AWS re:Invent

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

IOT201

Predicting equipment health with IoT in power and utilities

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Agenda

Introduction

P&U, predictive maintenance, business outcome

Dive deeper into current state, constraints, future options

AWS architecture options

Demo

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Who is this session for?



Business leaders



IT leaders and subject matter experts



OT leaders

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Business metrics

Process uptime

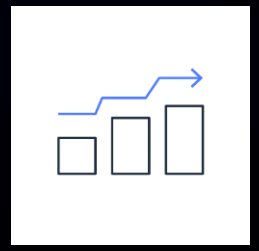


↑ 20%

Operations maintenance

Outage mitigation

Capital utilization



↑ 15%

Insights for max operational efficiency

Extend operational life

Operational expenses



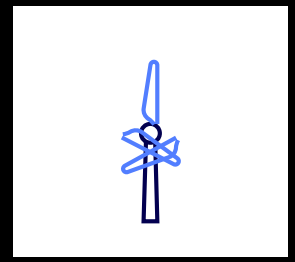
↓ 30%

Reduce operational breakdowns

Eliminate unplanned maintenance

Superior performance

Carbon footprint reduction



↓ 3%–4%

Regulatory compliance

Energy optimization

"Predictive Maintenance Market: The Evolution from Niche Topic to High ROI Application," IoT Analytics

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Industry challenges

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The challenges

- Aging networks with reliability metrics set by regulatory bodies
- Challenge of bending the O&M curve downward
- Improving uptime and reliability
- Propagation of DERs and two-way flow of energy
- Climate change impacts – short-term and long-term
- Achieving sustainability goals

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Grid resiliency is a priority

$100B+

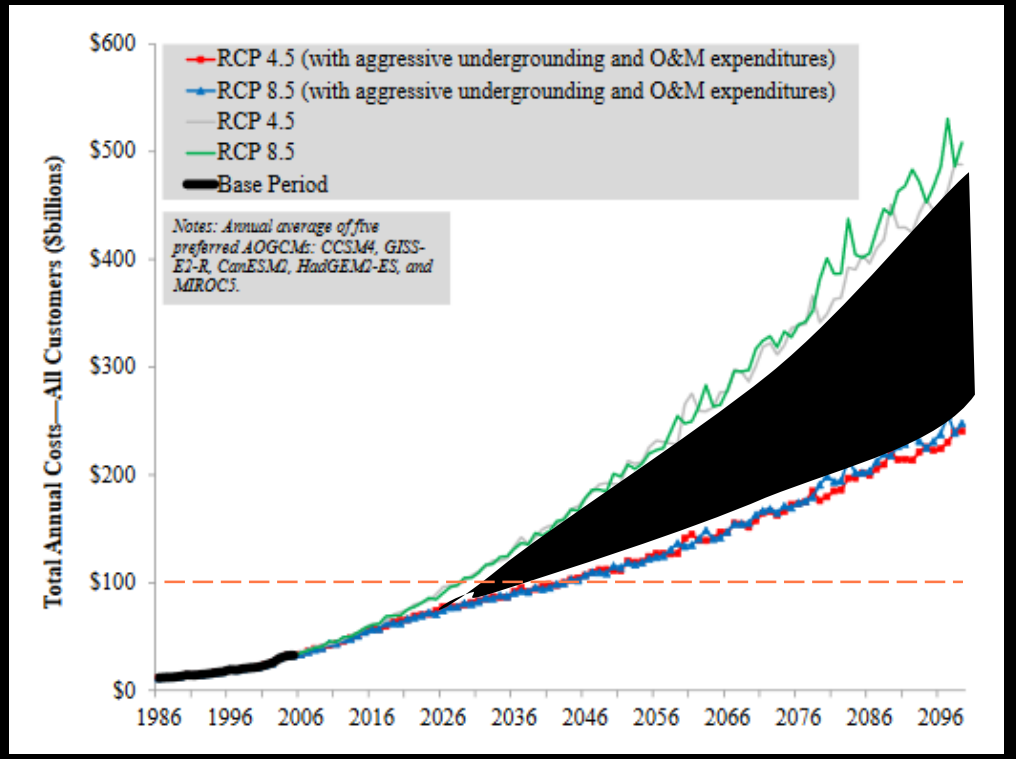
Cost of electrical outages to the US economy on track to exceed $100B[1]

