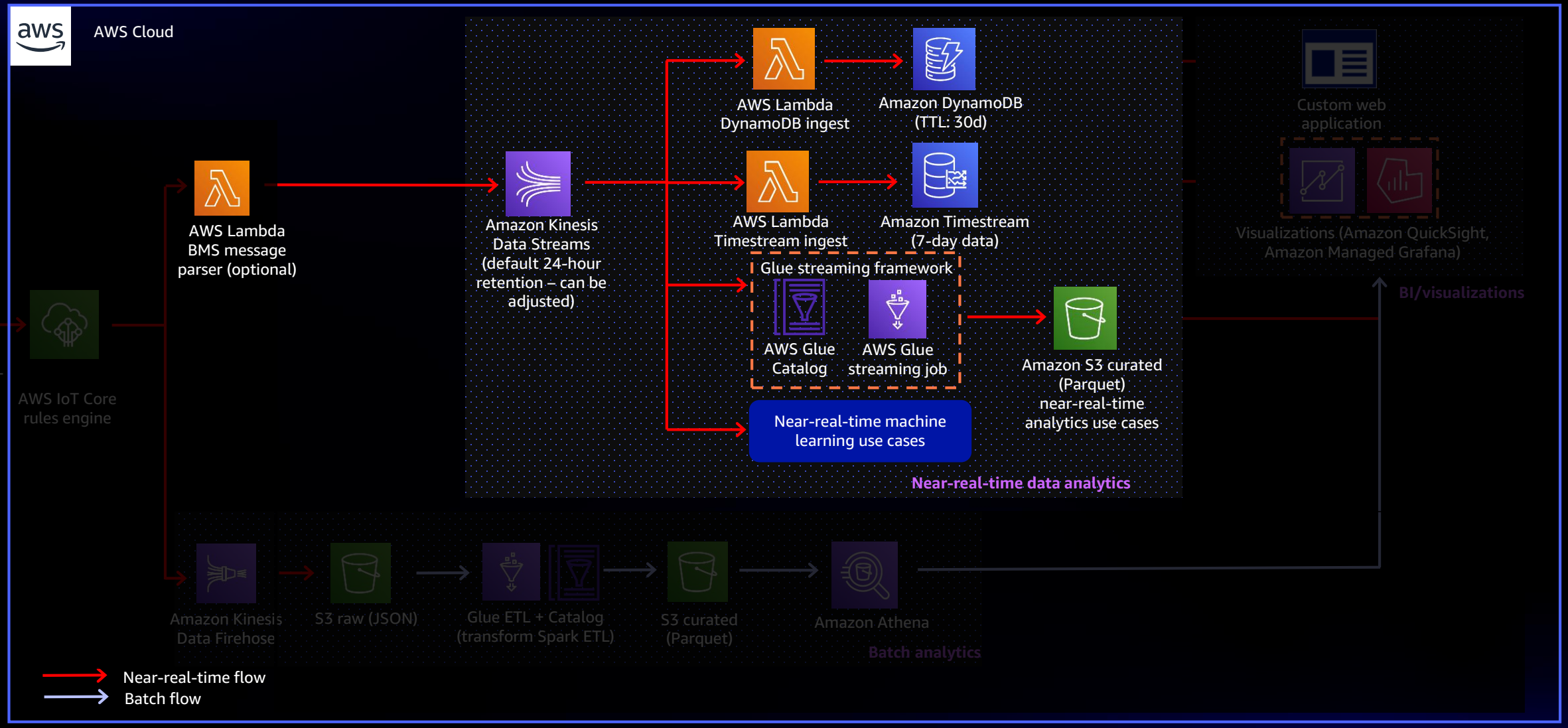
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Data flow (streaming BMS data)



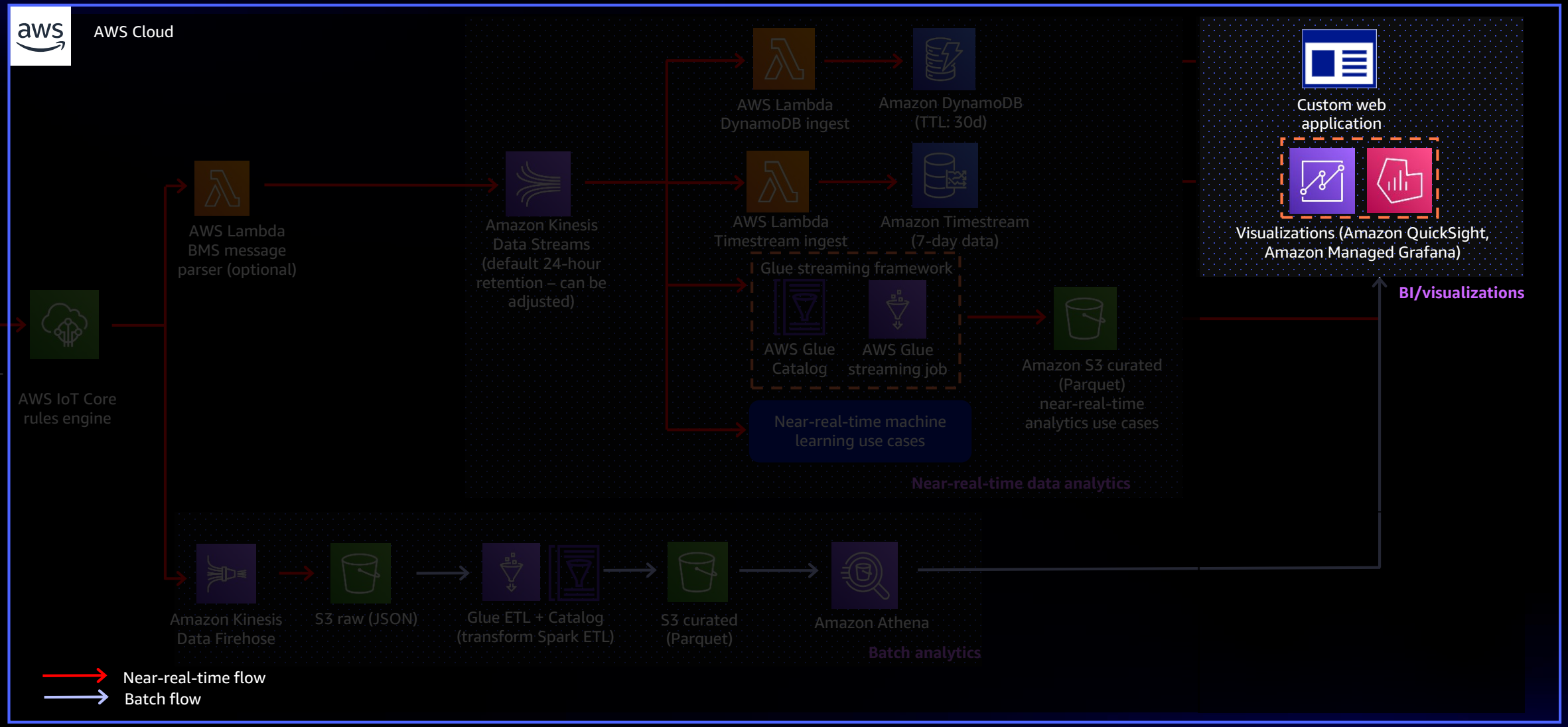
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Data flow (streaming BMS data)



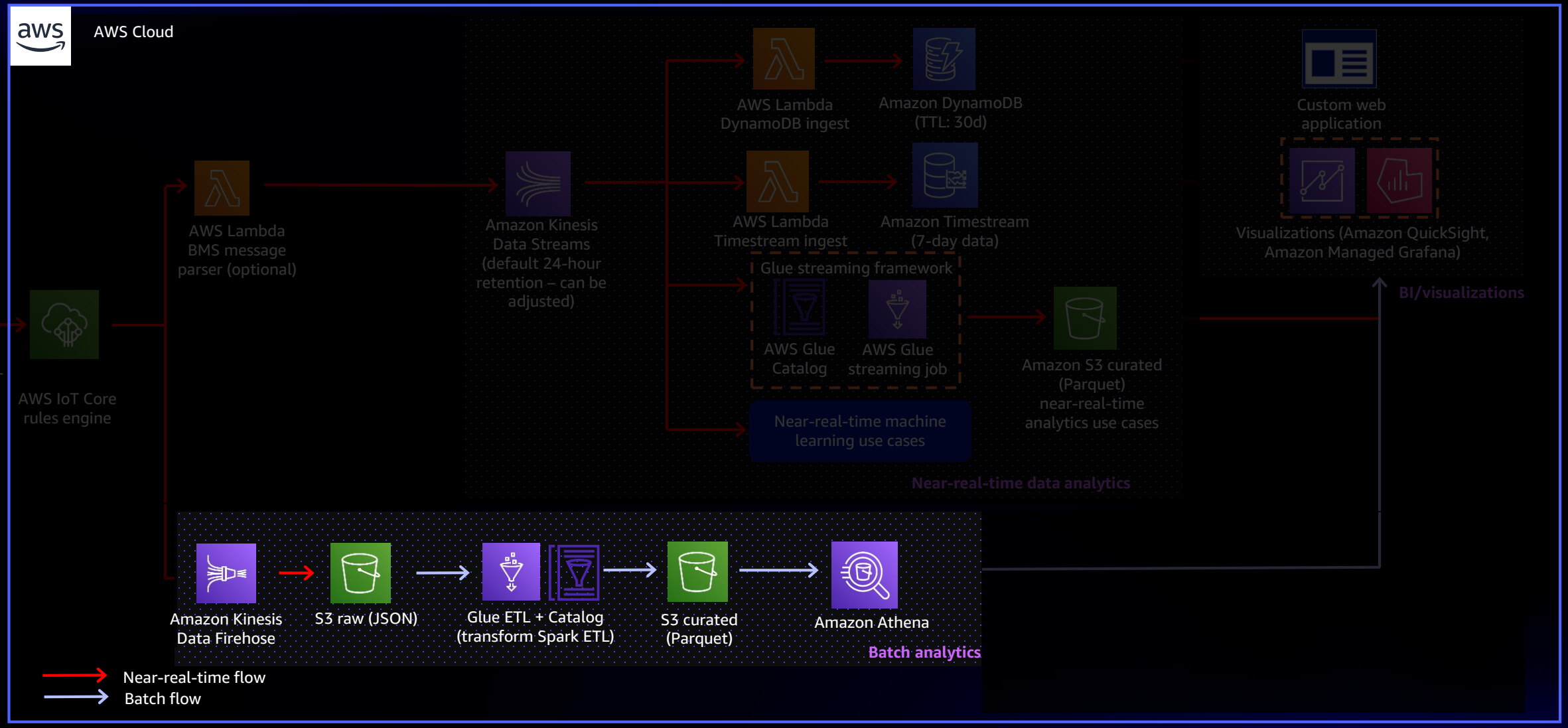
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Data flow (streaming BMS data)



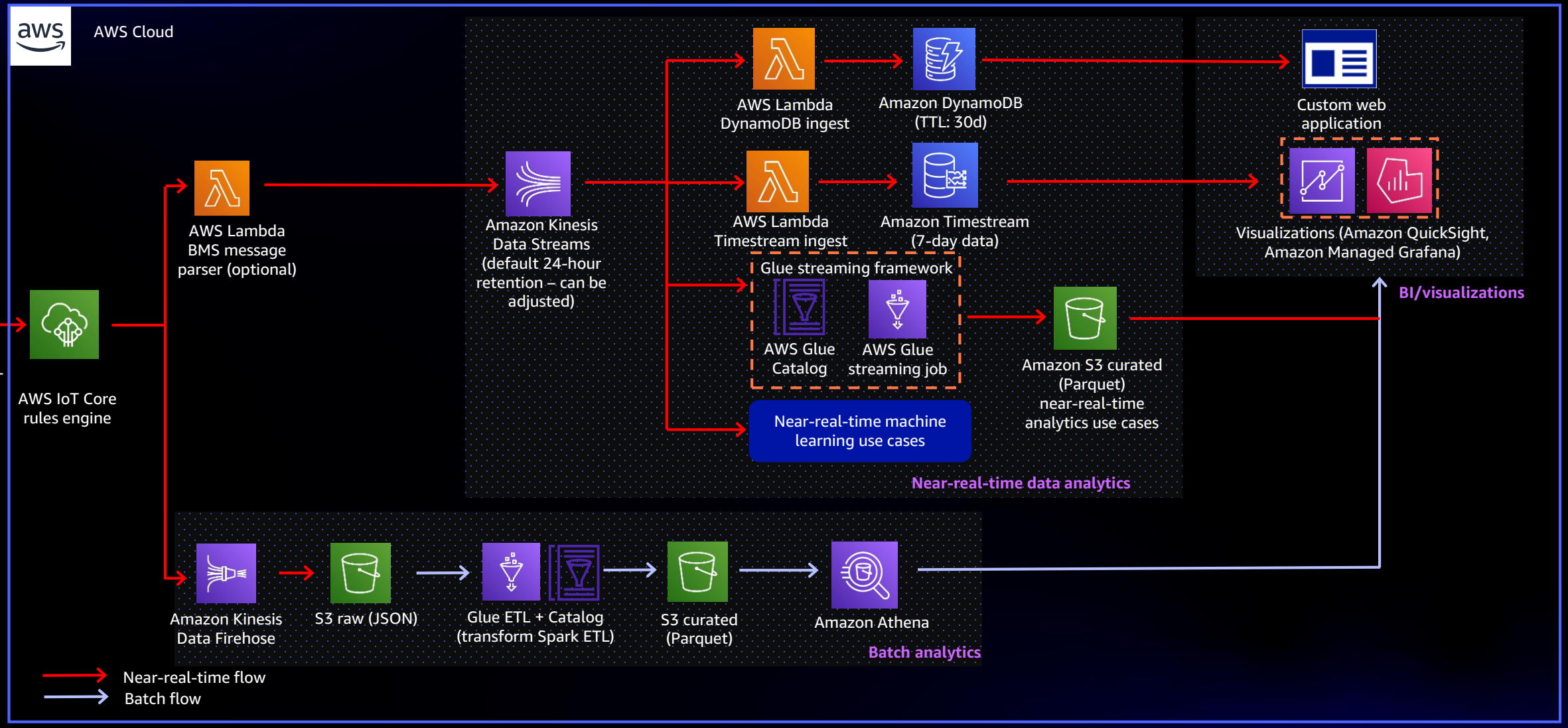
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Data flow (streaming BMS data)



