
AWS
re:Invent
NOV. 28 – DEC. 2, 2022 | LAS VEGAS, NV

SUS312

How innovators are driving more sustainable manufacturing

Muhammad Sajid

Solutions Architect
AWS

Marcus Ulmefors

Director Data & Machine Learning Platforms
Northvolt

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Death by 1,000 tabs

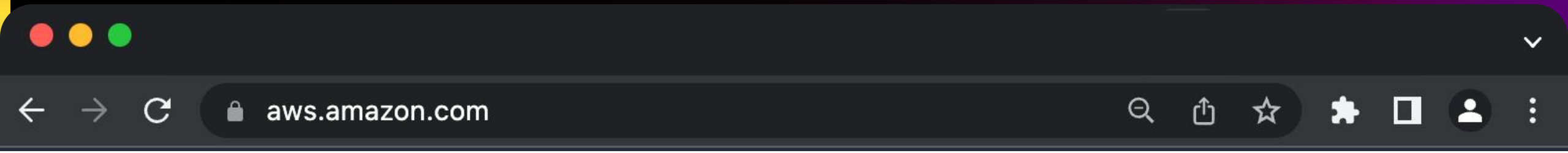


Tab-tsundoku

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Anything we can’t keep doing forever is not sustainable

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.



How innovators are driving more sustainable manufacturing

SUS312

Breakout Session

Level 300

Sustainability & Industry

Designing the factories of the future involves embracing two themes that innovative organizations prioritize—advanced digital design and sustainability. Modern manufacturers are using AWS to model and optimize factory operations and deliver lower-impact products. In this session, learn how battery manufacturer Northvolt manages their factories as digital assets, activating detailed traceability, near real-time

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Outline

Smart manufacturing, data, and sustainability

Technologies to optimize factory operations

Demo: AWS IoT TwinMaker

How Northvolt is using AWS to operate connected factories

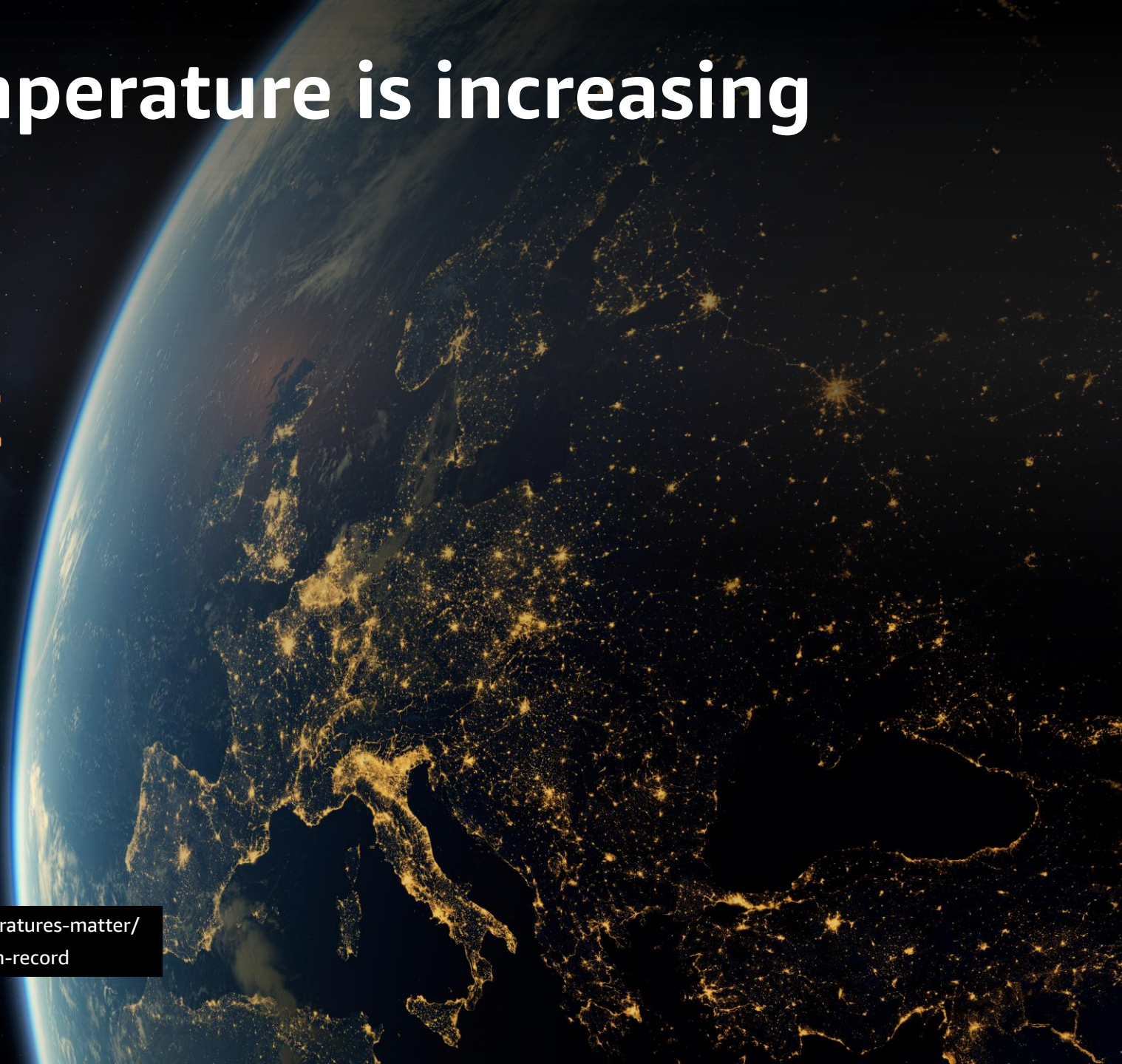
Call to action and resources

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Average temperature of the earth?

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Global average temperature is increasing



Earth’s average temperature is **15°C**

Why does **1.5°C** matter?

https://climate.nasa.gov/news/2865/a-degree-of-concern-why-global-temperatures-matter/
https://www.noaa.gov/news/september-2022-tied-as-earths-5th-warmest-on-record

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Why is earth’s temperature increasing?

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

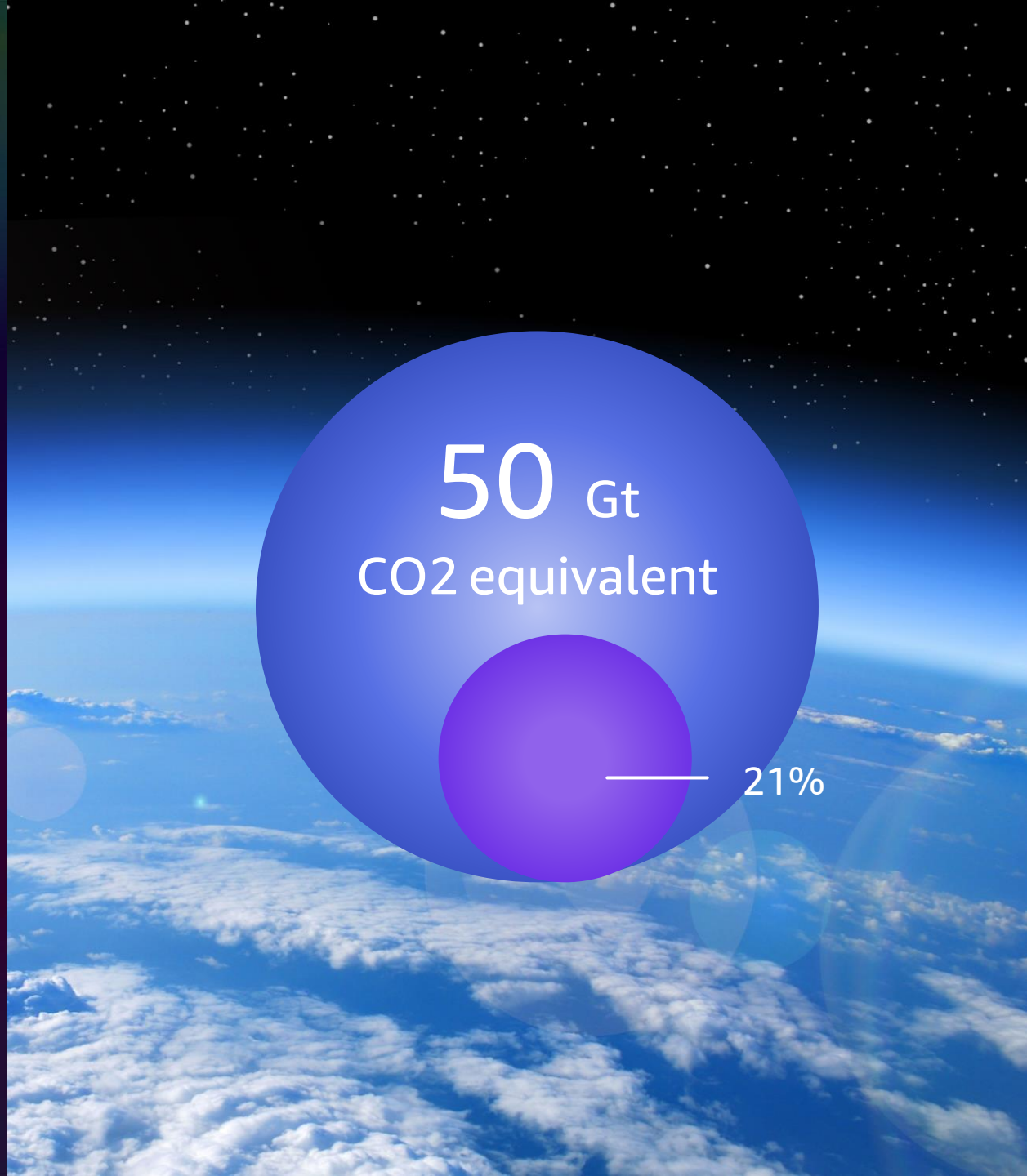
Greenhouse gases

Carbon dioxide

Methane

Nitrous oxide

Chlorofluorocarbons (CFCs)



https://www.wri.org/insights/4-charts-explain-greenhouse-gas-emissions-countries-and-sectors