29.7%

Of major electricity disturbances caused by **equipment failure** in the US (2012–2016)[2]

10+ years past life

Many parts of transmission and distribution networks were constructed 60–70 years ago with 50-year life expectancy of equipment



RCP – representative concentration pathways

[1] "Projecting Future Cost to U.S. Electric Utility Customer from Power Interruptions," Lawrence Berkley National Laboratory, January 2017, (LBNL – 1007027)
[2] DOE, EIA, and Rhodium Group analysis

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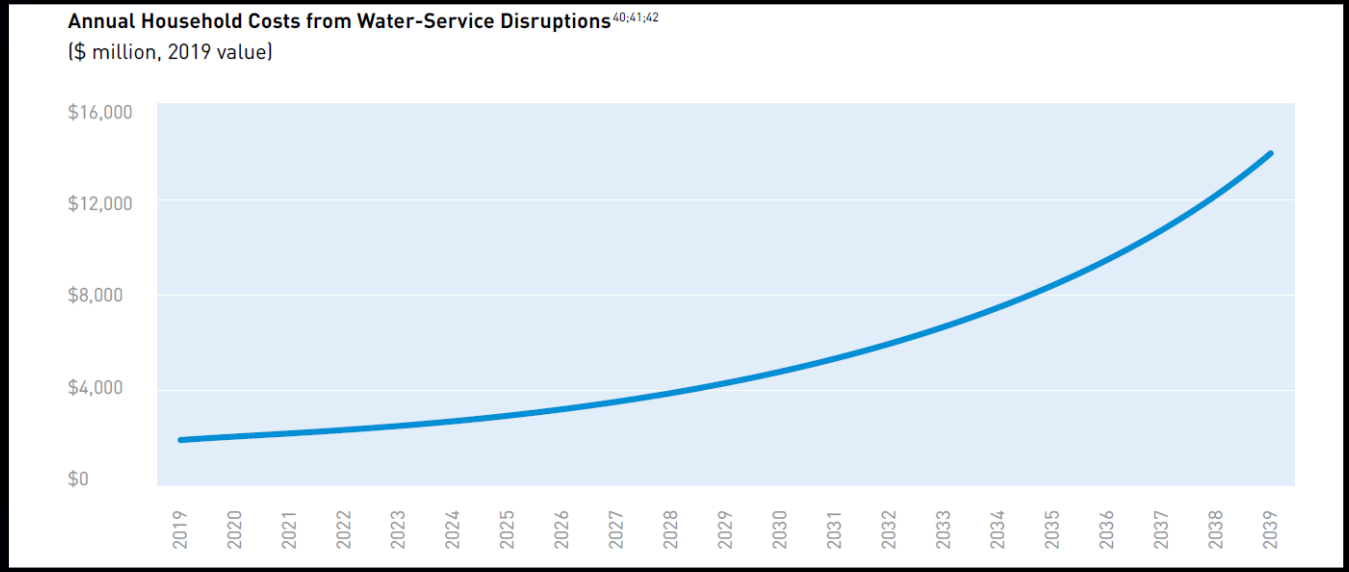
Aging water assets are a major problem

300,000

Water main breaks a year in the US, a rate of one every 2 minutes

2,100,000,000,000

Gallons of water lost each year due to leaks in the US, resulting in a **$7.6B** loss due to water leakage



Source: www.asce.org

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Utility challenges in optimizing assets