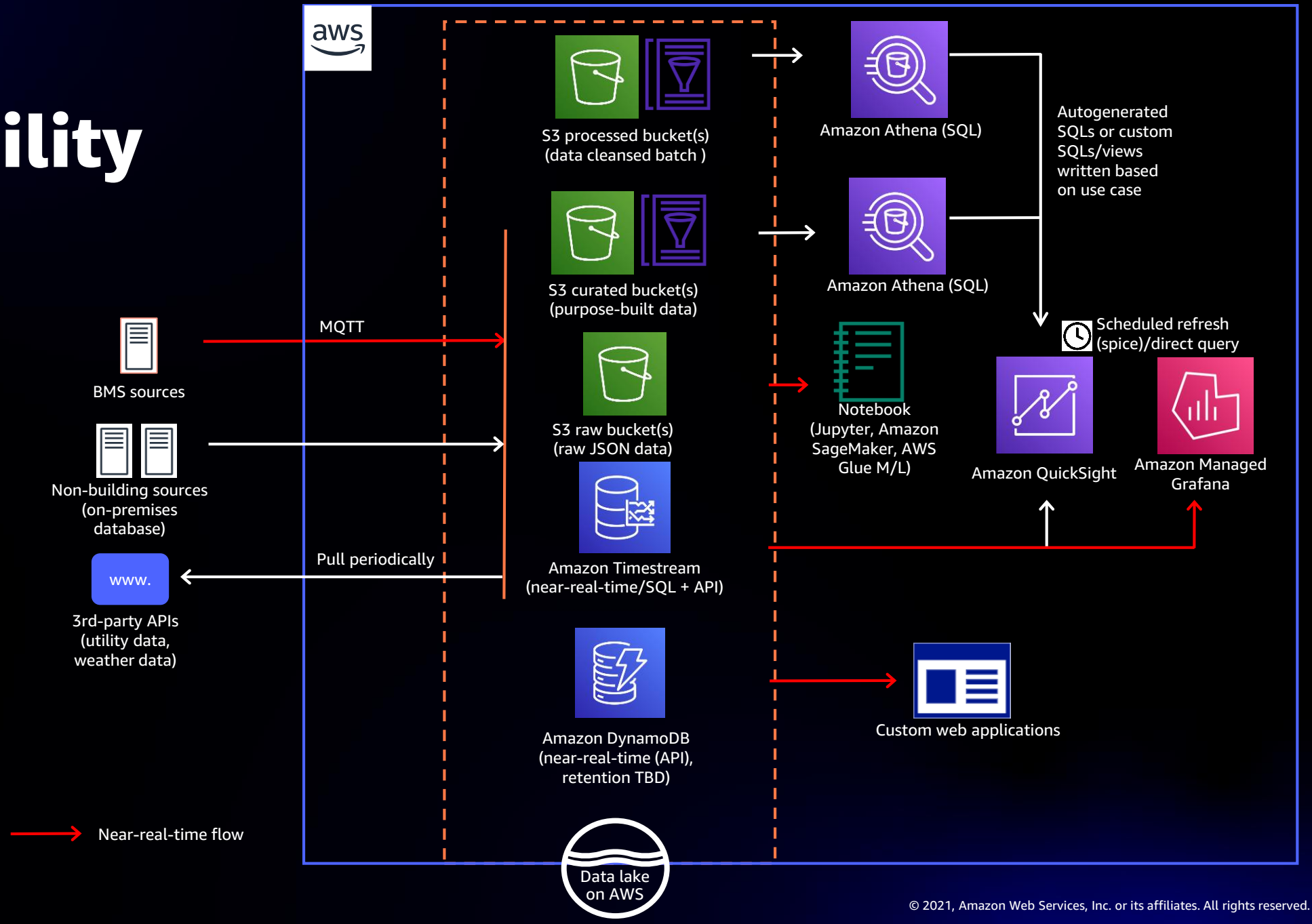
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Data flow (streaming BMS data)



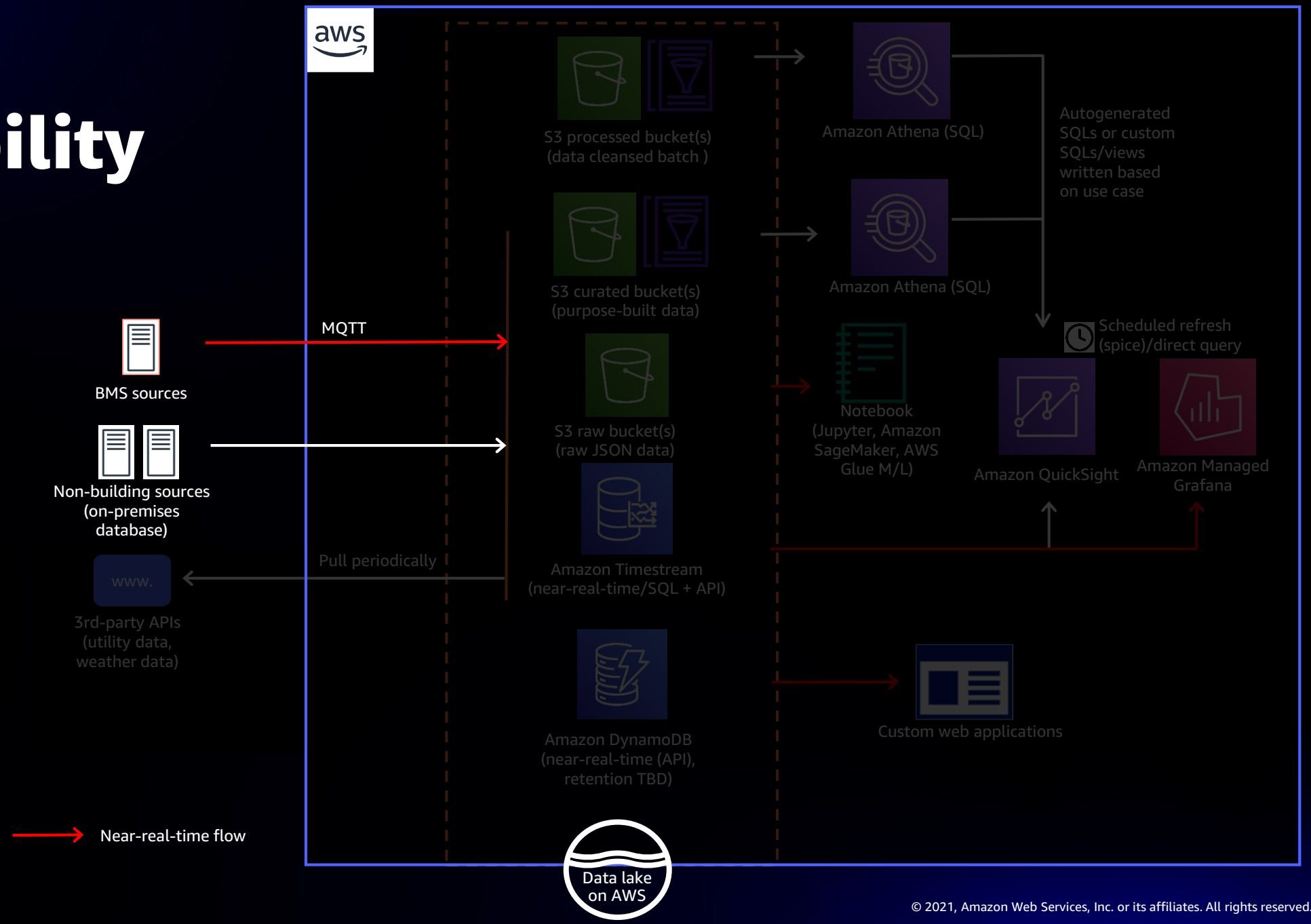
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Central sustainability data lake



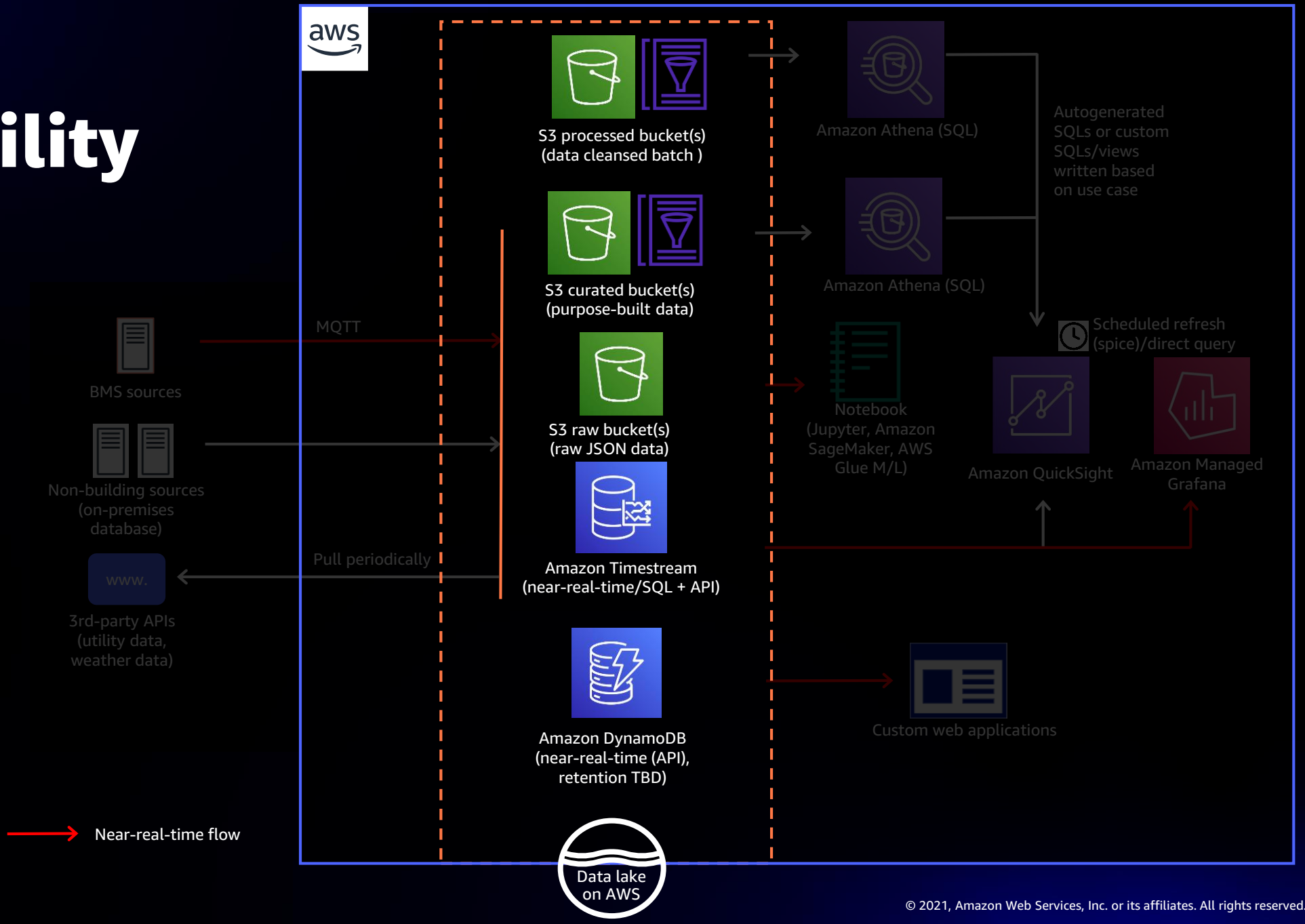
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Central sustainability data lake



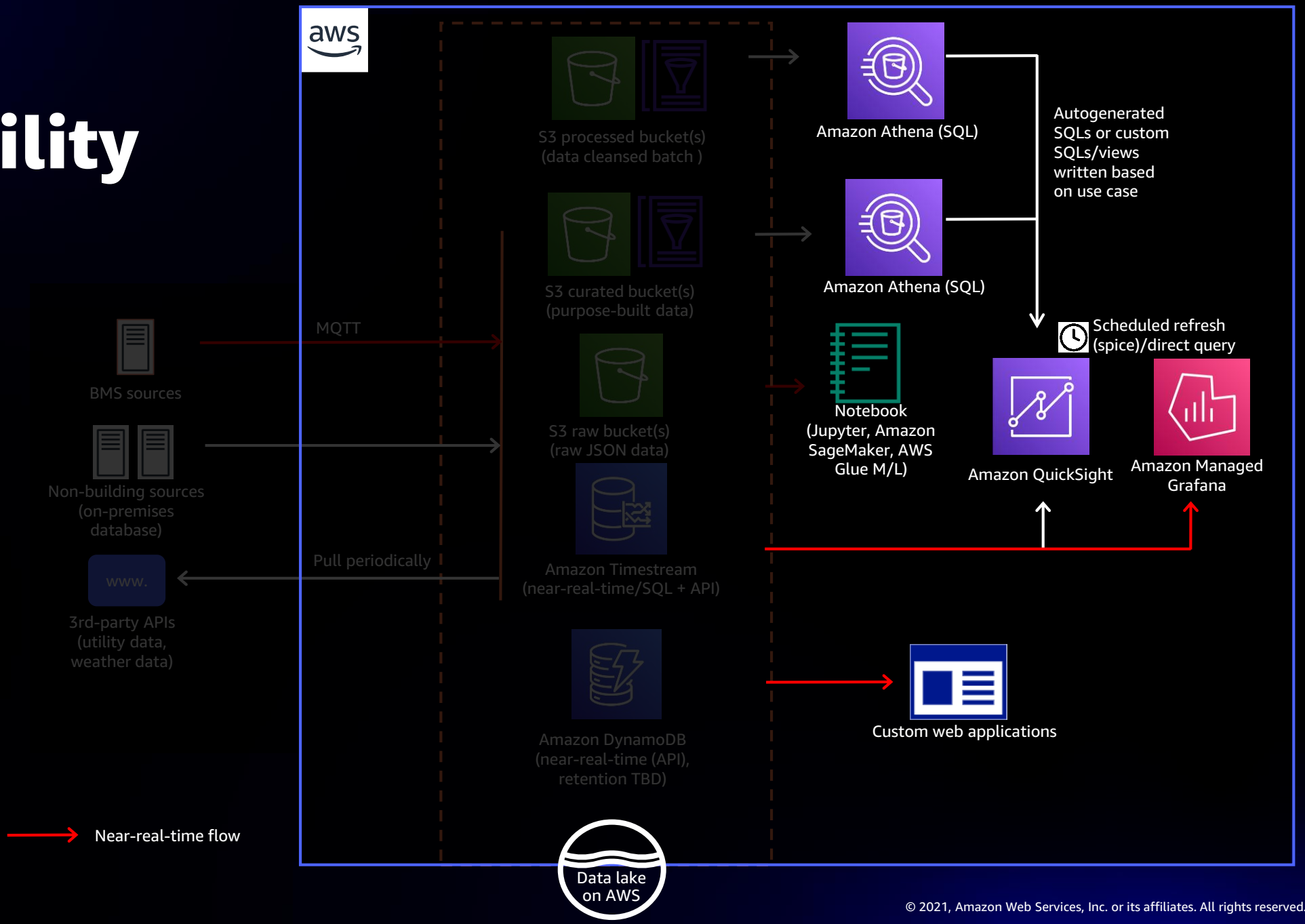
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Central sustainability data lake