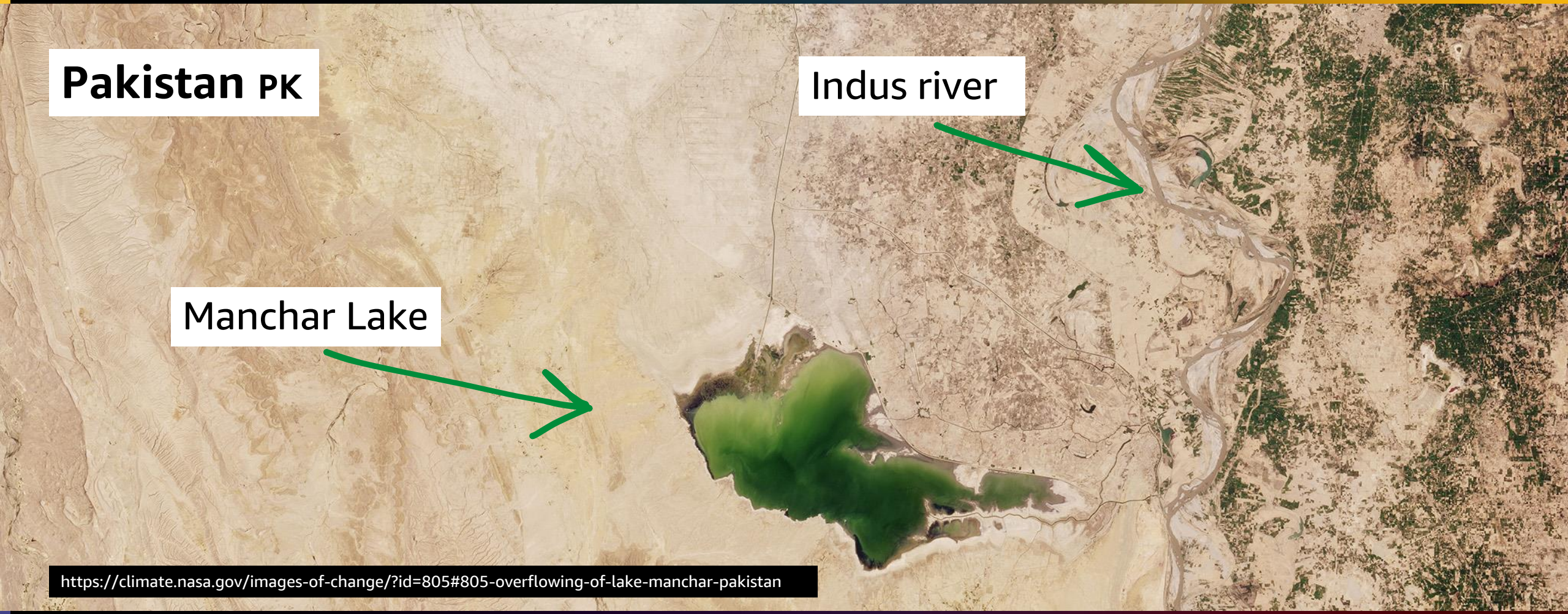
https://www.epa.gov/ghgemissions/overview-greenhouse-gases

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.


1 GT = 200M elephants x 10

Monster monsoon impacted 33M people



https://climate.nasa.gov/images-of-change/?id=805#805-overflowing-of-lake-manchar-pakistan

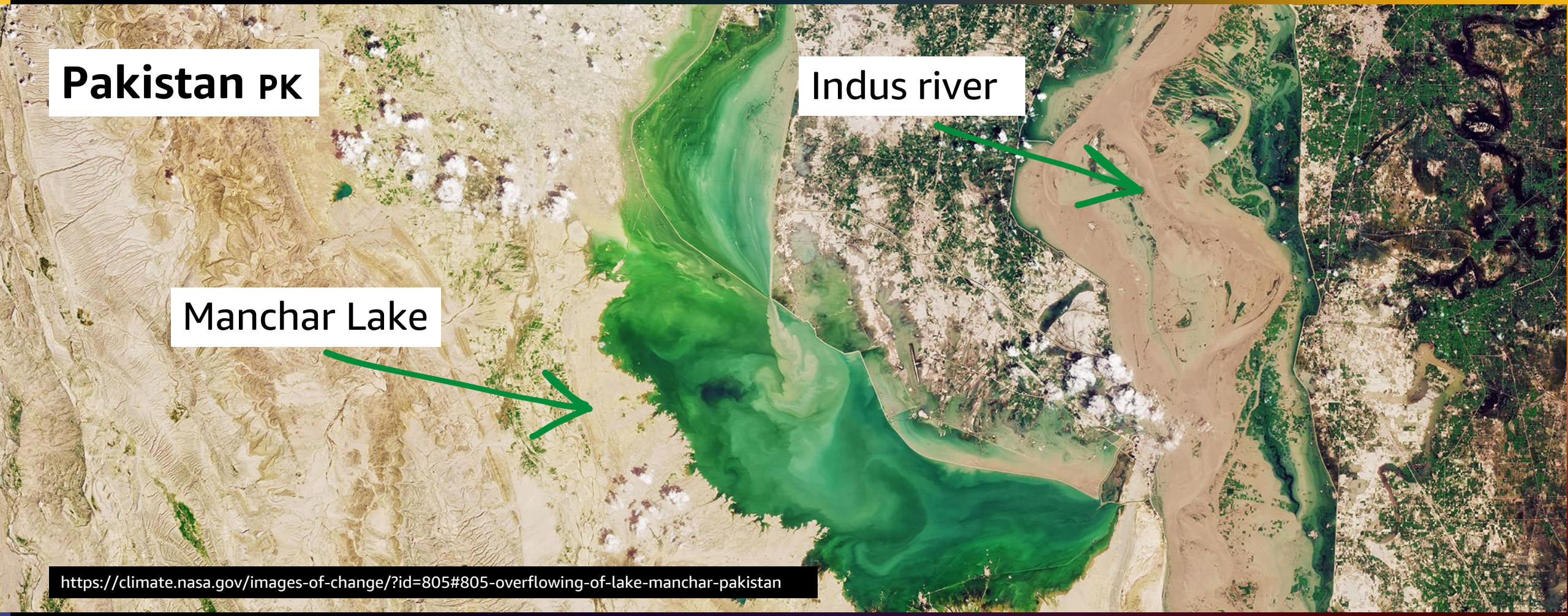
https://www.unicef.org/emergencies/devastating-floods-pakistan-2022

https://earthobservatory.nasa.gov/images/150306/lake-manchar-is-overflowing

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Monster monsoon impacted 33M people



https://climate.nasa.gov/images-of-change/?id=805#805-overflowing-of-lake-manchar-pakistan

https://www.unicef.org/emergencies/devastating-floods-pakistan-2022

https://earthobservatory.nasa.gov/images/150306/lake-manchar-is-overflowing

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

“Industrial activity in 2021 was directly responsible for emitting 9.4 Gt of CO2”