1. Limited visibility into asset performance

Operational data can be trapped in silos; lack of single source of truth



2. “Firefighting” vs. strategic improvement

Higher cost of reacting to unexpected failures and outages



3. Graying workforce & knowledge gap

Decades of experience in managing infrastructure moving toward retirement

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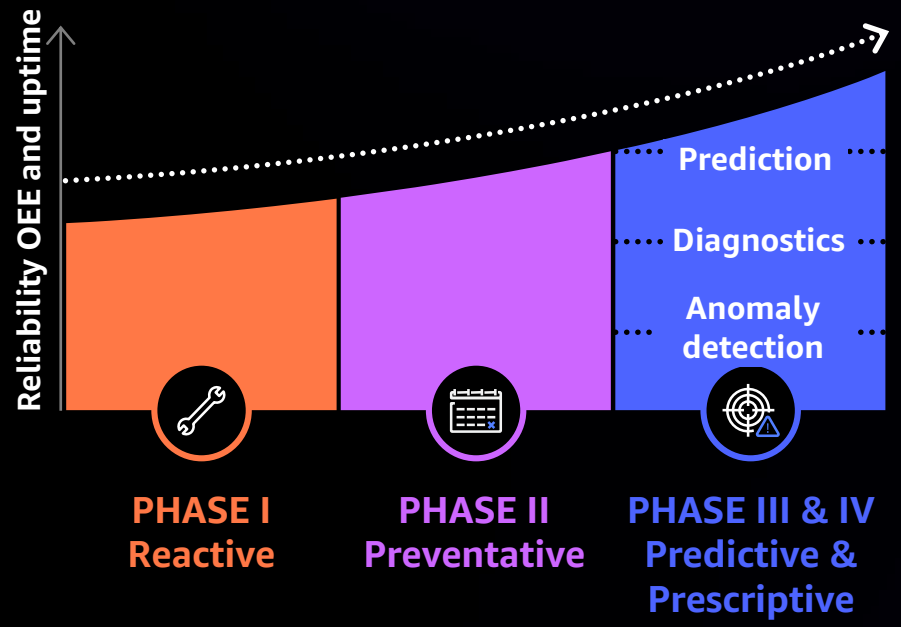
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Case for predictive maintenance

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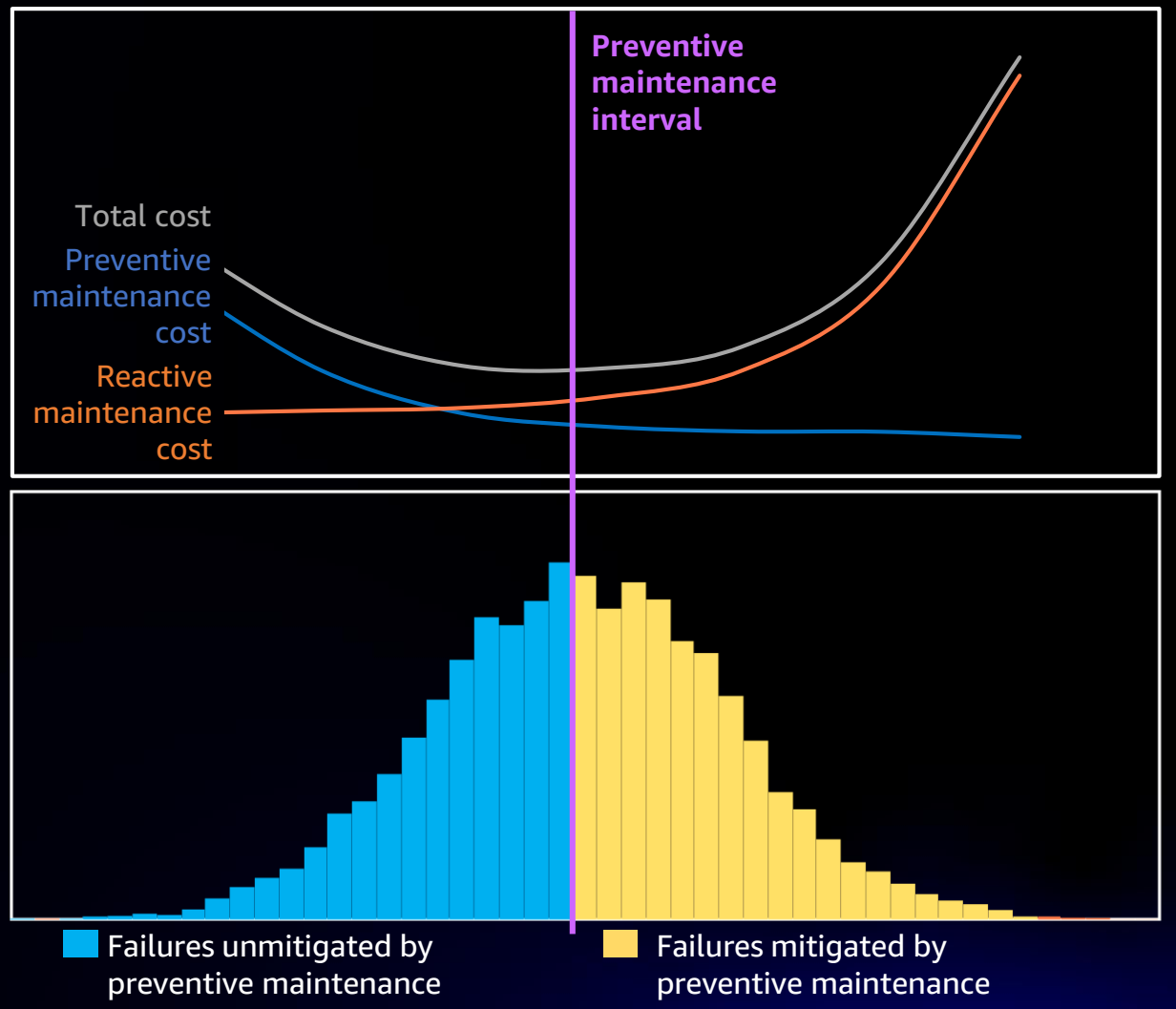
Journey to data-driven operations