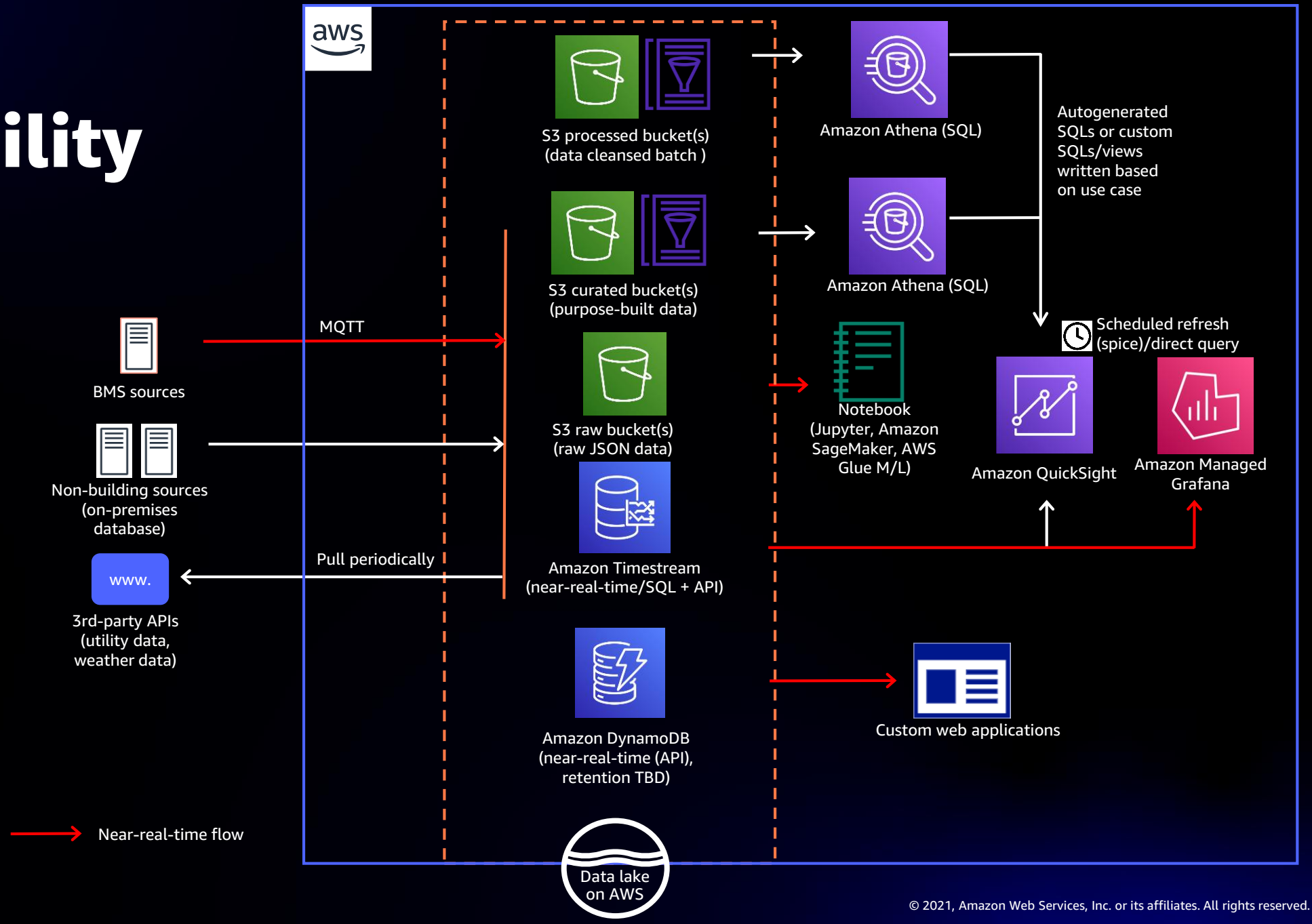
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Central sustainability data lake



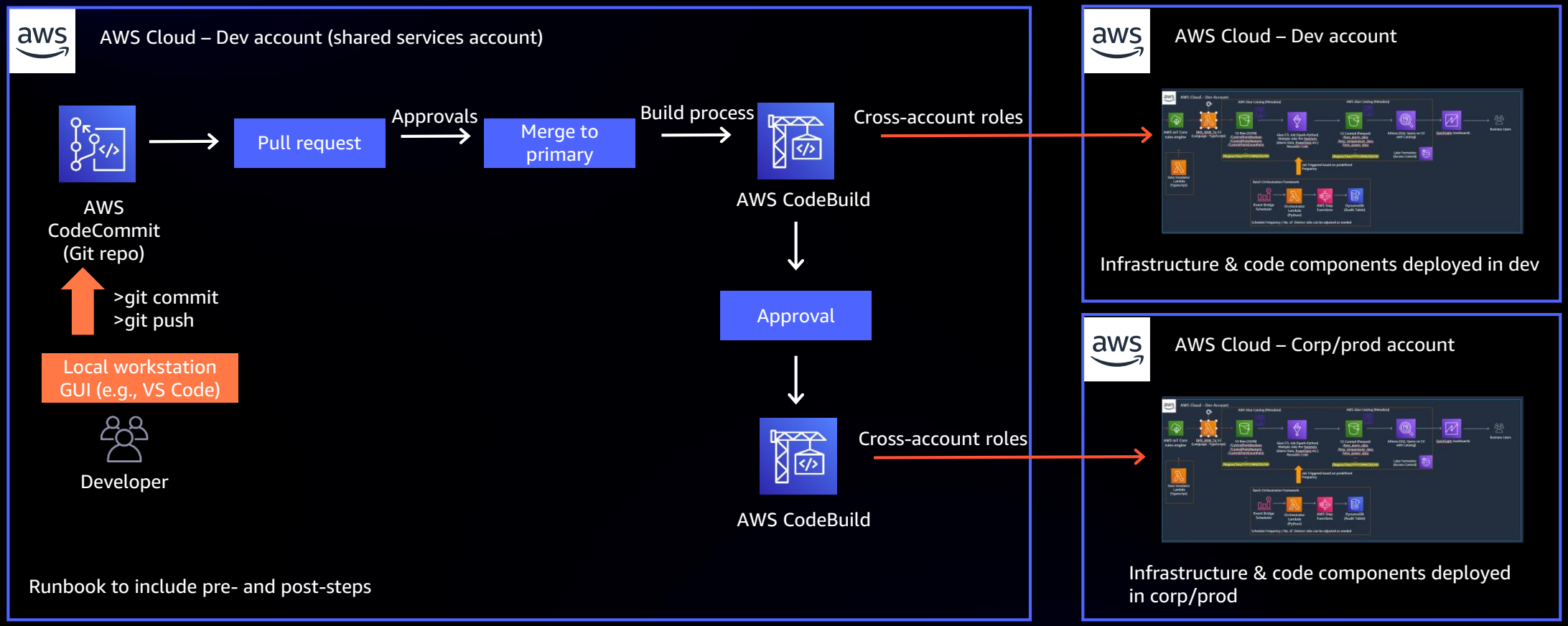
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Central sustainability data lake



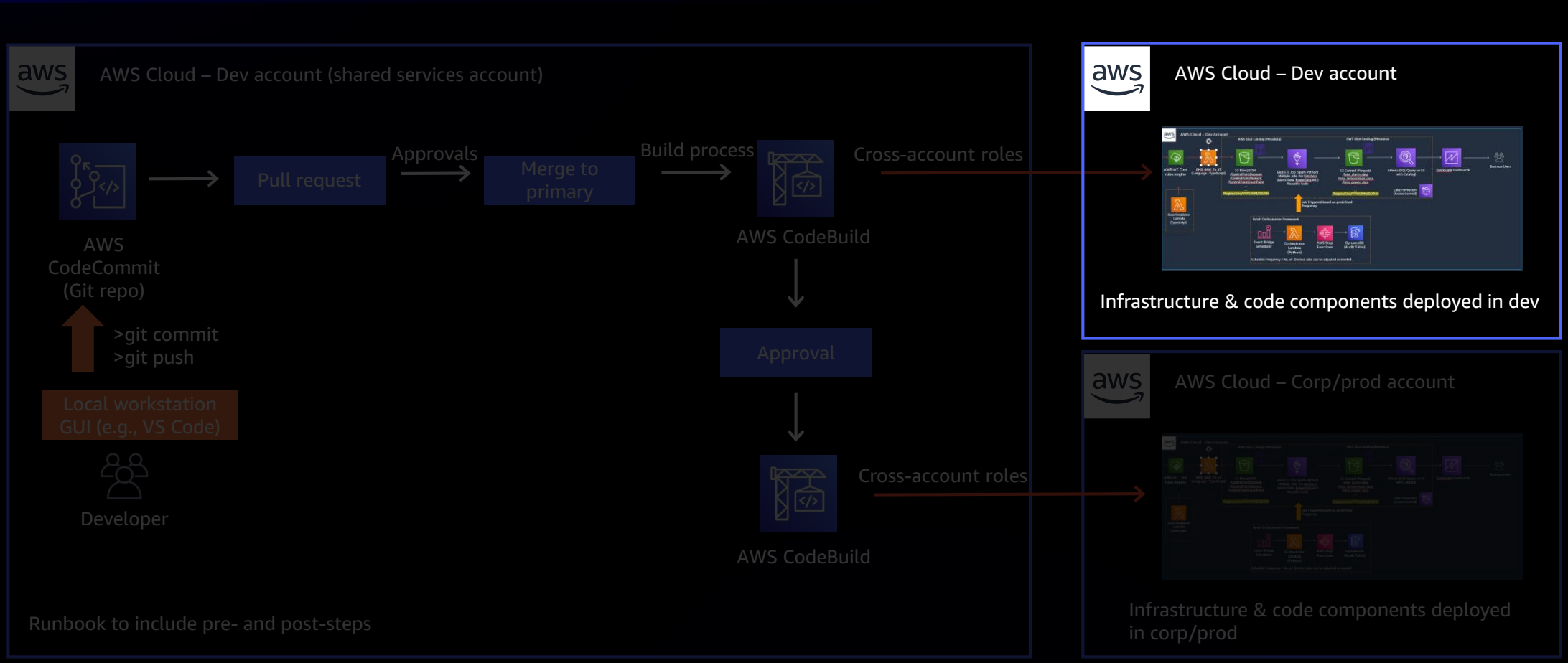
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Automated DevOps pipelines



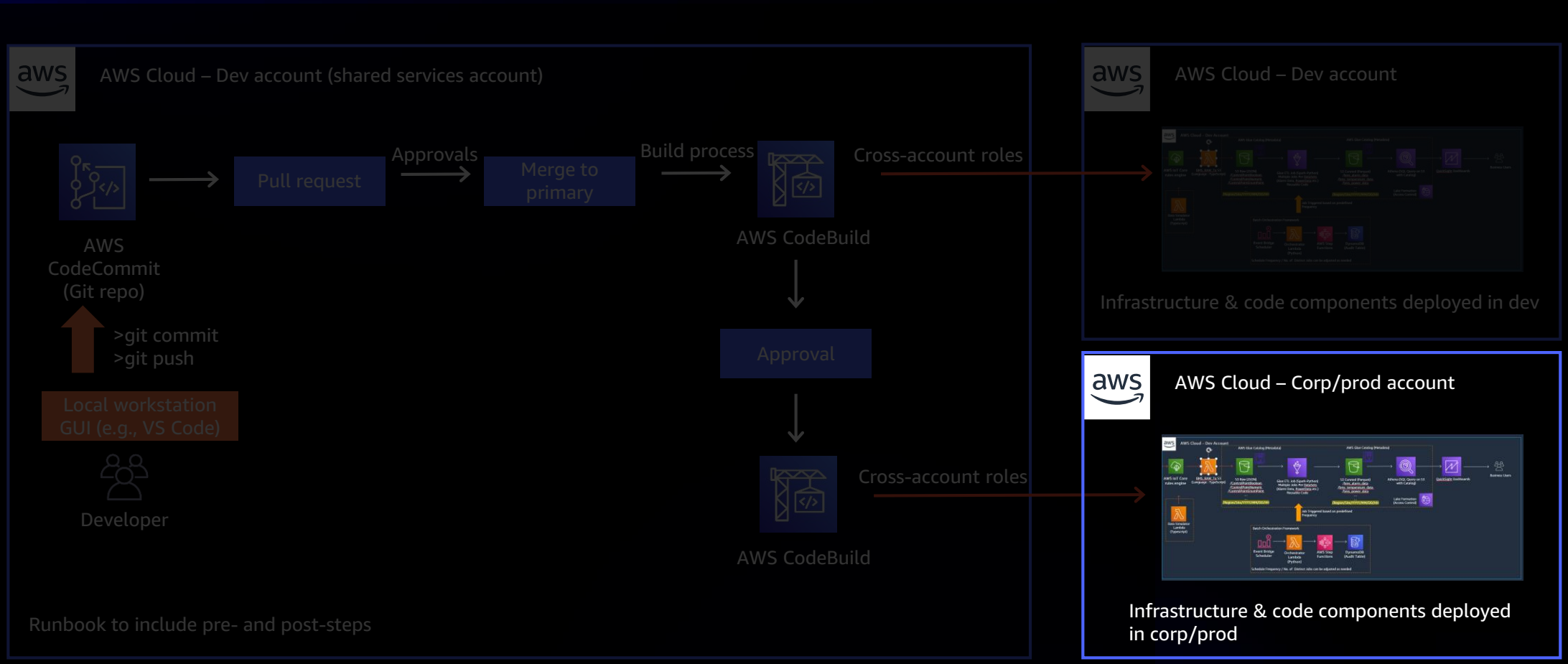
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Automated DevOps pipelines