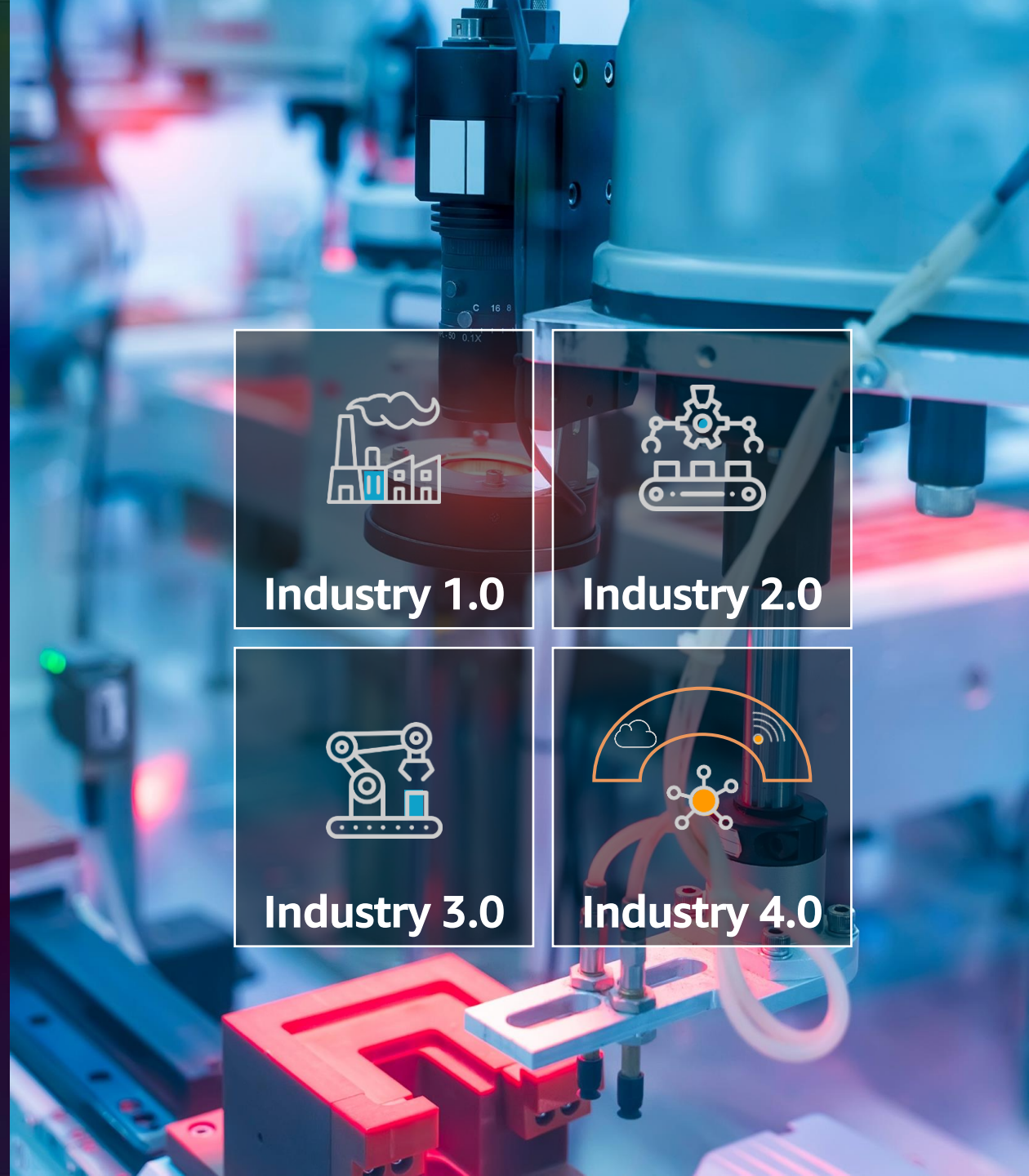
International Energy Agency

“Tracking report – Industry,” released September 2022
https://www.iea.org/reports/industry

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Manufacturers use data to improve insight

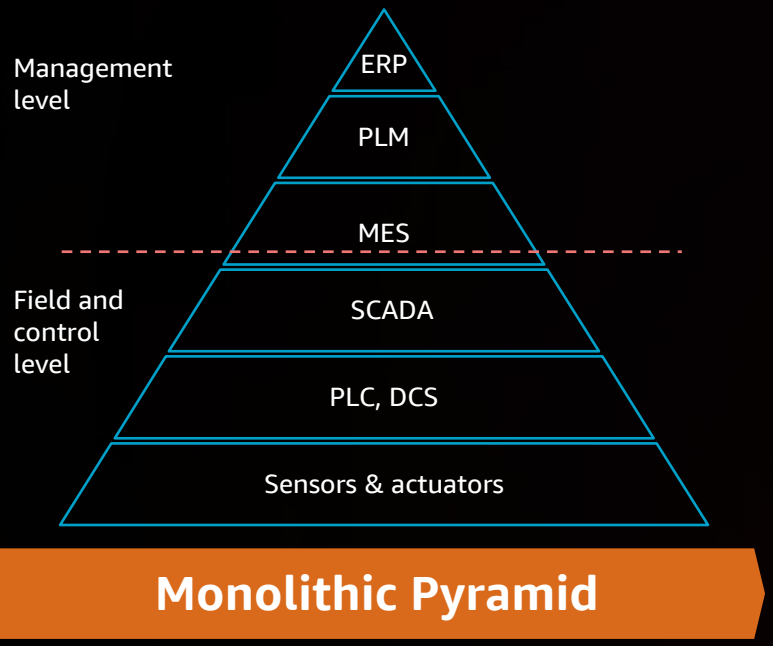
- Single view of operations
- Insight from hard-to-reach stranded data – OT
- Real-time inventory management
- Prescriptive maintenance
- Sustainability improvements
- and more . . .



aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Evolving ISA95 to transform

ISA95 - INTERNATIONAL STANDARD FOR ENTERPRISE AND CONTROL SYSTEMS INTEGRATION



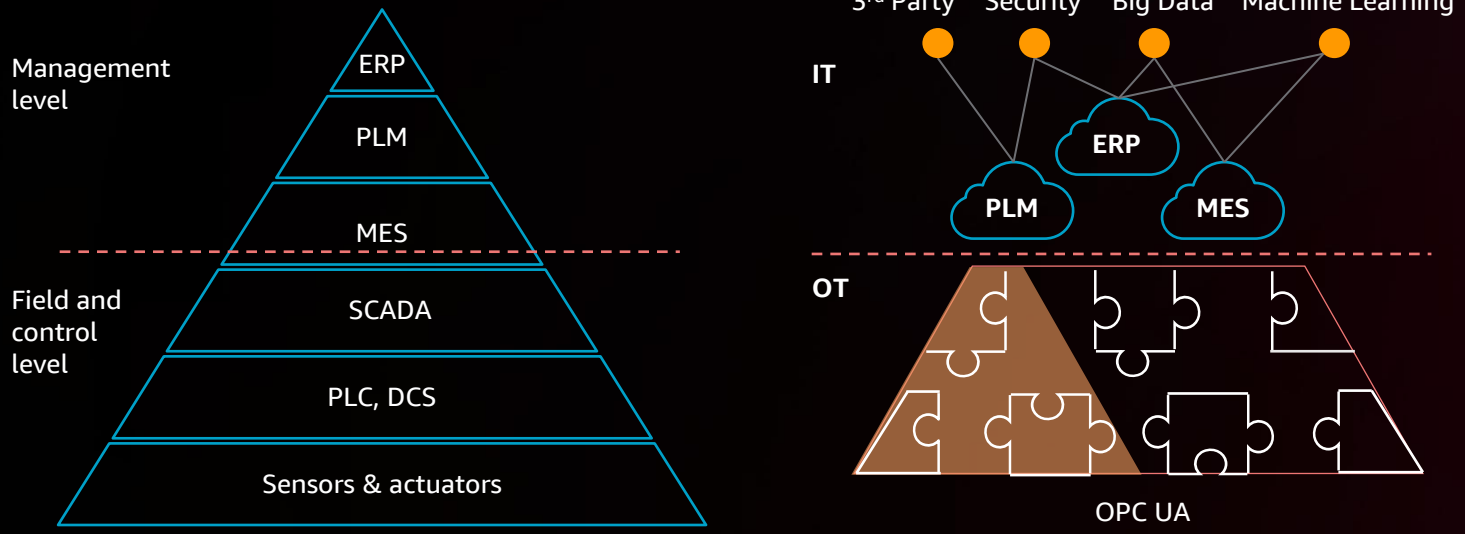
Monolithic Pyramid

- Standalone applications
- Data silos
- Poor upstream/downstream communication
- Disparate proprietary protocols

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Evolving ISA95 to transform

ISA95 - INTERNATIONAL STANDARD FOR ENTERPRISE AND CONTROL SYSTEMS INTEGRATION



Monolithic Pyramid

- Standalone applications
- Data silos
- Poor upstream/downstream communication
- Disparate proprietary protocols

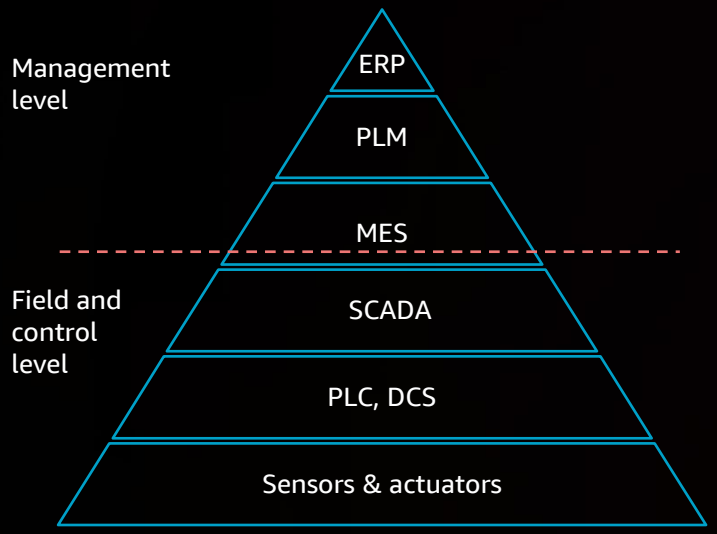
Converging IT and OT

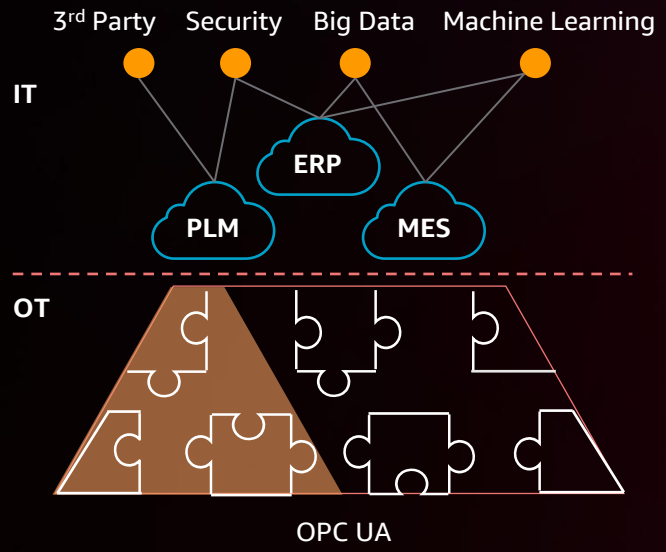
- Cloud computing revolutionized IT
- Flexible shop floor connectivity
- Descriptive protocols
- System integration