Customer are moving away from reactive and planned maintenance approaches . . .



. . . to data-driven operations

Source: Deloitte



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Predictive asset health drives high ROI

Reactive/run to failure

Assumed to be lowest cost for maintenance department

Actually, highest cost for the company when enterprise costs and penalties are considered

Preventative maintenance

8%–12% cost reduction

Based on assumption that failure curves allow proactive (time-based) actions to prevent failure

Reality is that 82% of grid equipment failures are based on a random pattern

Predictive and prescriptive maintenance

30% cost reduction

30%–45% reduction in downtime

75% reduction of breakdowns

Most utilities operate in one of these two modes

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Woodside avoids costly gas plant issues using 200,000 IoT sensors running on AWS

Challenge

Woodside owns and manages gas plants around the world

In order to improve maintenance efficiency, the company wanted to use its plants' sensors to predict maintenance needs and help avoid issues that can shut down the plant for weeks or months

Solution

Woodside scaled up to activate 200,000 IoT-based sensors in the AWS Cloud

Benefits

- Scaled with the flick of a switch
- Runs **6,000 analytics models and 3 million daily** calculations
- Monitors equipment and enables **preventative maintenance** before major issues occur

"When I started, we had a culture of technology evolving over years; now it's months and down into weeks. It has had such a positive impact on what traditionally was a heavy industry, to one that's **pushing the boundaries of IoT and making a difference**."

Shaun Gregory, Senior Vice President and CTO, Woodside

Company: Woodside

Country: AU

Number of employees: 3,500

Website: woodside.com.au

About Woodside

Woodside is Australia's largest oil and gas company with a global presence.

Smart energy metering

Challenge

Enel was looking to manage network distribution at the edge

They were seeking to collect sensor and meter data over 500,000 cabins distributed across the territory to measure energy consumption, monitor network behavior in real time, and track effects of seismic waves and earthquakes

Solution

Enel implemented AWS IoT Greengrass to collect, convey, and process the largest amount of data to trigger actions, govern activities, respond to anomalies, and promote new services

Benefits

- The project is the **widest so far in Europe** and provides Enel an opportunity to use data to design a better future
- Provide accurate **15-minute consumption readings** to end customers
- **Process large amounts of data to trigger actions, govern activities, respond to anomalies, and promote new services**

“AWS provides us with an environment where these projects will flourish. We want to foster creation of a platform where our energy management systems can grow and interact with each other. The idea is **to provide an environment that makes us learn quickly**.”

Fabio Veronese, Head of Technology Services, Enel

Company: Enel, Inc.

Country: Global

Number of employees: 65,000+

Website: https://www.enel.com/

About Enel

Enel, an Italian multinational manufacturer and distributor of electricity and gas, operates in more than 30 countries.