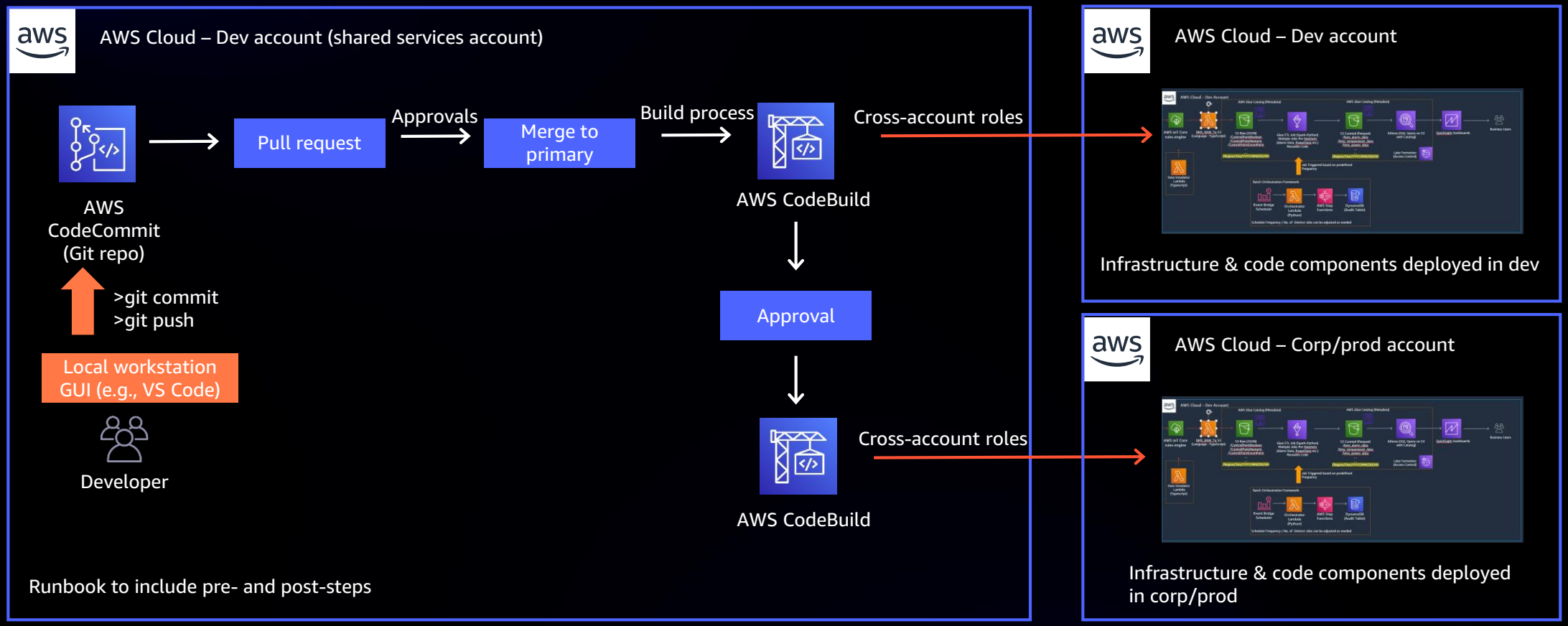
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Automated DevOps pipelines



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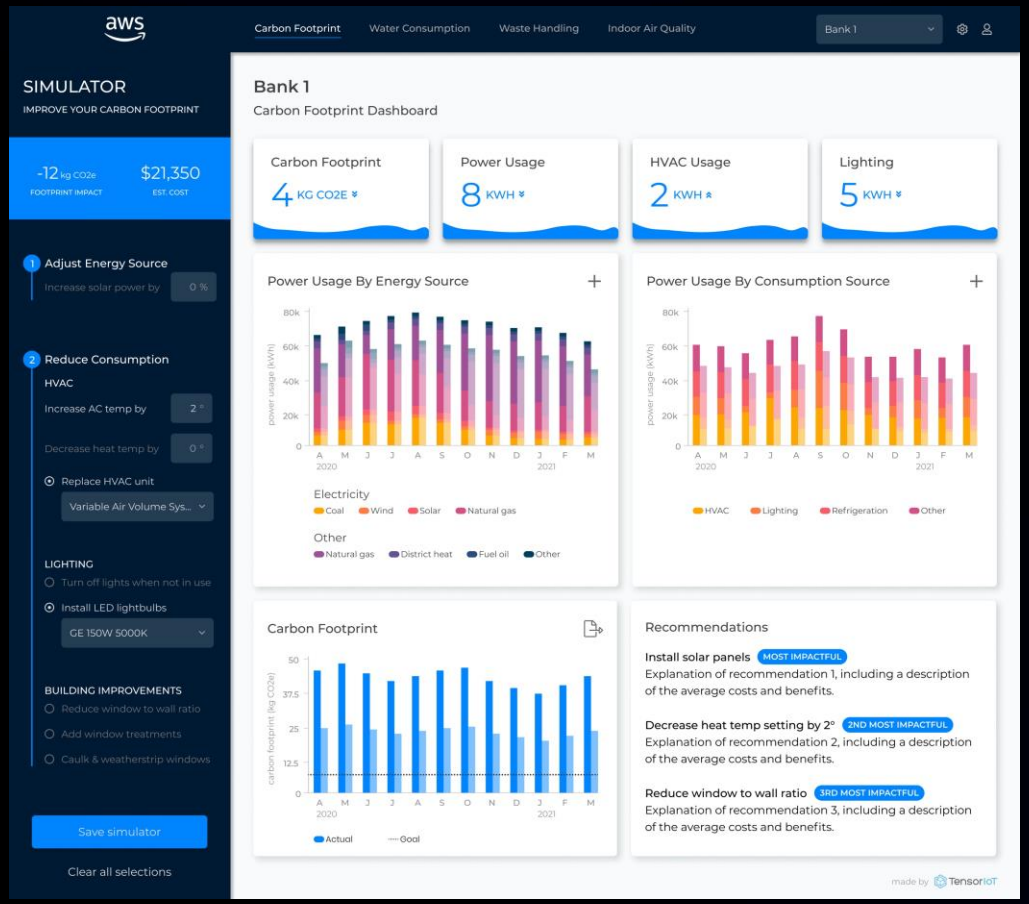
Automated DevOps pipelines

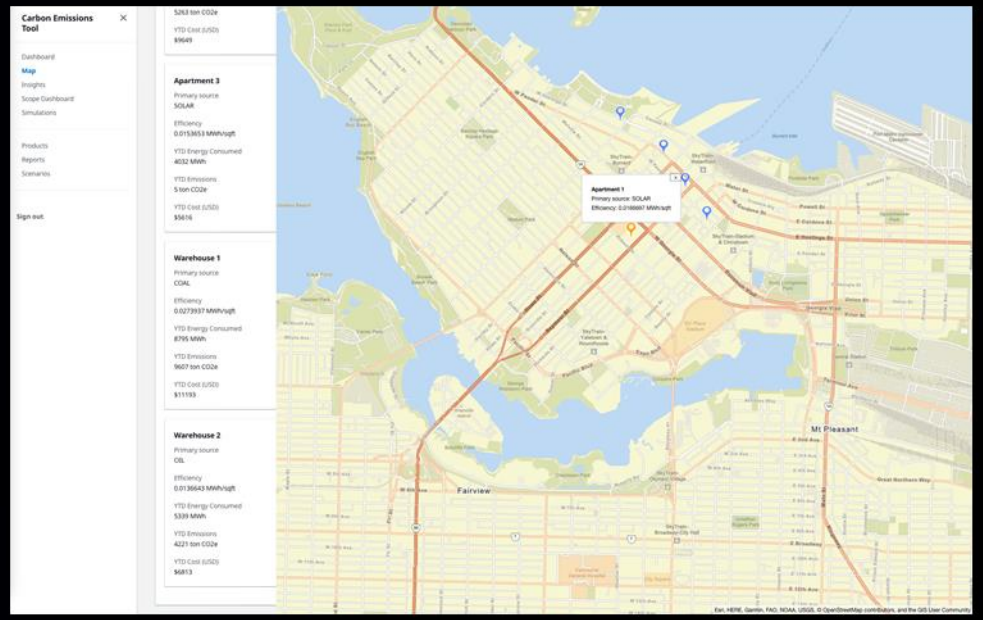


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Streamlined, accurate reporting

Amazon Sustainable Building Dashboard





Scope details

Scope 1: 5

Source	Value	Date
Diesel	2	7/29/21
Refrigerants	3	7/29/21

Scope 2: 25

Source	Value	Date
Electricity	25	8/04/21

Scope 3: 72

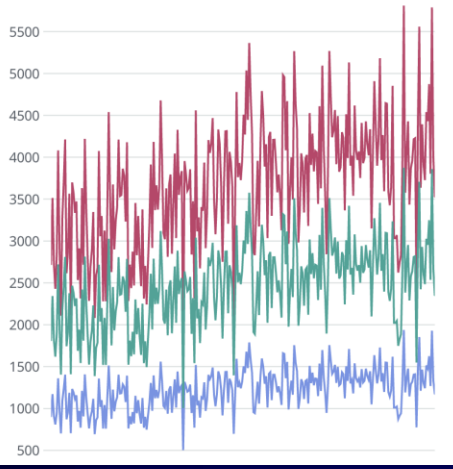
Source	Value	Date
Building Materials	2	7/29/21
Transportation Teams	8	7/29/21
Transportation Attendees	50	7/29/21

Scope level totals

Filter displayed data

Filter data

co2e lb



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Climate Pledge Arena

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“First certified zero carbon and net-zero energy sporting venue and NHL hockey team on the planet”

Net-zero carbon

- Arena to be powered by 100% renewable energy
- Achieve ILFI Zero Carbon Certification
- Offsetting 100% of carbon emissions from events
- Lowest embodied energy of any arena (recycled roof!)



Rainwater to rink





INSPIRED BY THE ROOF

RAINWATER TO ICE SYSTEM

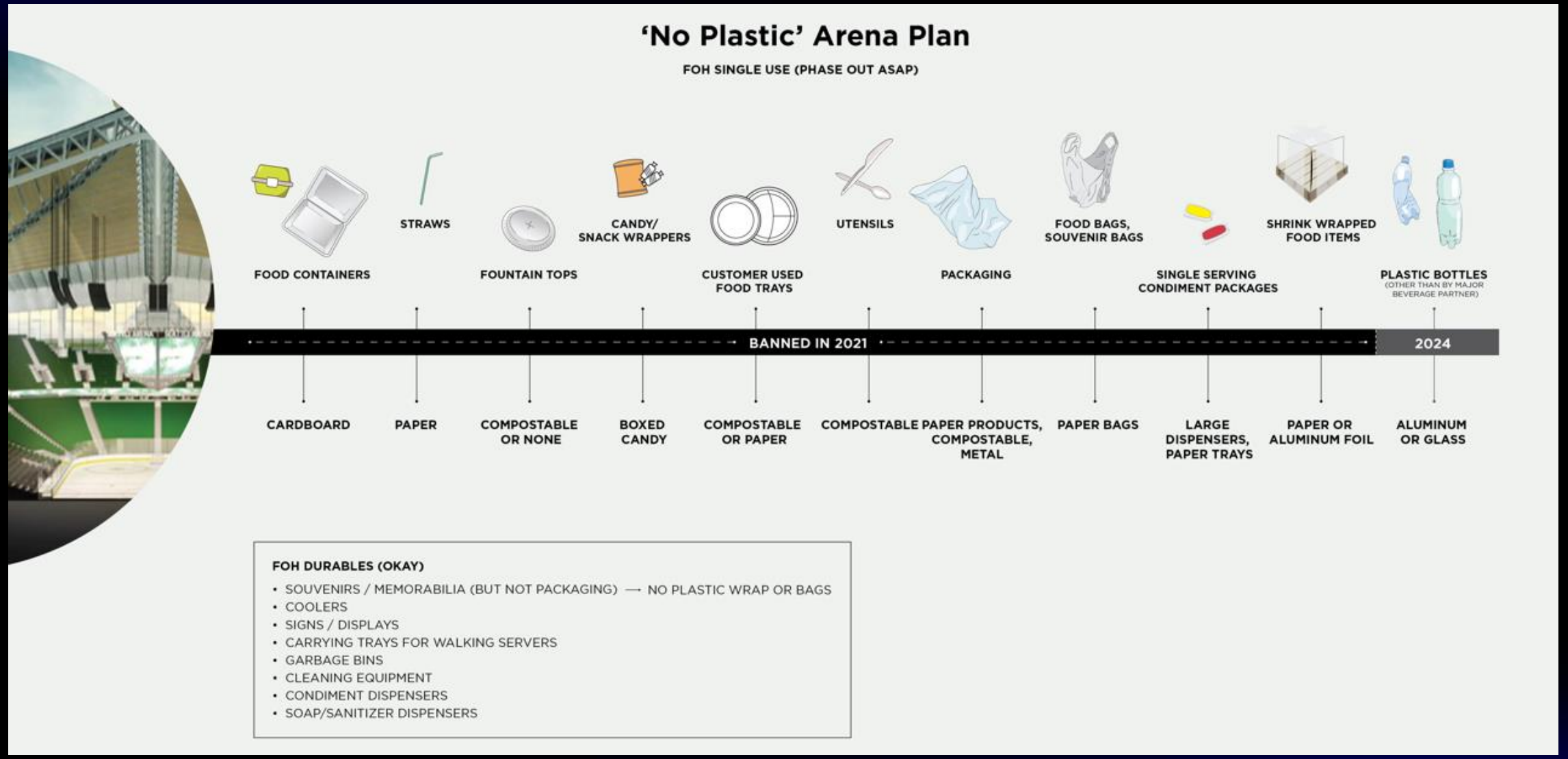
- PAUL THIRY'S DESIGN OF THE ORIGINAL WASHINGTON STATE PAVILION WAS INSPIRED BY RAIN HATS WORN BY THE NATIVE SALISH PEOPLE OF PUGET SOUND