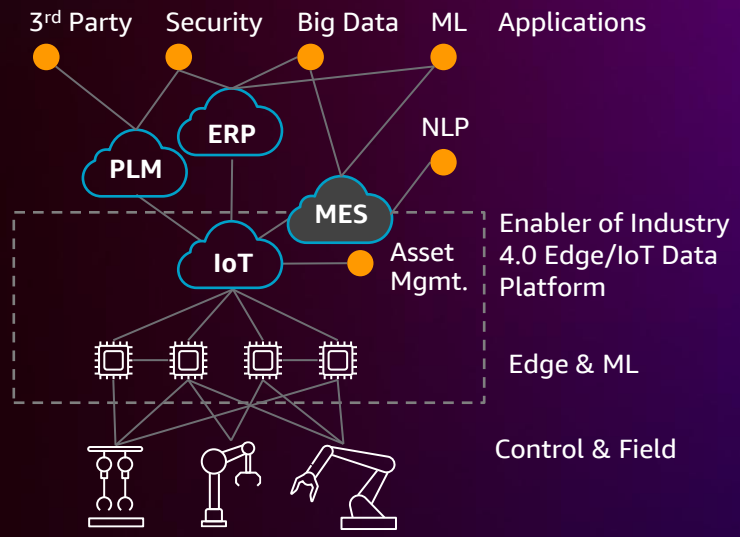
aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Evolving ISA95 to transform

ISA95 - INTERNATIONAL STANDARD FOR ENTERPRISE AND CONTROL SYSTEMS INTEGRATION







Monolithic Pyramid

- Standalone applications
- Data silos
- Poor upstream/downstream communication
- Disparate proprietary protocols

Converging IT and OT

- Cloud computing revolutionized IT
- Flexible shop floor connectivity
- Descriptive protocols
- System integration

Smart Factory

- IT–OT border is gone
- Any to any communication
- Data transparency
- Edge/Cloud hybrid model

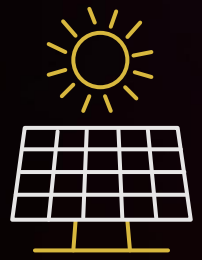
aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Sustainability and smart manufacturing



Improve the efficiency of buildings and equipment



Manage energy resources more efficiently



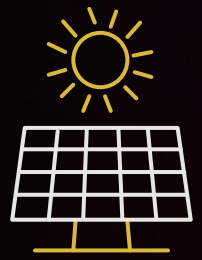
Monitor and reduce water and materials usage

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Sustainability and smart manufacturing



Improve the efficiency of buildings and equipment



Manage energy resources more efficiently



Monitor and reduce water and materials usage



Extend equipment life with predictive maintenance



Reduced waste through inventory management



Enhance safety on the factory floor

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

. . . but realizing value from data is challenging

Collecting data | **Taking action** | **Scaling**

Surveying manufacturing executives:

only 39%

Have successfully scaled data driven use cases

Data sources: World Economic Forum, Forbes

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

. . . but realizing value from data is challenging

Collecting data | **Taking action** | **Scaling**

Surveying manufacturing executives:

19%
Have not harnessed data insights

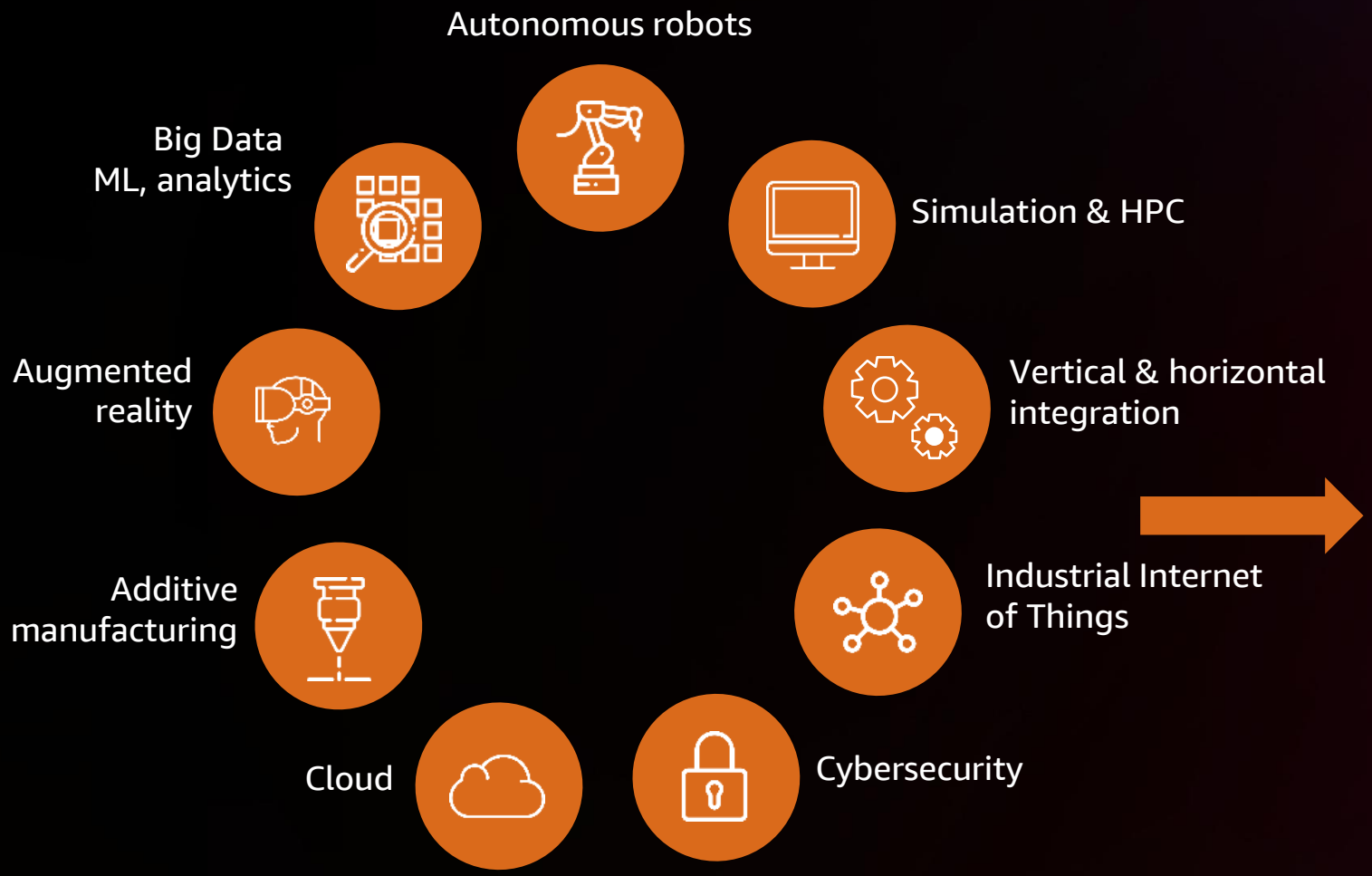
only 44%
Received actionable data from recent modernization

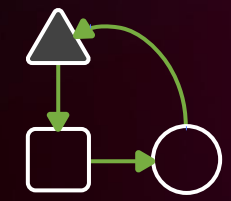
only 39%
Have successfully scaled data driven use cases