Innovyze brings real-time water operations and analytics to their customers with AWS

Challenge

Utilities need solutions to help them **monitor system performance, understand where they are losing sellable water, and track system events and disruptions to ensure they are meeting consumer demand and operating at peak performance**

Solution

Innovyze implemented a technology stack based on AWS, including AWS IoT Greengrass, IoT, and AWS IoT Core, along with AWS-based third-party tools like Snowflake, to better serve their customers

Their Info360.com SaaS solution provides water utilities with business intelligence and operational decision support, giving users the ability to solve the daily operational challenges of water distribution and collection networks

Benefits

- Save water utilities up to **20% in operating expenses** through effective insight and analytics delivered through AWS
- Fully scalable solution requires minimal utility IT investment
- Utilities reduce **water loss up to 20%**
- Utilities gain a proactive and predictive approach to making operational decisions, **increasing efficiency and reducing risk**
- Solution minimizes impacts of planned or unplanned system maintenance

"Info360.com marks a significant uplift in our technological capabilities by accessing the many benefits of AWS. Partnering with AWS is enabling us to deliver the industry's most robust, flexible, and scalable solutions to water utilities so they can efficiently and reliably meet the water needs of their communities."

Rick Gruenhagen, CTO, Innovyze

Innovyze®

Company: Innovyze, Inc.