- 59 YEARS LATER, THAT VERY ROOF WILL BECOME THE PRIMARY VESSEL FOR HARVESTING AND RE-USING RAINWATER TO CREATE A NEW WORLD-CLASS ICE RINK BENEATH IT

- ON-SITE HISTORIC AND EDUCATIONAL DISPLAYS WILL CELEBRATE THIS LEGACY STORY AND BE VISIBLE TO THE COMMUNITY AND VISITORS TO THE SITE AND SEATTLE CENTER

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Single-use plastics



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Sustainable & healthy food

- 75% of food ingredients sourced within a 300-mile radius
- House wines and craft beer from Washington and Oregon
- USDA-certified organic produce as standard
- All seafood meets Monterey Bay Aquarium sustainable Seafood Watch rating
- Plant-based proteins and prevalent vegan/vegetarian options
- Antibiotic and hormone free proteins – grass-fed beef
- 100% of eggs from cage-free hens
- And many others



Monterey Bay Aquarium Seafood Watch

FAIR TRADE CERTIFIED™

USDA ORGANIC

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Zero waste

- 97%+ diversion rate
- Dishwashers!



Transportation

- Implementation of an artist-led carbon offset to cover the emissions from travel
- Subsidizing round-trip public transit rides for any fan attending home NHL games
- $7M investment in private sector upgrades to the publicly owned Seattle Center Monorail



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Challenges

- Data from diverse business lines
- Data collection in wildly different forms
- Metrics; business as usual use case
- Carbon accounting
- Storytelling



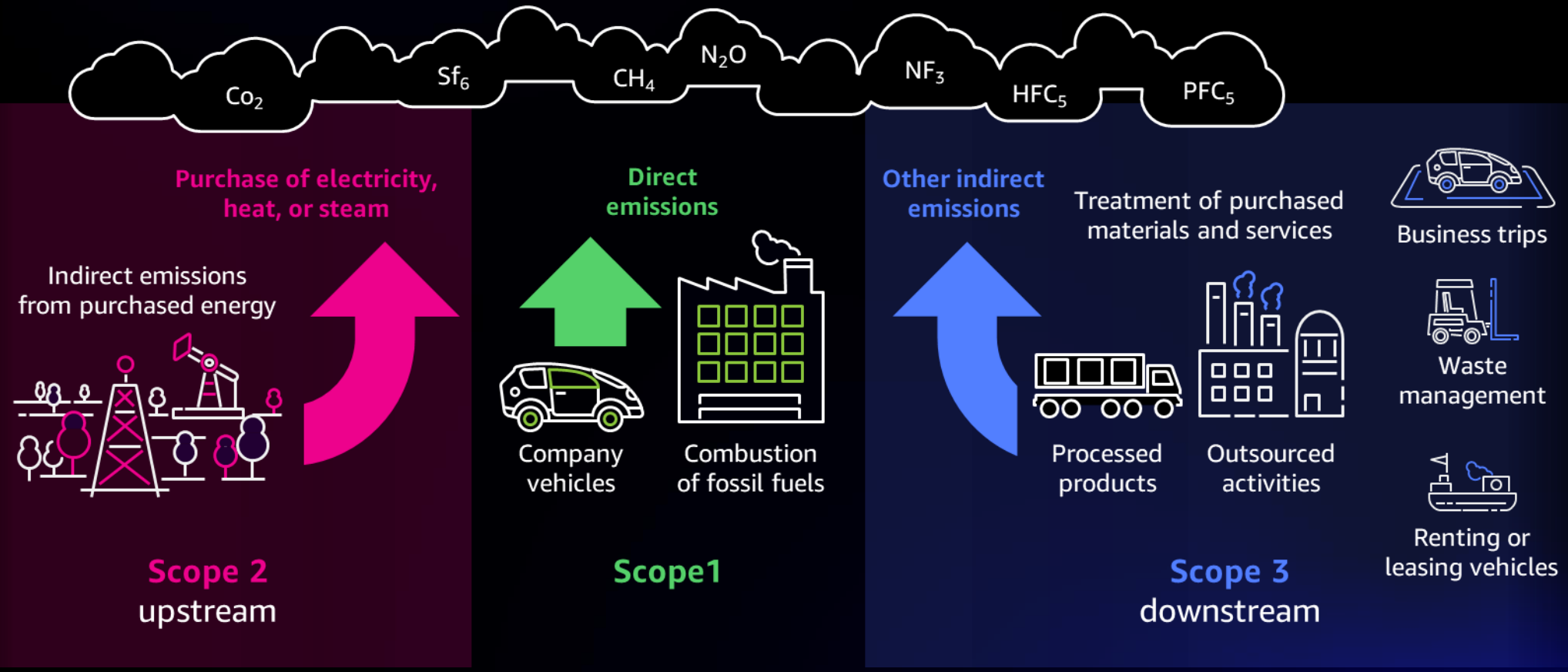
Carbon Footprint Platform

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Sustainability targets and reporting

Reporting on greenhouse gases: GHG Protocol

Direct vs. indirect emissions

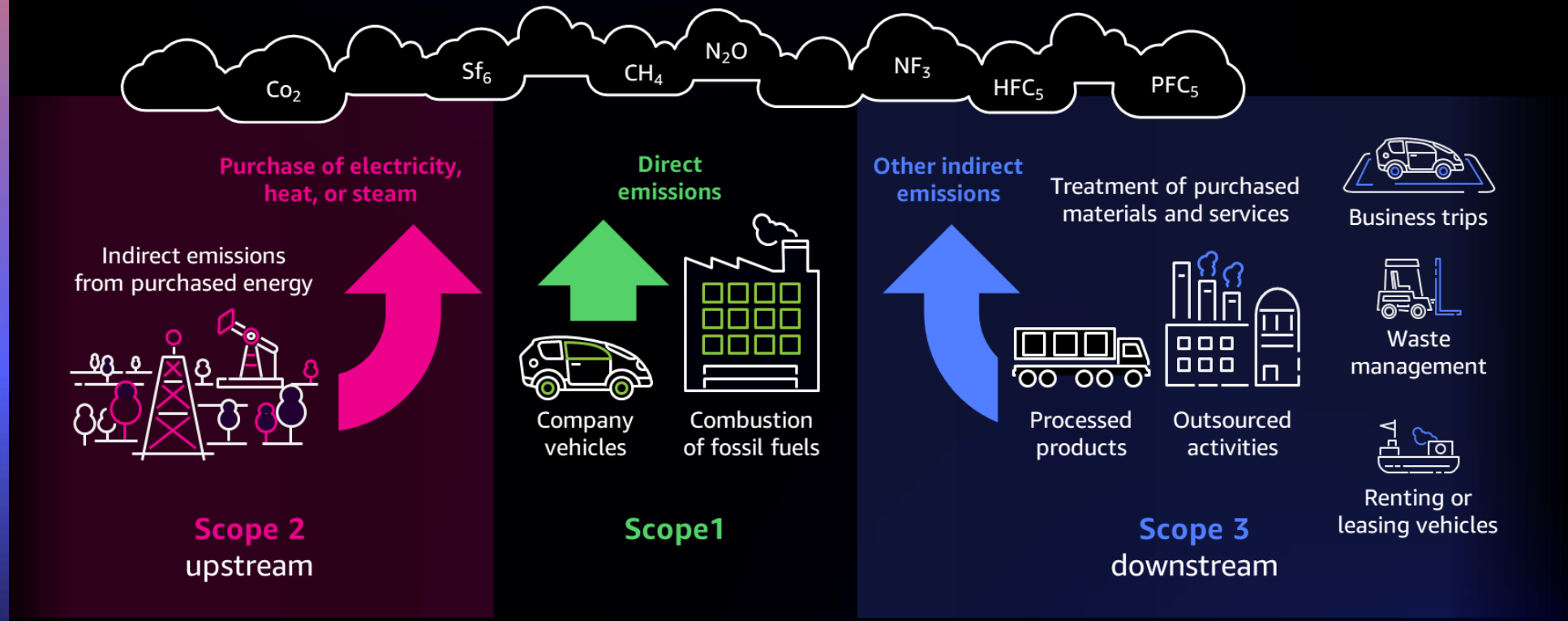


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Sustainability targets and reporting

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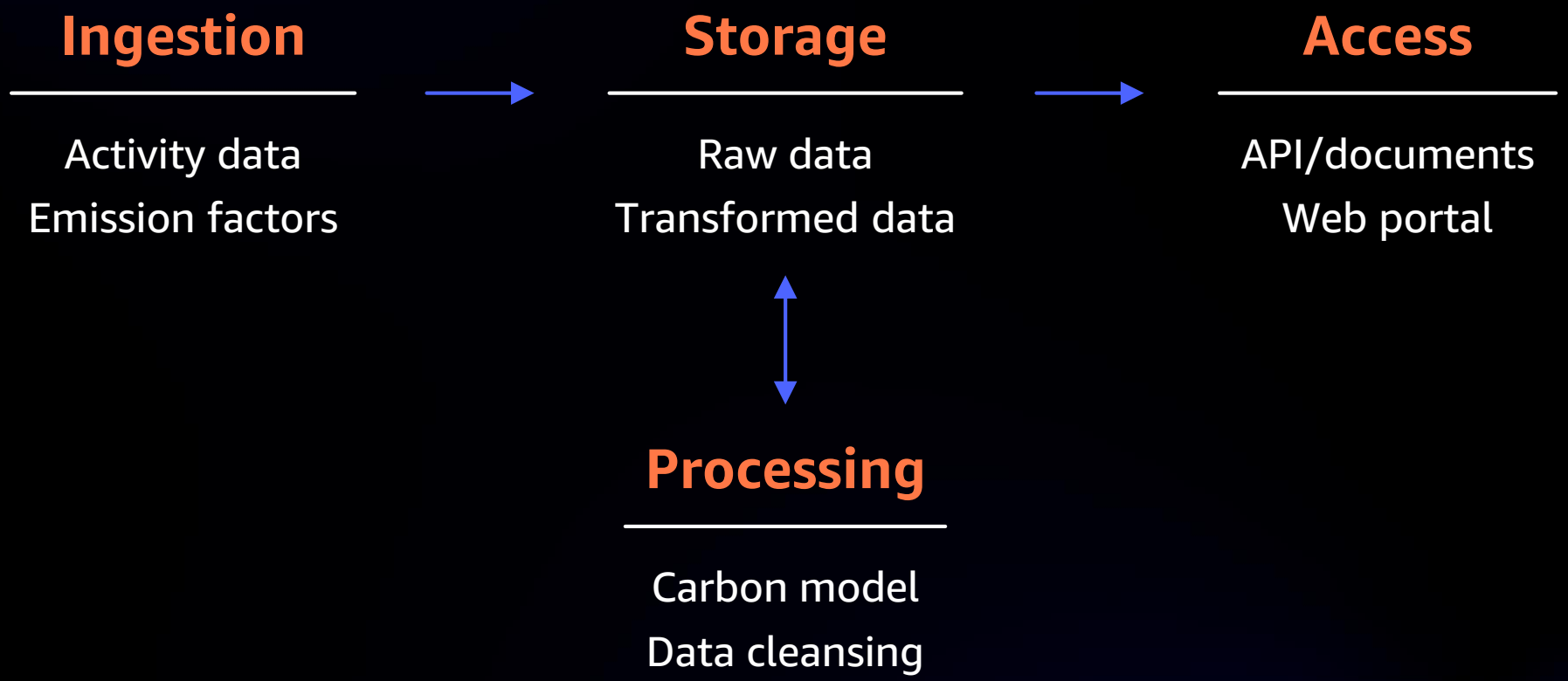
Carbon footprint =

Total emitted greenhouse gas

Expressed in CO_2 equivalent (CO_2e)

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Carbon accounting is a data challenge



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Data ingestion challenges

- Food and beverage
  - Harbor Foods – monthly CSV file
  - Delaware North – API-based data ingestion
- Waste Management – monthly CSV file
- Seattle Public Utility (Water) – monthly PDF file