Data sources: World Economic Forum, Forbes

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

AWS drives smart manufacturing initiatives





Innovation and Automation



Utilize the scalability, reliability and portfolio of the cloud



Provide tight integration between OT & IT



Leverage skills and resources

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

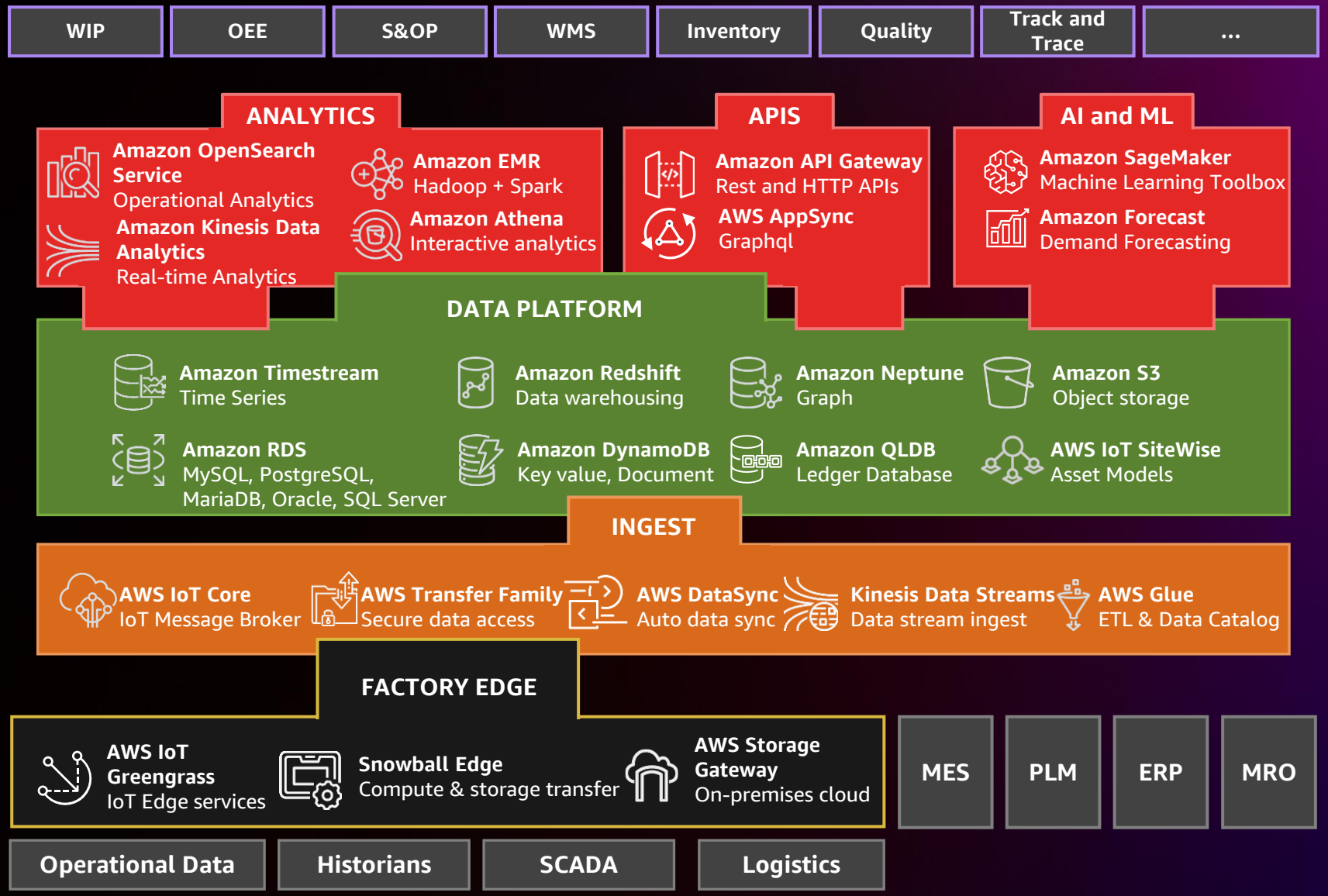
One way to manage is to extend data to the “industrial edge”

Industrial edge – a **compute** and **storage** platform within the four walls of a factory which extends **cloud services** to the shop floor environments



aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

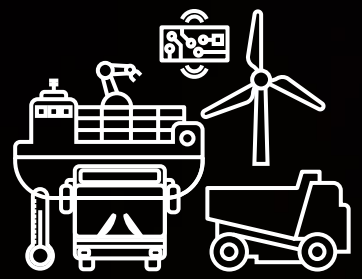
Industrial Data Platform



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Going a step further – Digital twins

Digital twin: A living **digital representation** of a **physical system** that is **dynamically updated** to mimic the structure, state, and behavior of the physical system to drive **business outcomes**



Physical systems

Connected world



Digital twins

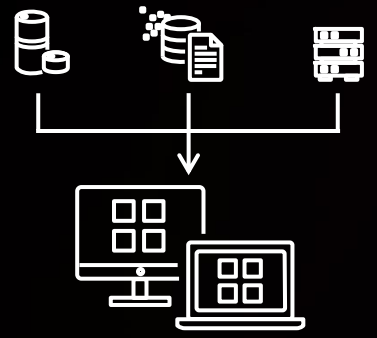




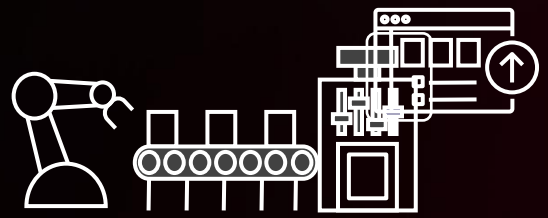
Business outcomes

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

However, building digital twins is hard



Use data from disparate sources



Model assets over their lifetime



Create effective visualizations

aws

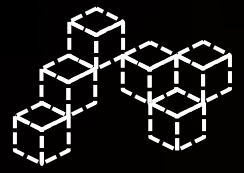
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Introduction to AWS IoT TwinMaker

OPTIMIZE OPERATIONS BY CREATING DIGITAL TWINS OF REAL-WORLD SYSTEMS



Access data no matter where it lives



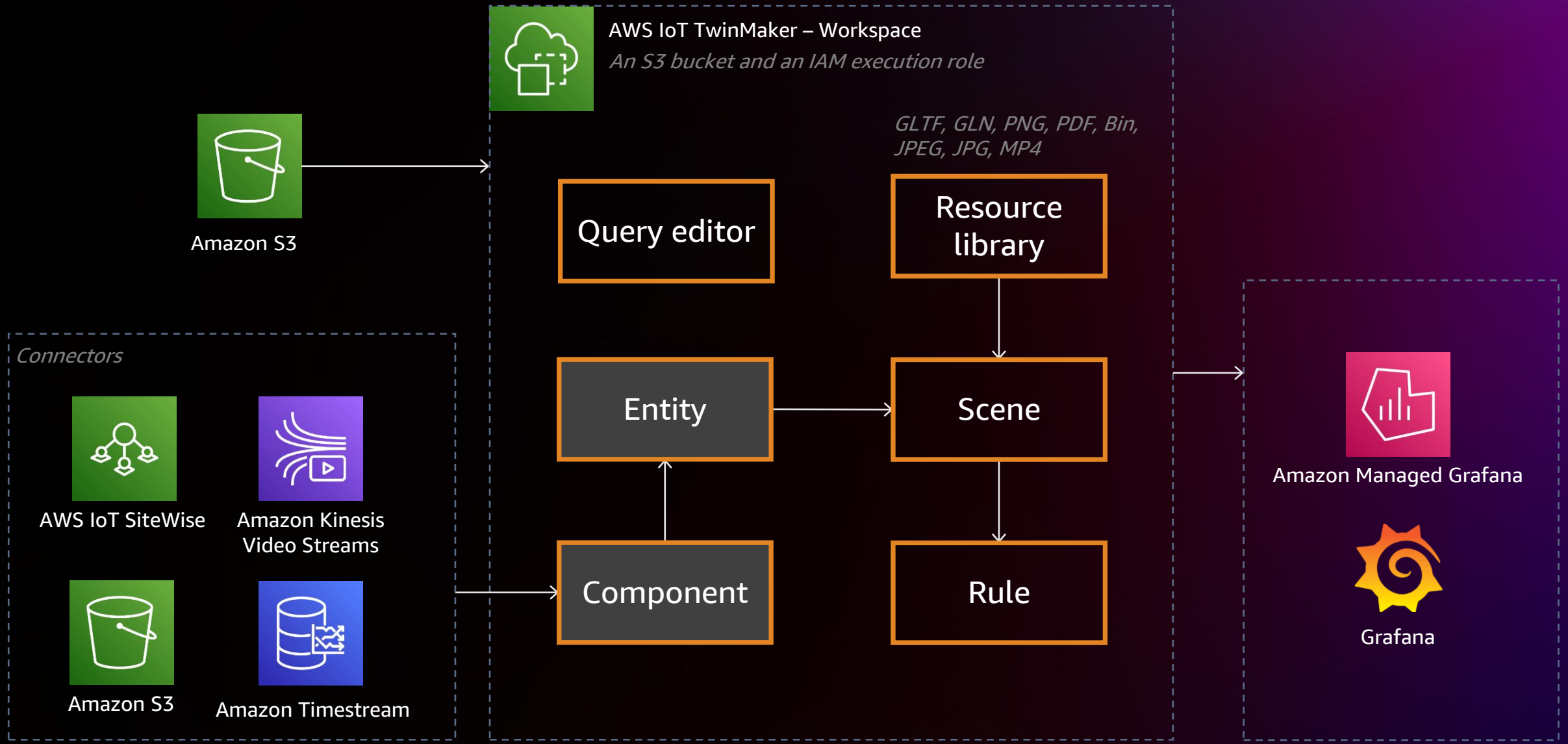
Accurately model your built environment



Create immersive 3D views of your operations

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

AWS IoT TwinMaker demo

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Get started with AWS IoT TwinMaker

AWS IoT TwinMaker now generally available!
https://github.com/aws-samples/aws-iot-twinmaker-samples