Country: Global

Number of employees: 200+

Website: www.innovyze.com

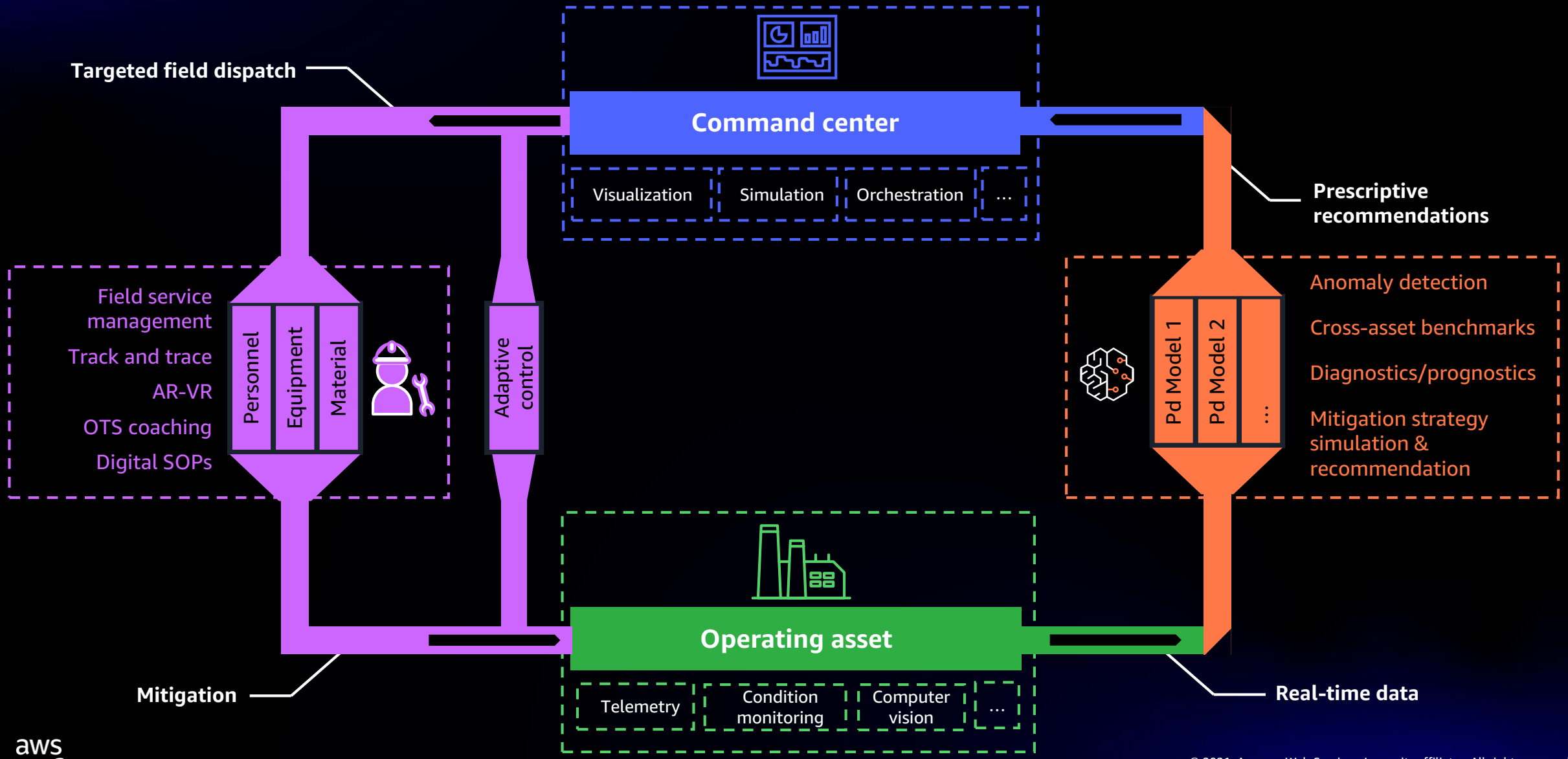
About Innovyze

Innovyze is a global leader in building innovative, industry-leading software for the water industry for over 35 years.

Solution vision

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Art of the possible



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Predictive maintenance: Data gathering

DATA GATHERING → DATA PROCESSING & PREPARATION → ML INTELLIGENCE → TAKE ACTION



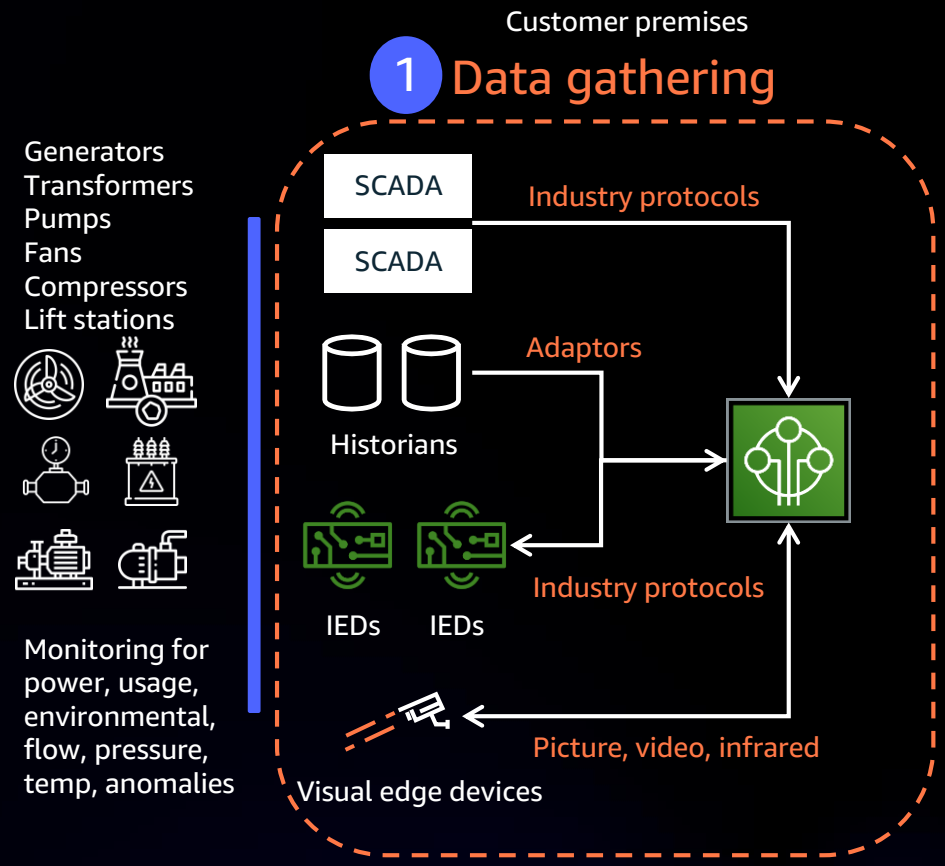
PLC/SCADA systems/historian



Sensor data (Any sensors)