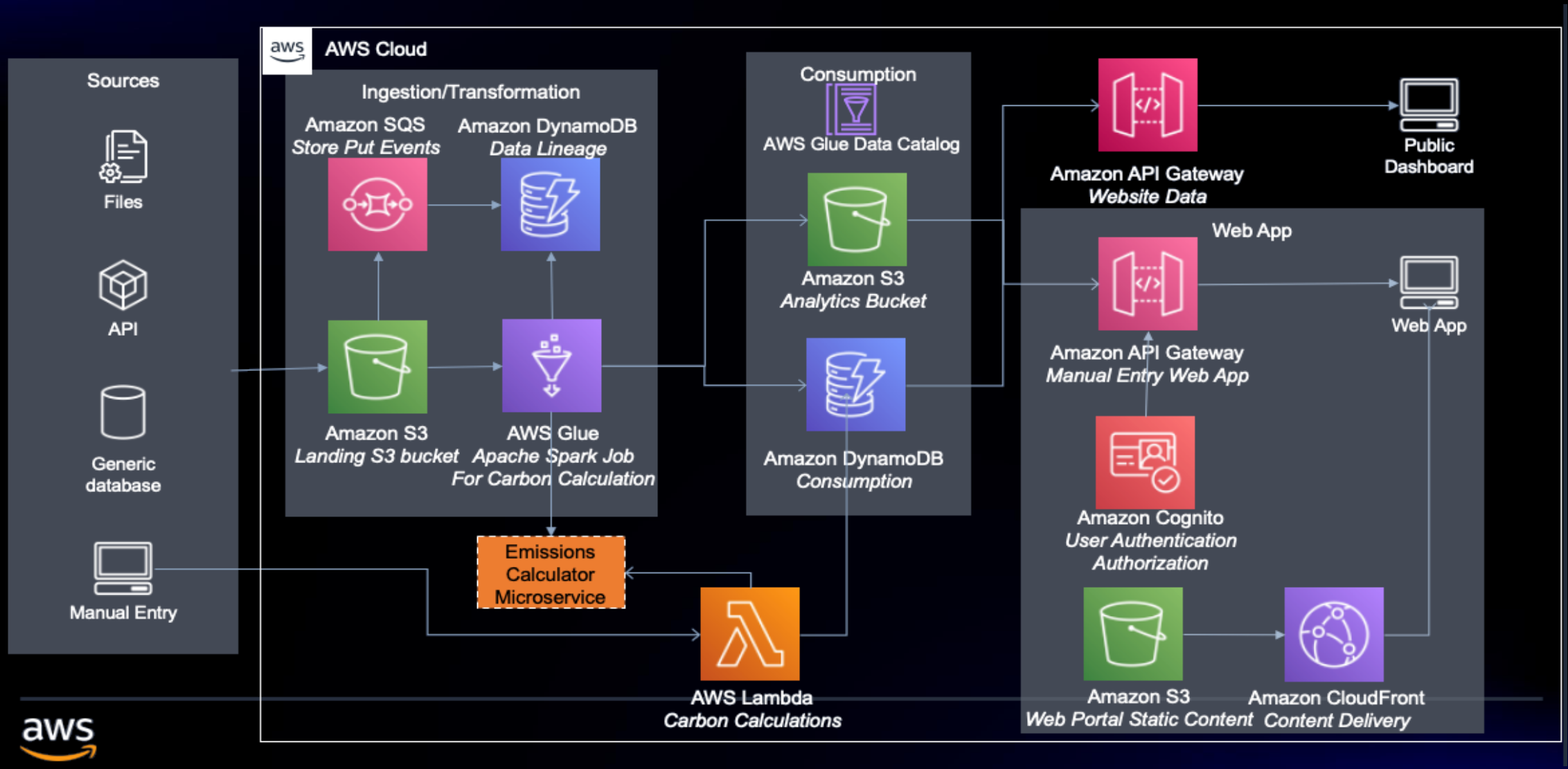
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Carbon emissions calculation

Activity	x	Emission factor	=	CO_2e
100 kWh electricity	x	0.13 kg CO_2e/kWh of grid electricity	=	13 kg CO_2e
Utility bill		Regional grid averages from US EPA's eGRID database		All greenhouse gases normalized to CO_2e

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Climate Pledge Arena architecture



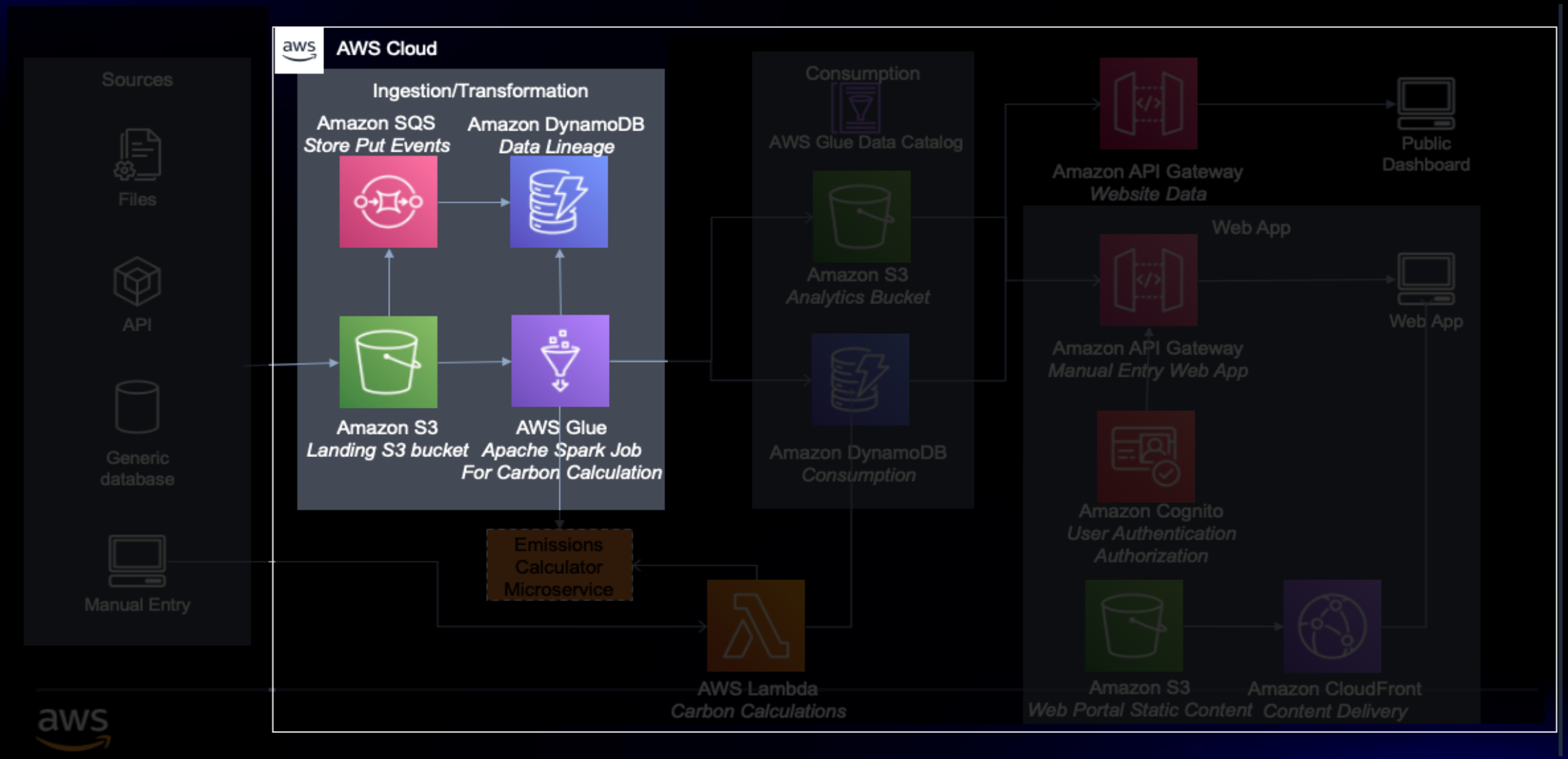
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Climate Pledge Arena architecture



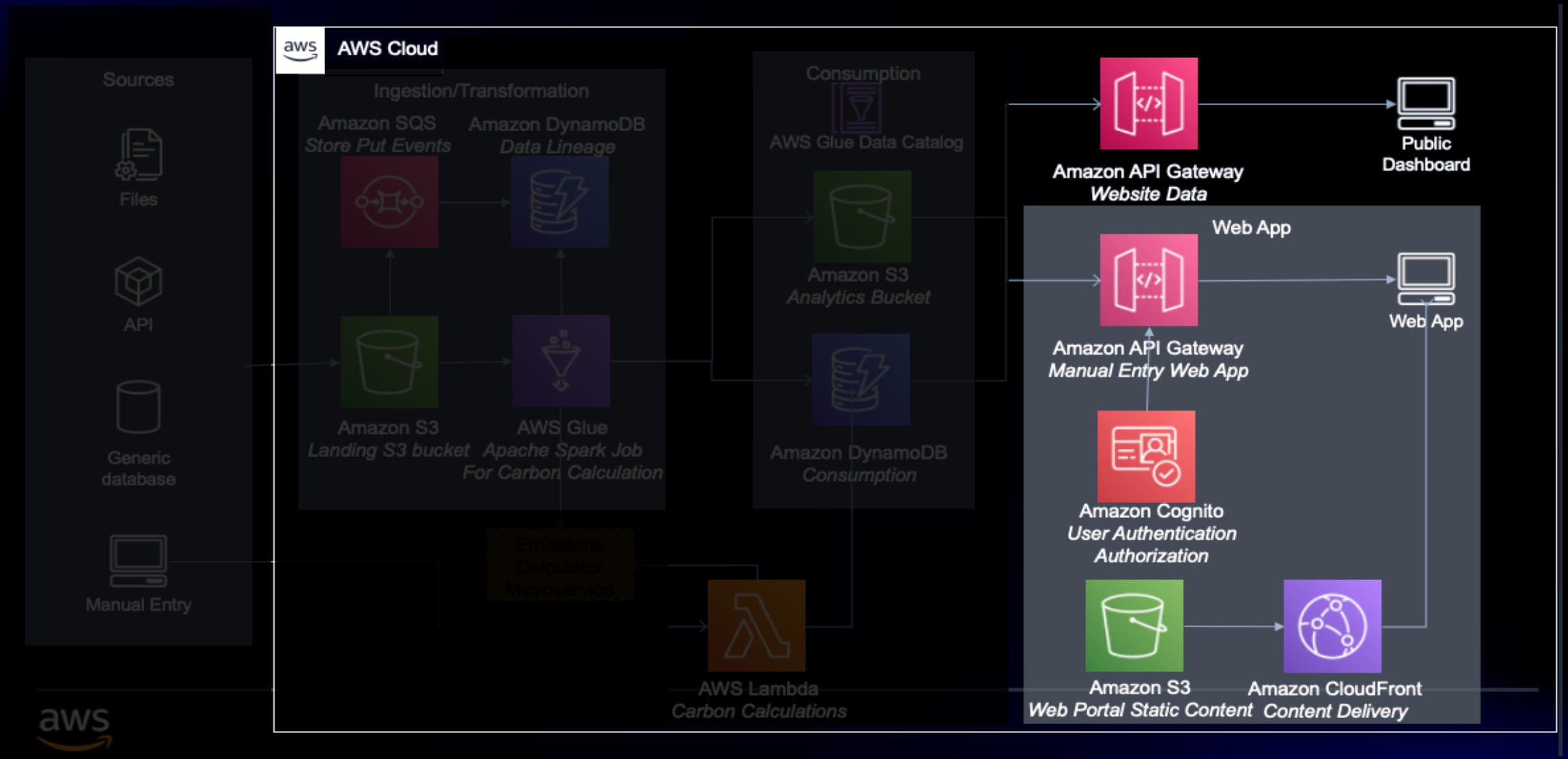
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Climate Pledge Arena architecture



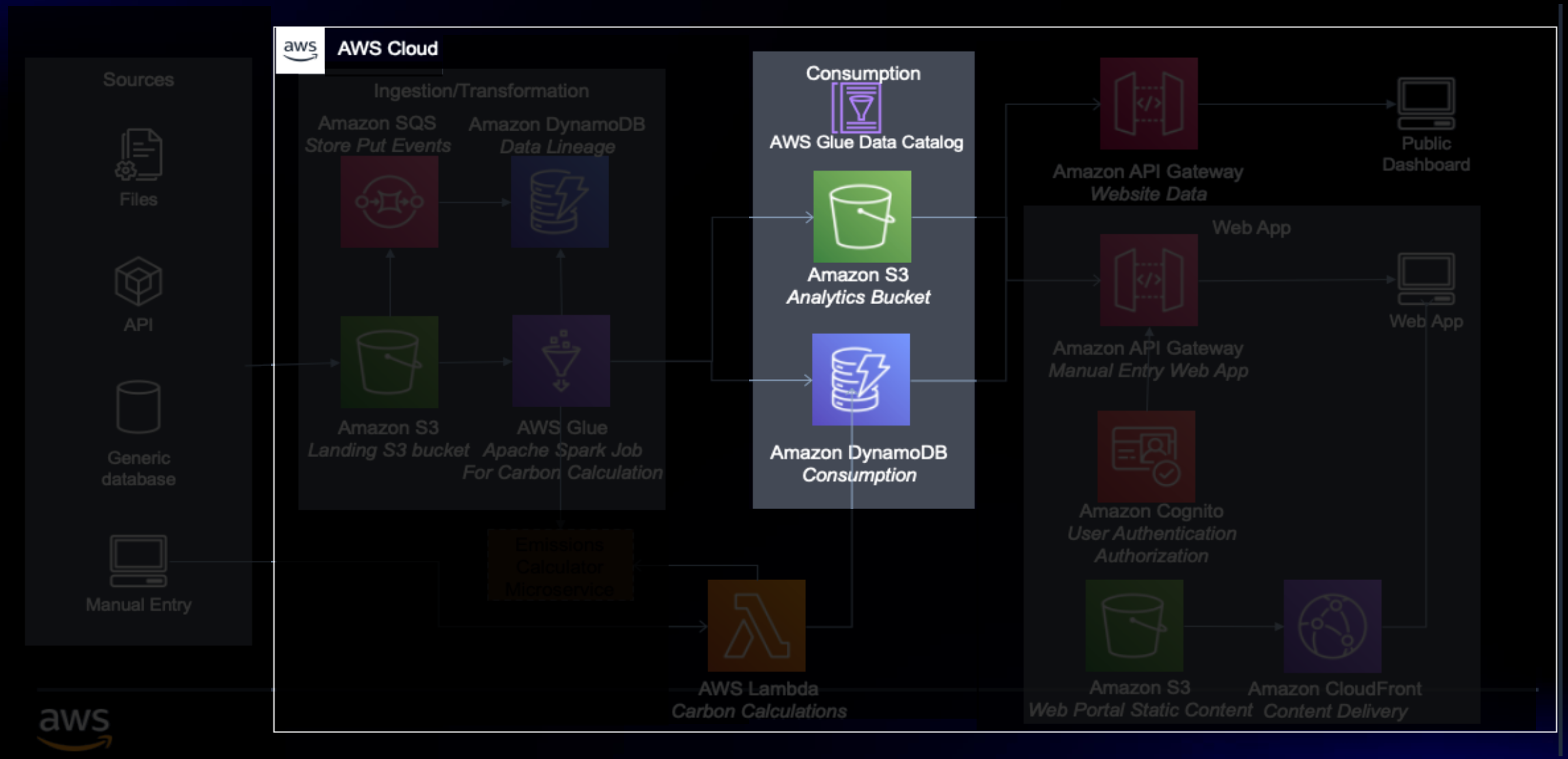
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Climate Pledge Arena architecture