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

northvolt®

Northvolt uses AWS to design, build, and operate connected factories at scale



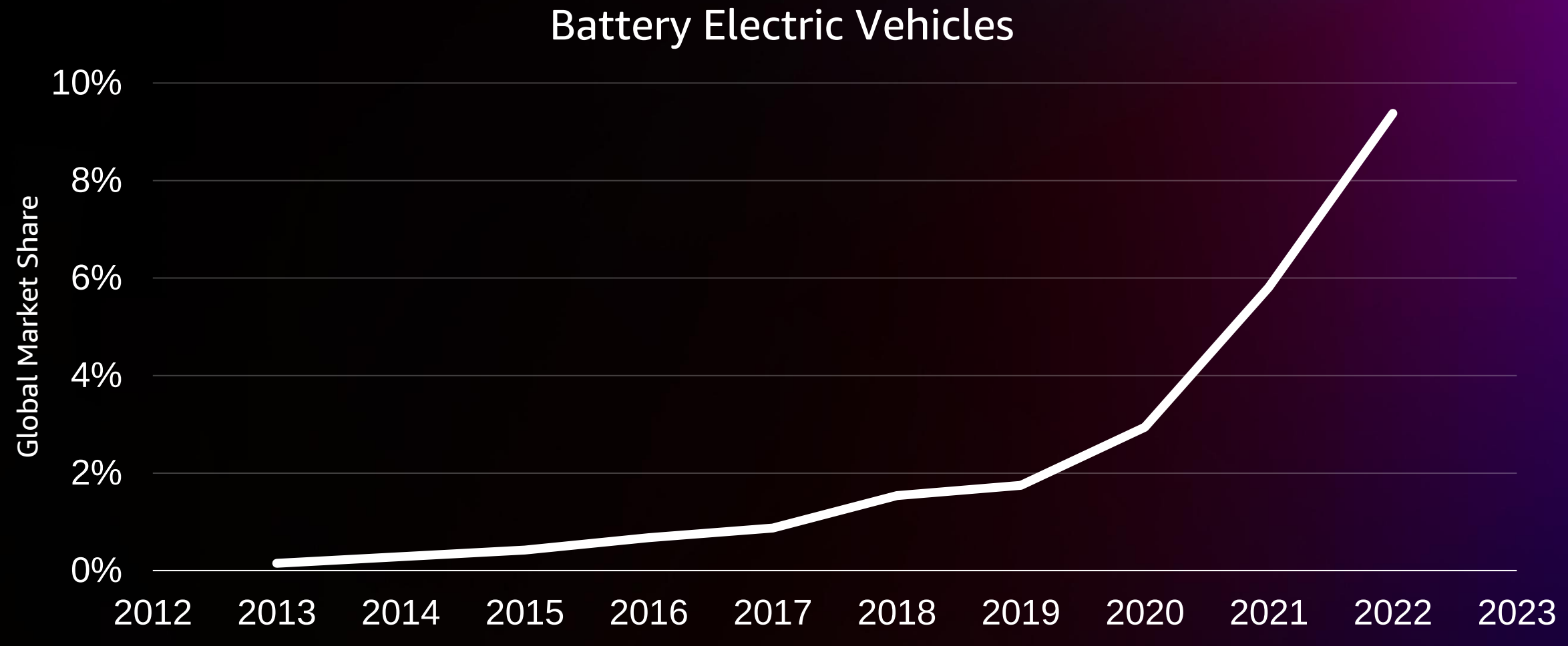
aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

northvolt®

Enabling the Future of Energy

Electric Vehicle Sales

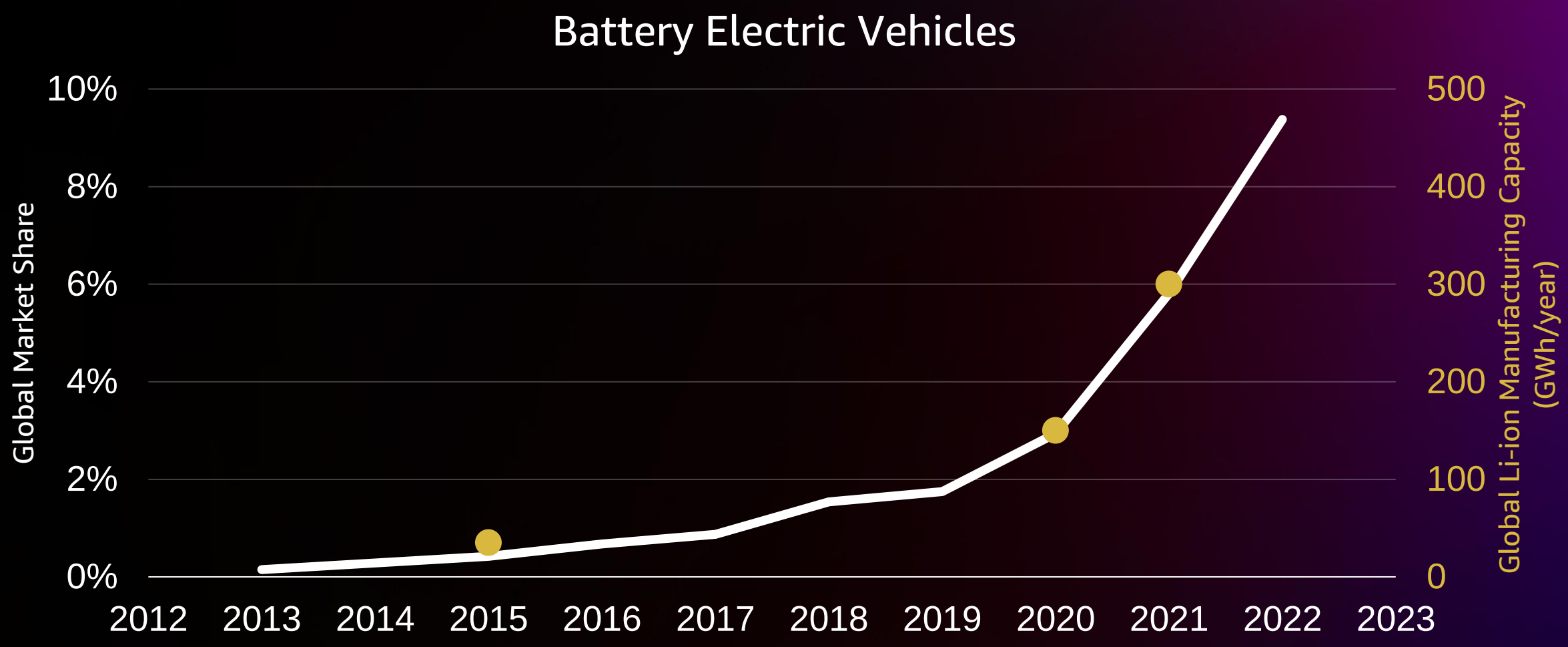


www.ev-volumes.com

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Electric Vehicle Sales

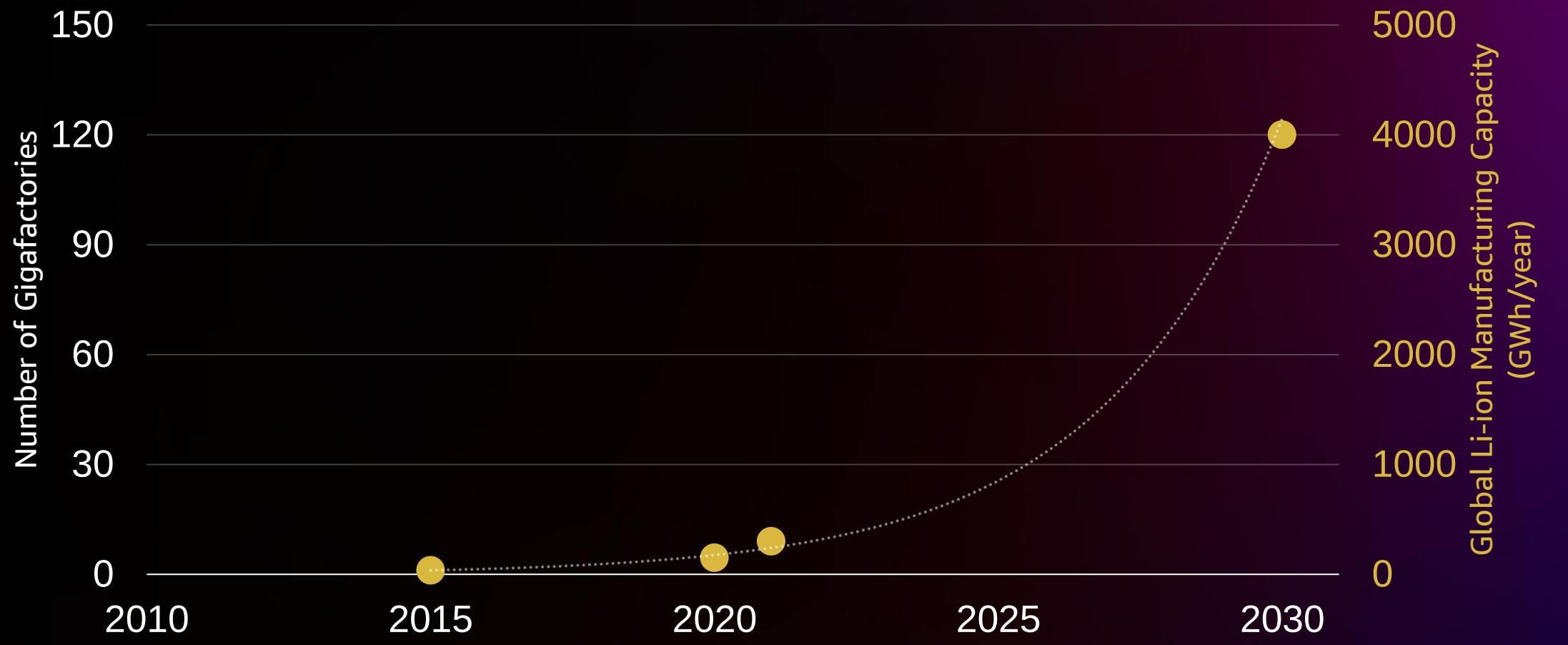


www.ev-volumes.com

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Global Li-ion Manufacturing Capacity



Benchmark Mineral Intelligence

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Northvolt Ett, Skellefteå, Sweden
European Giga-scale Li-ion manufacturing



Active Material

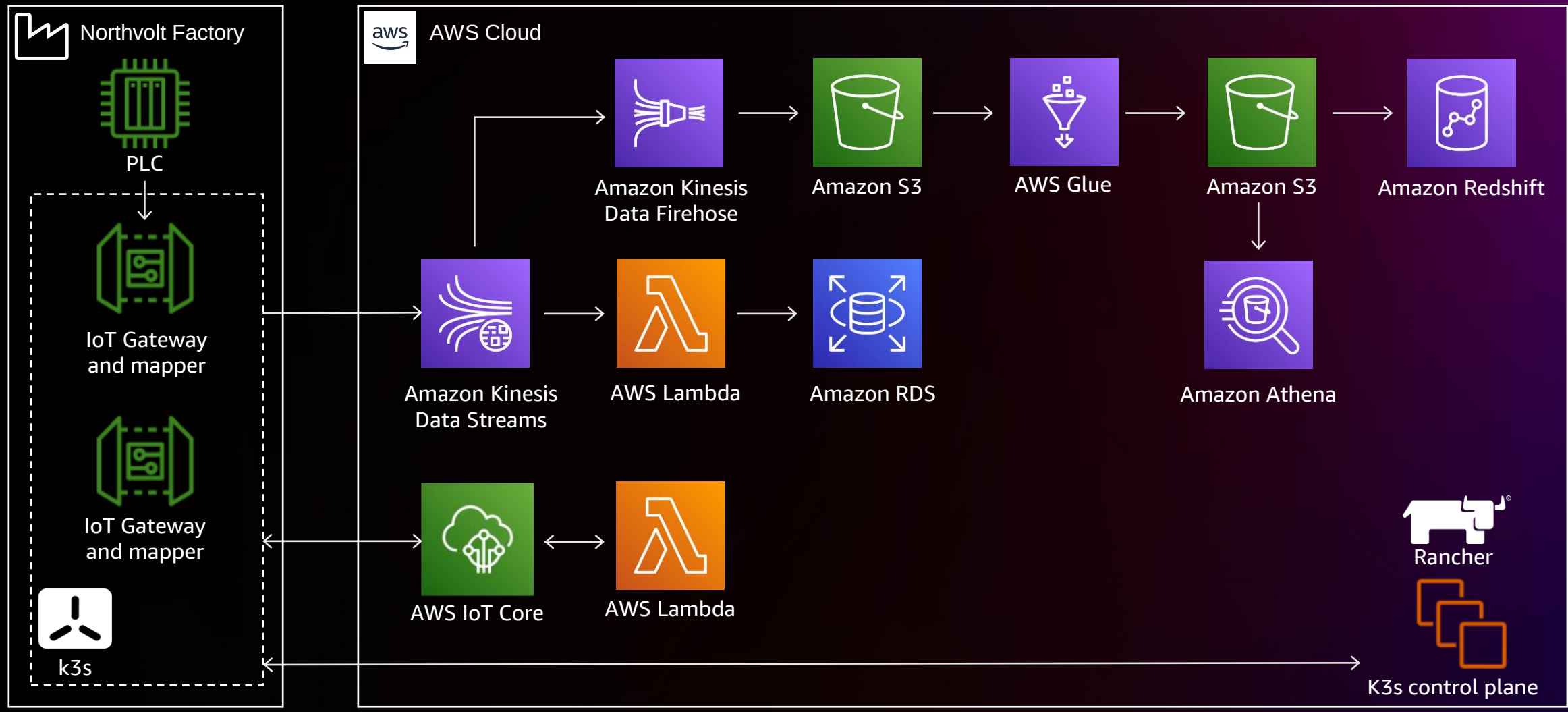
Cell Production

Pack Production

Battery System Operating Life

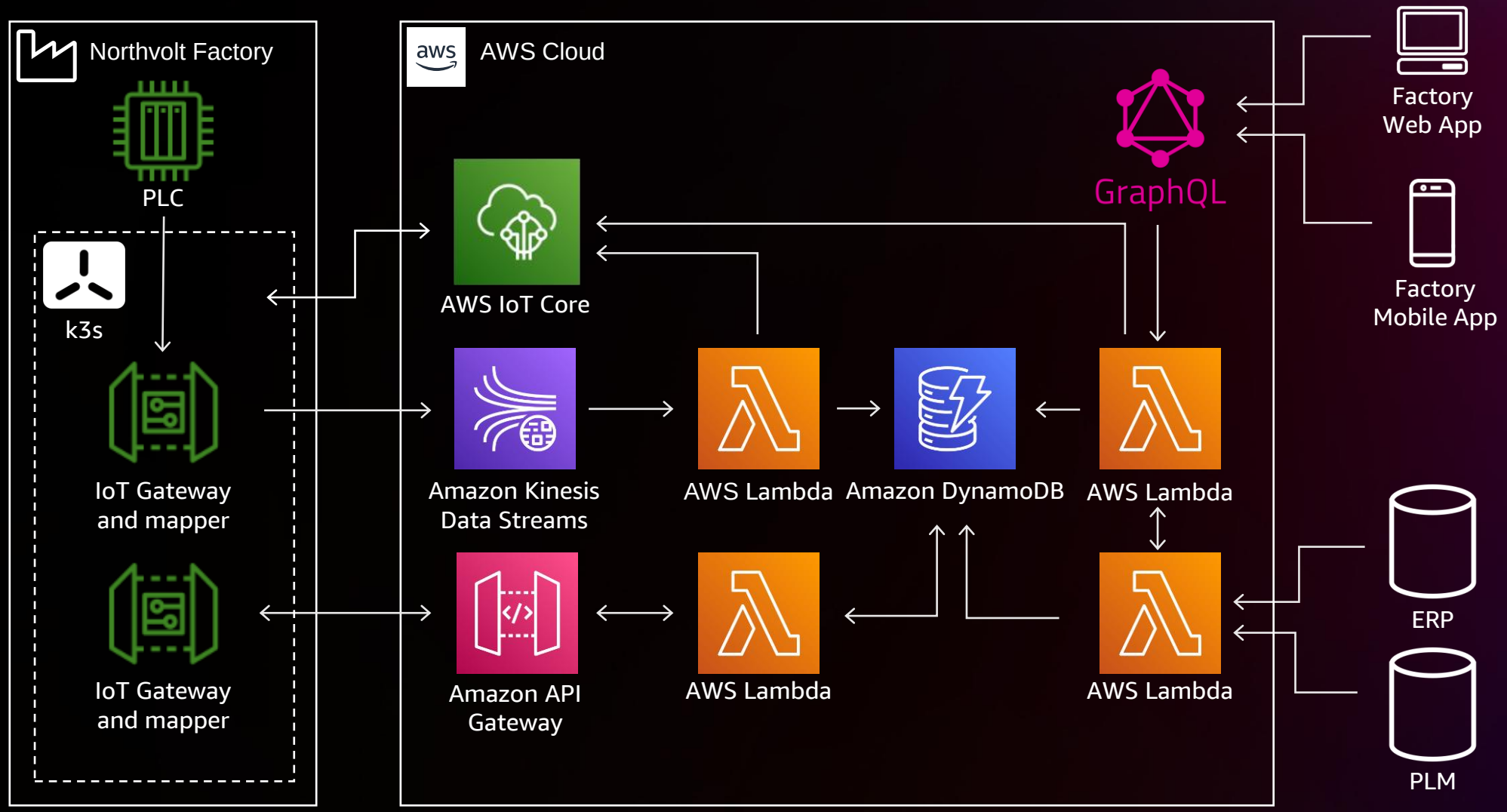
Recycling

Monitoring the factory



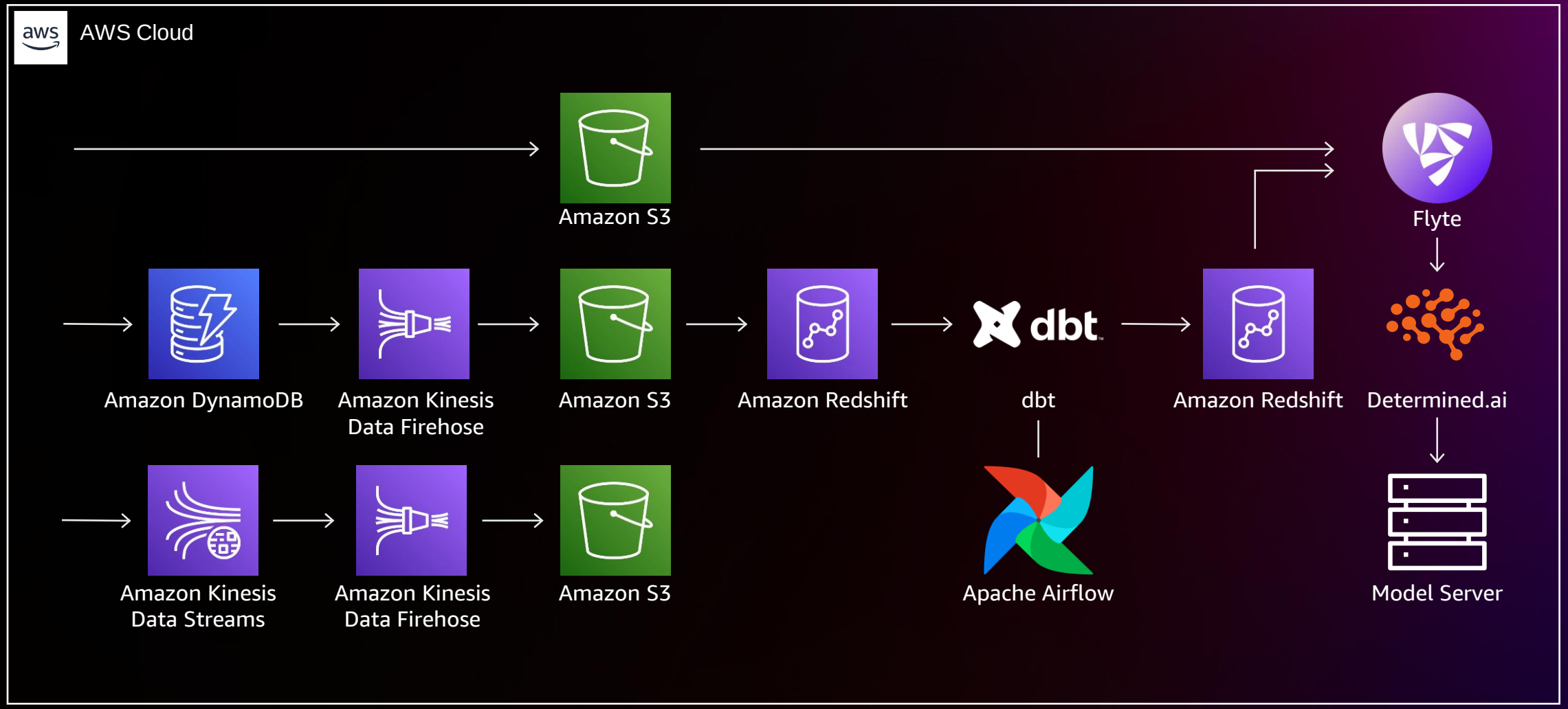
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Controlling the factory



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Data-driven factory



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Scalability strategy

GREENFIELD. CLOUD FIRST. SERVERLESS FIRST.



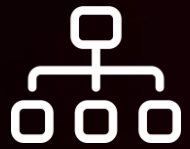
Reliability



Blast radius



Scalability



Modularity



Sustainability

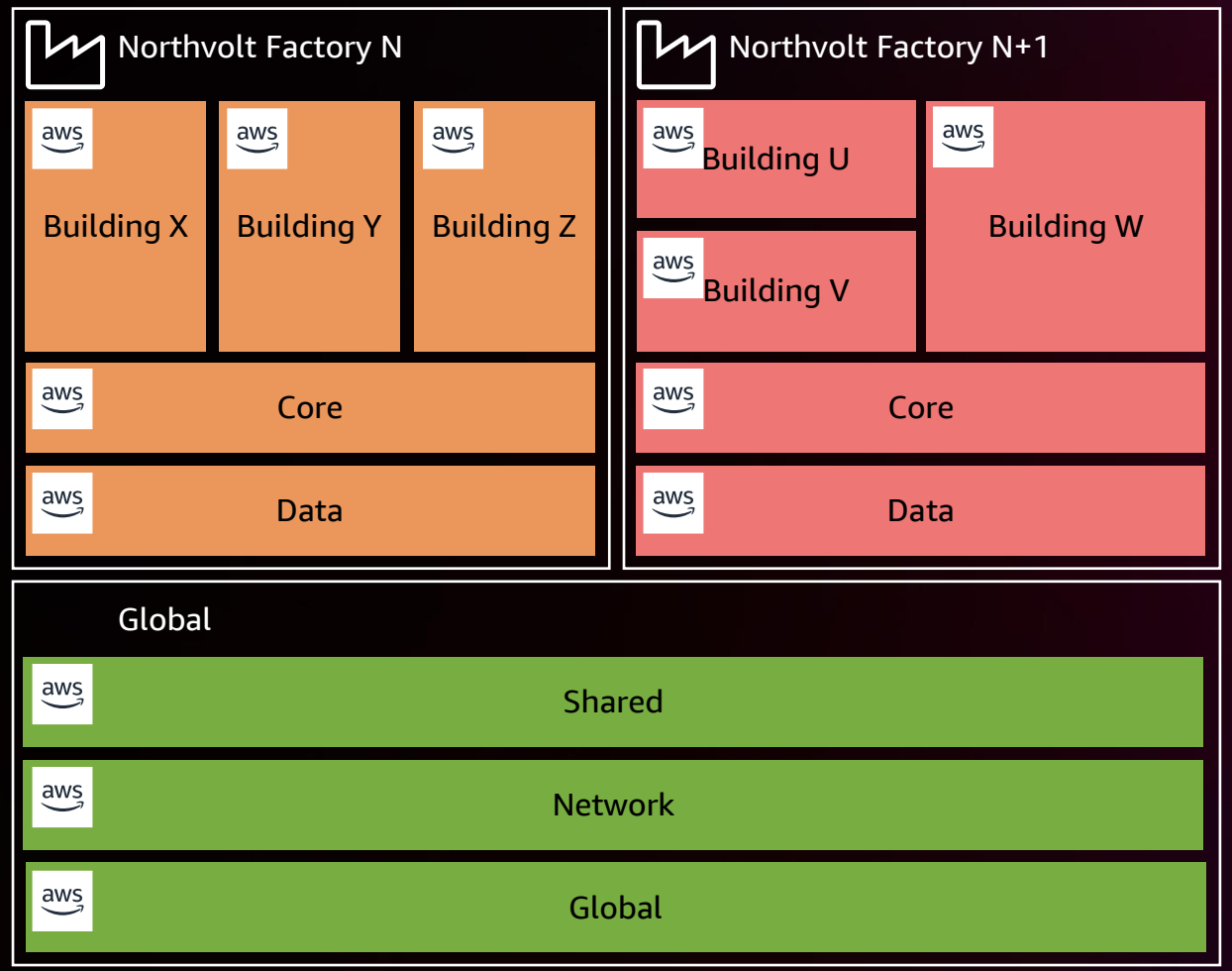


Rollout Flexibility

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Cloud Factory Modules



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Scalability vision

FACTORY AS CODE

```
$ terraform apply -target=factory-ett
```

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Unique collaboration between Northvolt and AWS

Working together to make a greener future by decarbonizing the energy





aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

What’s next?



Manufacturing simplifying digital transformation
https://aws.amazon.com/manufacturing/



AWS for Industrial
https://aws.amazon.com/industrial/



AWS enables sustainable solutions
https://aws.amazon.com/sustainability/



AWS Well-Architected Sustainability Pillar
https://docs.aws.amazon.com/wellarchitected/latest/sustainability-pillar/sustainability-pillar.html



The full Amazon sustainability report
https://sustainability.aboutamazon.com/reporting-and-downloads



Northvolt’s next-gen connected factory
https://aws.amazon.com/blogs/industries/northvolts-next-gen-connected-factory-a-digital-blueprint-factory-built-from-scratch/