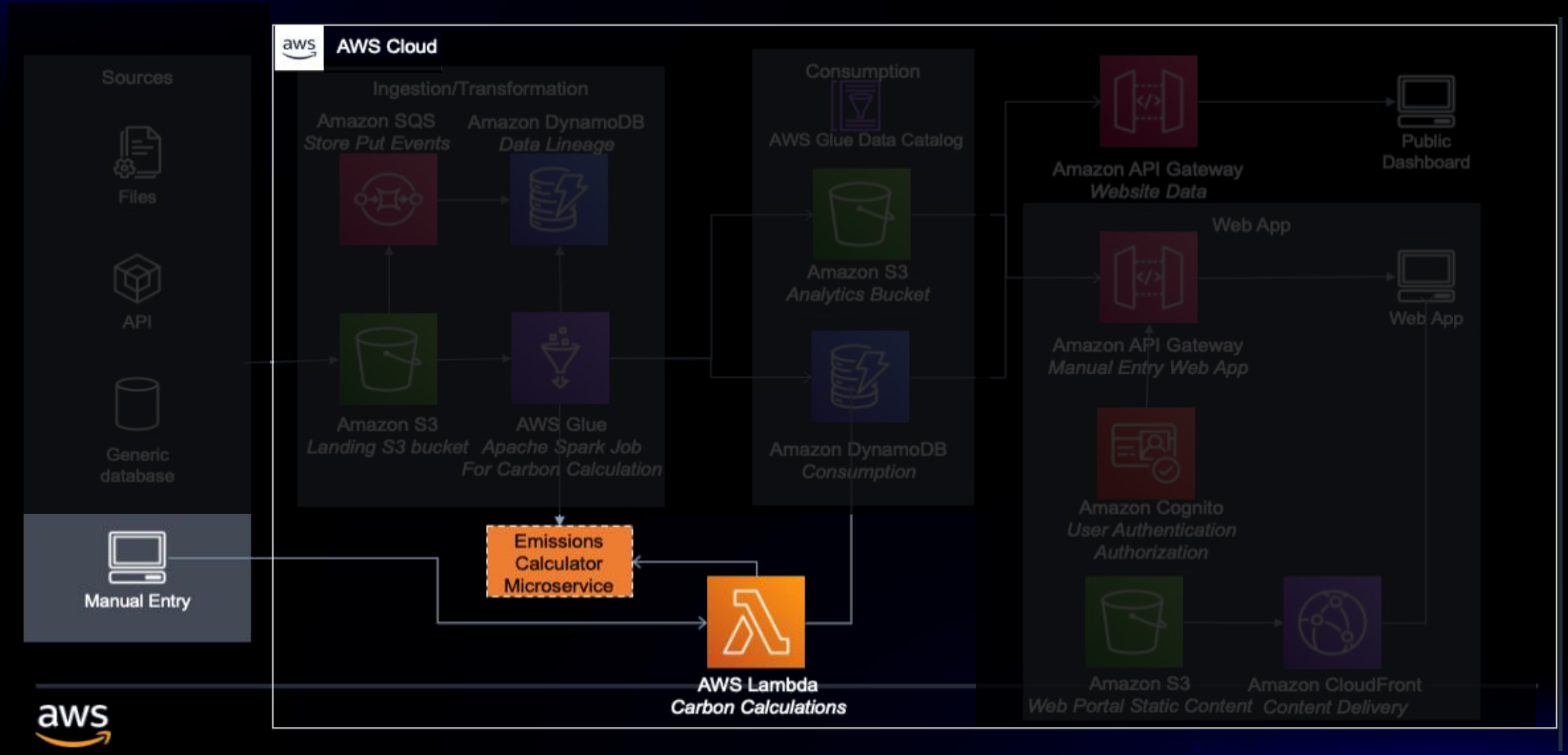
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Climate Pledge Arena architecture



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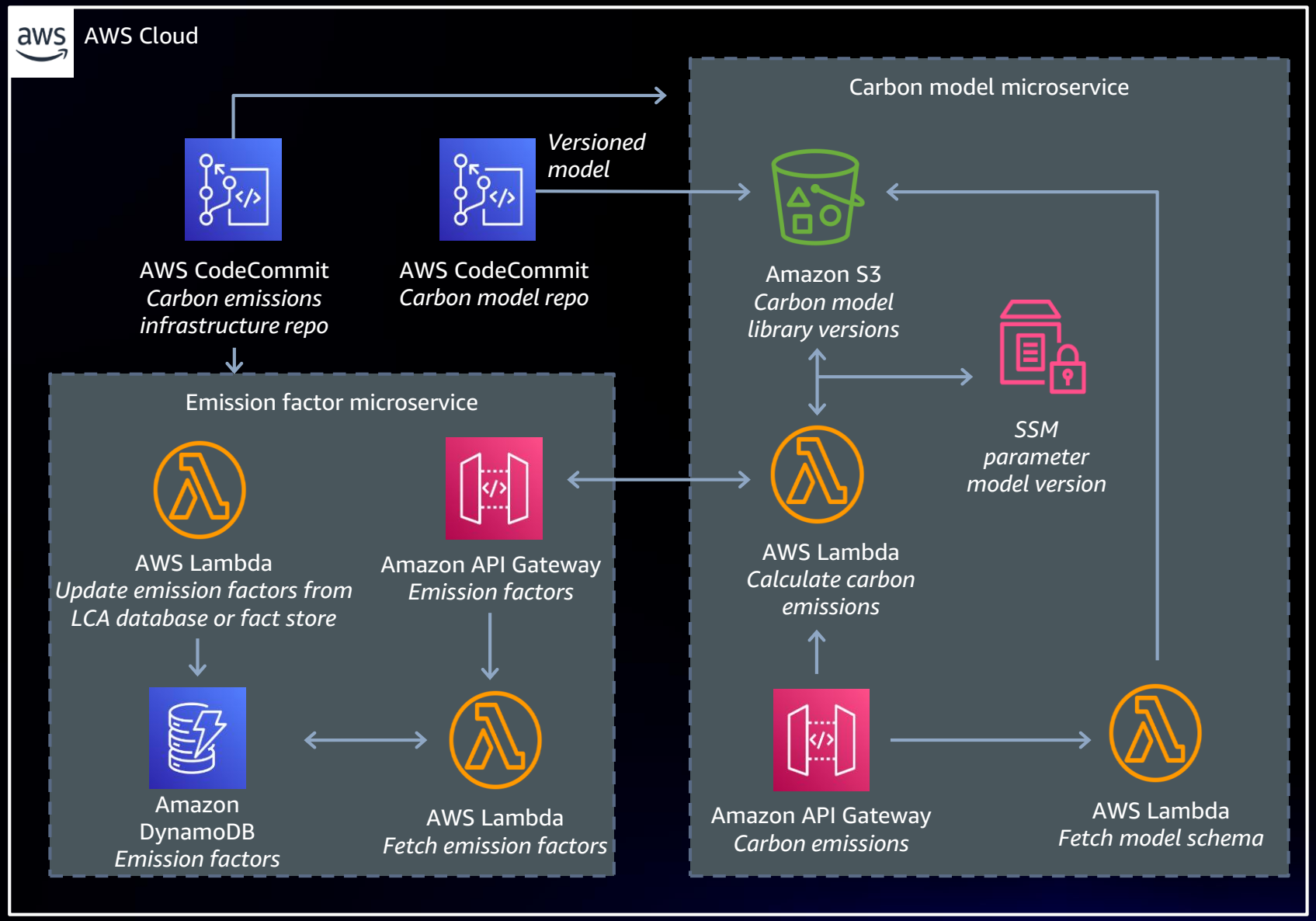
Climate Pledge Arena architecture



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Carbon model microservice architecture

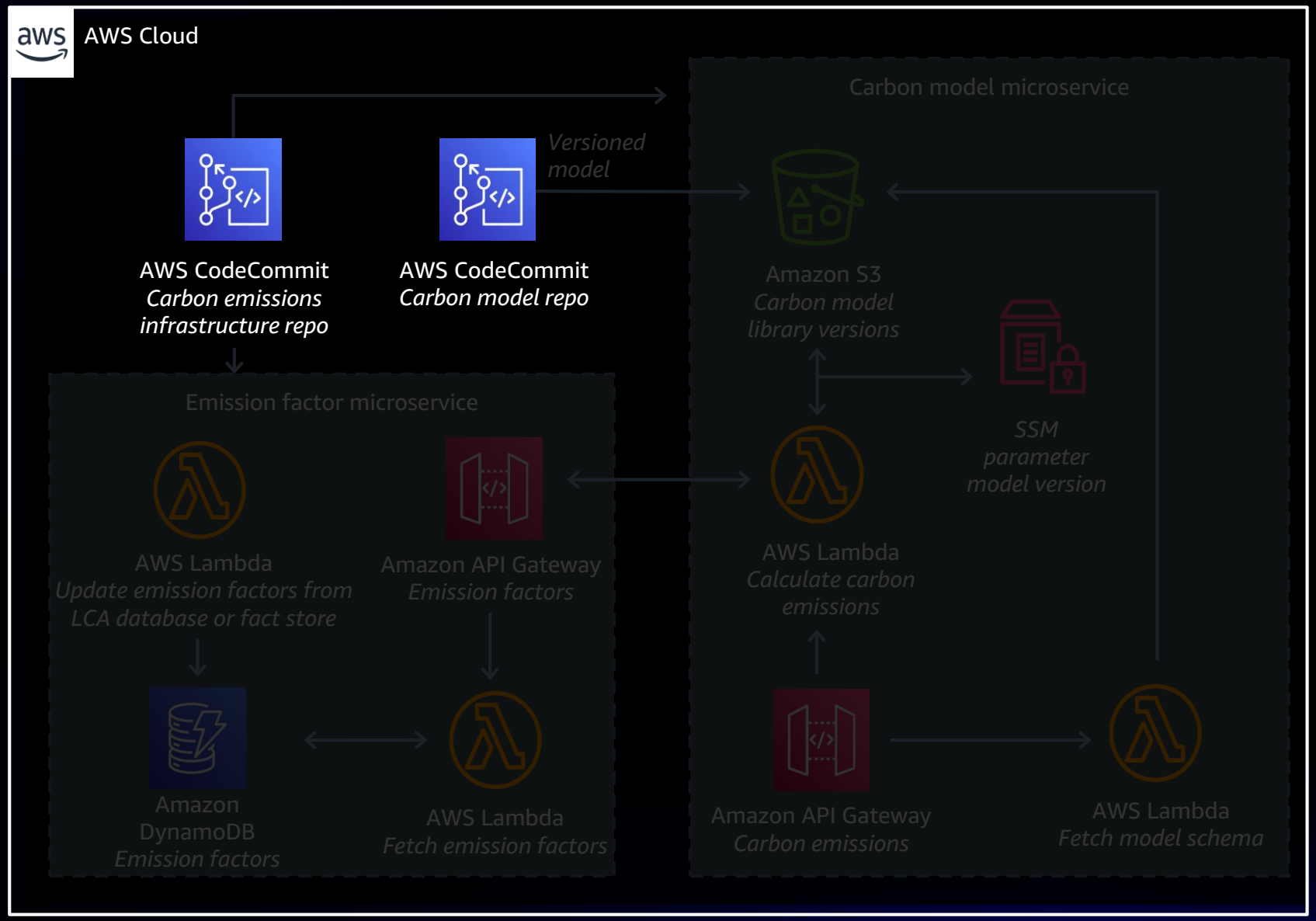
- Decoupled versioned carbon model that can be managed by environmental professionals without AWS experience
- Decoupled central data store for emission factors



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Carbon model microservice architecture

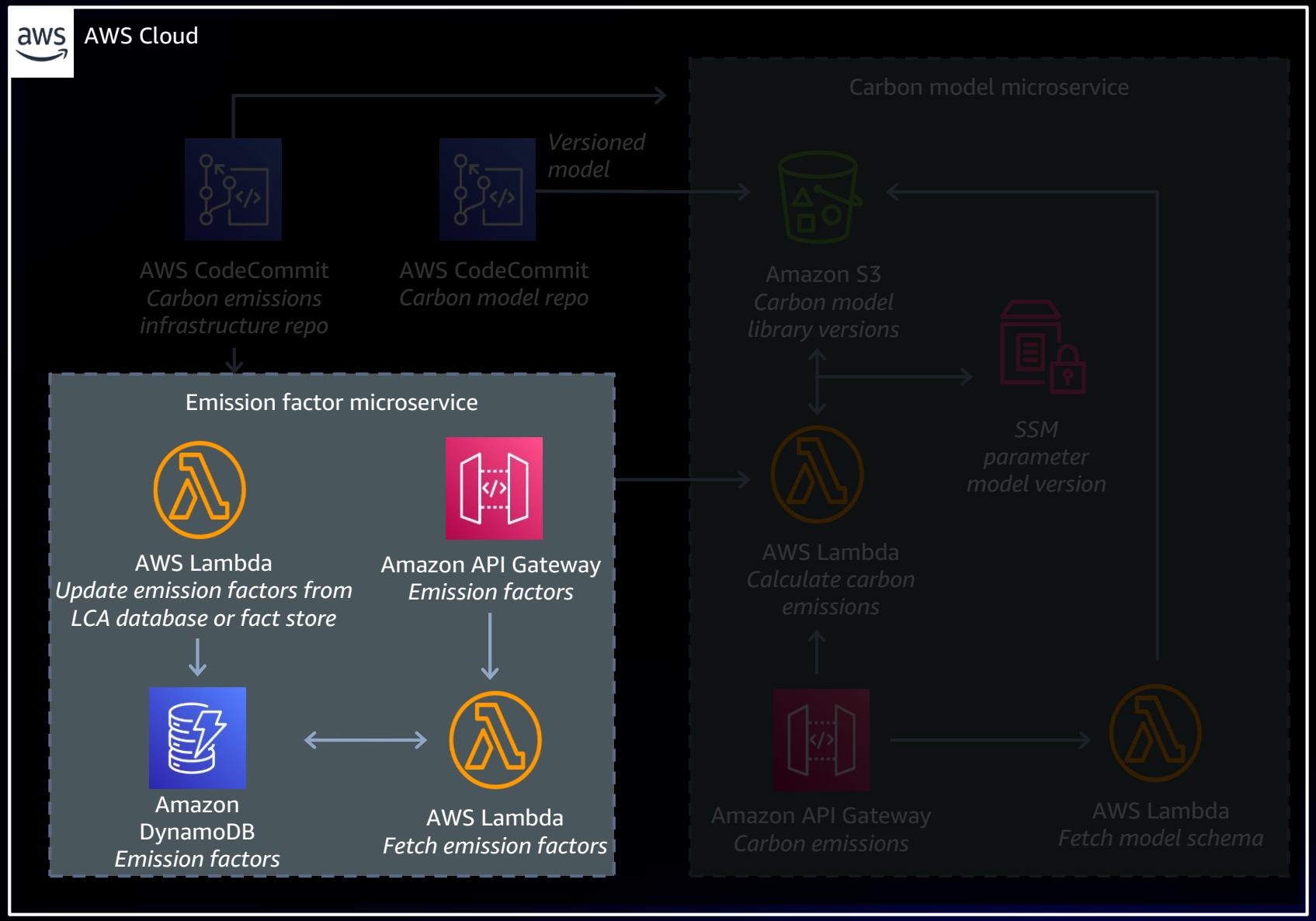
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Carbon model microservice architecture

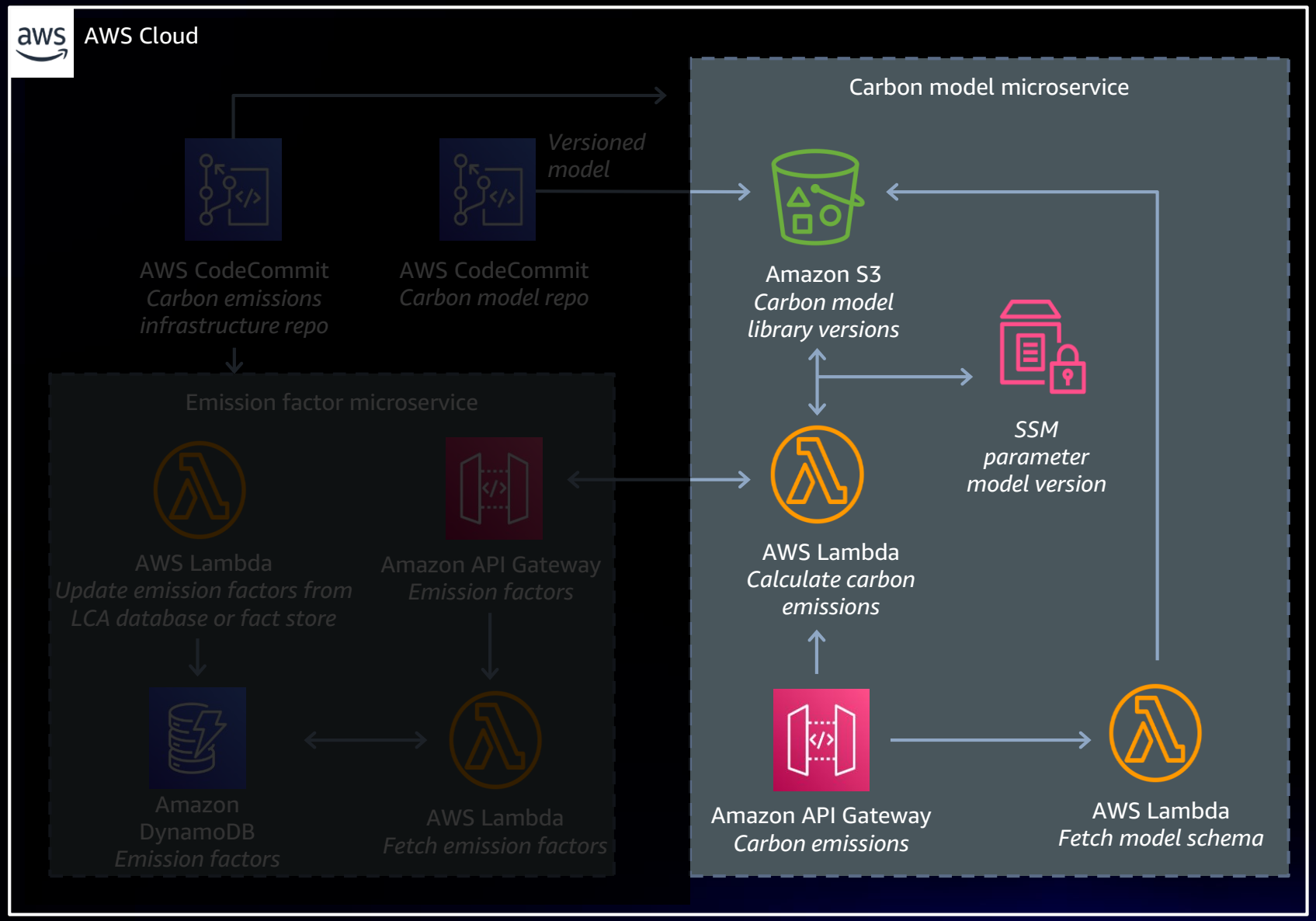
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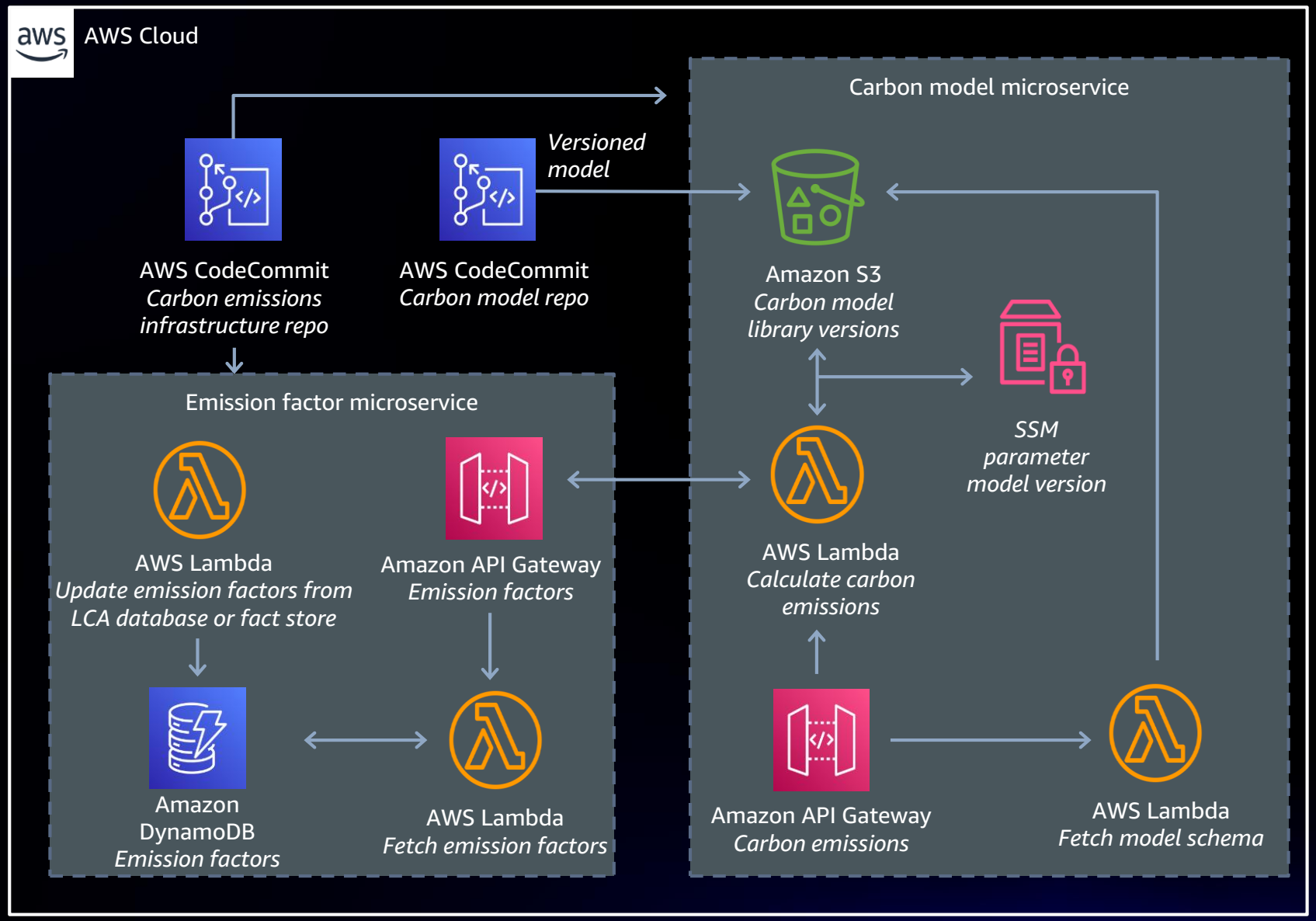
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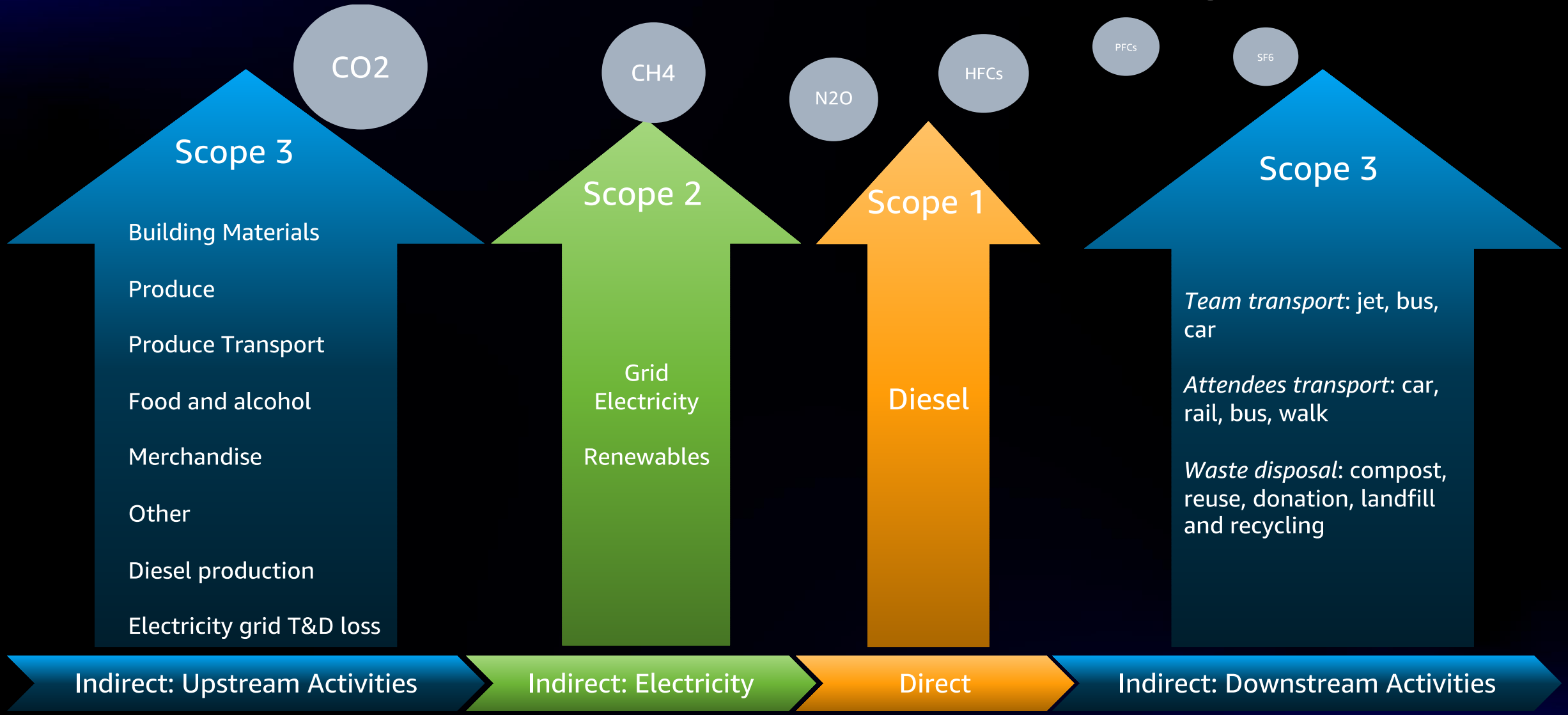
Carbon model microservice architecture

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Emission sources from Climate Pledge Arena



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How to get started

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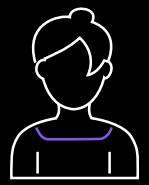
Achieving your commitments



How do I identify carbon emission hotspots?



How can I innovate to achieve sustainability transformation?



How do I reduce energy and water usage in my operations?



How do I collaborate with others in my value chain to reduce carbon emissions?

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Resources



AWS Sustainability Website
https://aws.amazon.com/sustainability/

Review case studies, customer use cases, and sustainability resources



AWS Professional Services engagement

Leverage sustainability technologists and solutions and innovate across your business



Build with AWS services and partner solutions

Identify use cases, select AWS technologies and partners



Amazon Sustainability Data Initiative, AWS Data Exchange

Find sustainability datasets for research and innovation

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Thank you!

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