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Sustainability breakout sessions

SUS204: Sustainability in AWS Global Infrastructure

SUS205: Architecting sustainably and reducing your AWS carbon footprint

SUS206: Sustainability and AWS Silicon

SUS208: Utilizing sustainability data at scale

SUS210: Modeling climate change impacts and risks at scale

SUS211: Water stewardship and renewable energy at scale

SUS212: Accelerating decarbonization & sustainability transformation

SUS301: Sustainable machine learning for protecting natural resources

SUS303: Delivering sustainable, high-performing architectures

SUS312: How innovators are driving more sustainable manufacturing

STP213: Scaling global carbon footprint management

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Sustainability workshops and chalk talks

SUS201: Detecting deforestation with geospatial images and Amazon SageMaker

SUS202: Using Amazon SageMaker, AutoGluon, and ASDI to predict air quality

SUS203: Carbon emissions reporting using modern data architecture on AWS

SUS207: Patterns for obtaining insights from sustainability data

SUS302: Optimizing architectures for sustainability

AER305: Use AWS IoT TwinMaker to easily create digital twins for aerospace uses

MFG302: Deep dive into architecting a factory of the future

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

“We must conserve what we still have, . . . restore what we’ve lost and . . . grow what we need to live, without degrading the planet for future generations”

Jeff Bezos

Amazon founder

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Thank you!

Muhammad Sajid
sjidmu@amazon.com
/in/musa
@sajid_nazeer

Marcus Ulmefors
marcus.ulmefors@northvolt.com
/in/ulmefors



Please complete the session survey in the **mobile app**

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.