Industrial data acquisition systems



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Predictive maintenance: Data gathering

DATA GATHERING → DATA PROCESSING & PREPARATION → ML INTELLIGENCE → TAKE ACTION

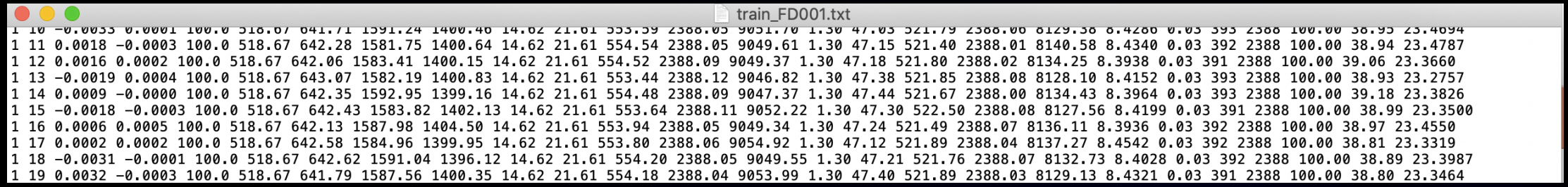
- Time series data from fans
- Different degrees of initial wear and manufacturing variations (normal, not a fault condition)

- 3 operational settings which could affect performance
- Contaminated with some sensor noise
- Varying conditions and fault modes

Hardware
AWS-qualified devices from AWS Partners, such as OnLogic, ADLINK, Lenovo, Advantech, and more

Software
AWS IoT Greengrass

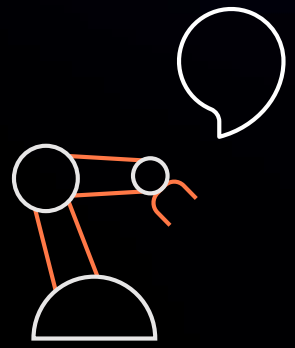
Application code
Ignition drivers, Kepware drivers, or other OPC-UA drivers and adapters



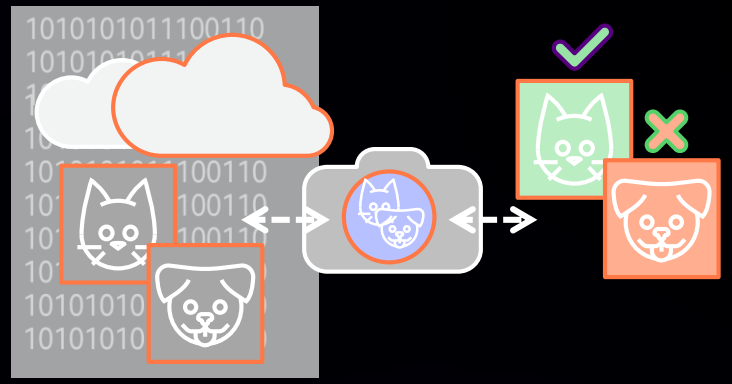
Sample: Turbofan dataset from NASA, https://data.nasa.gov/dataset/Turbofan-engine-degradation-simulation-data-set/vrks-gjie

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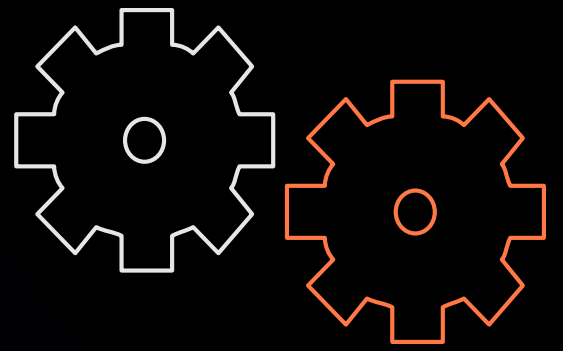
AWS IoT Greengrass provides 3 core use cases



Local actions &
remote control



Machine learning
inference



Extract,
aggregate, load

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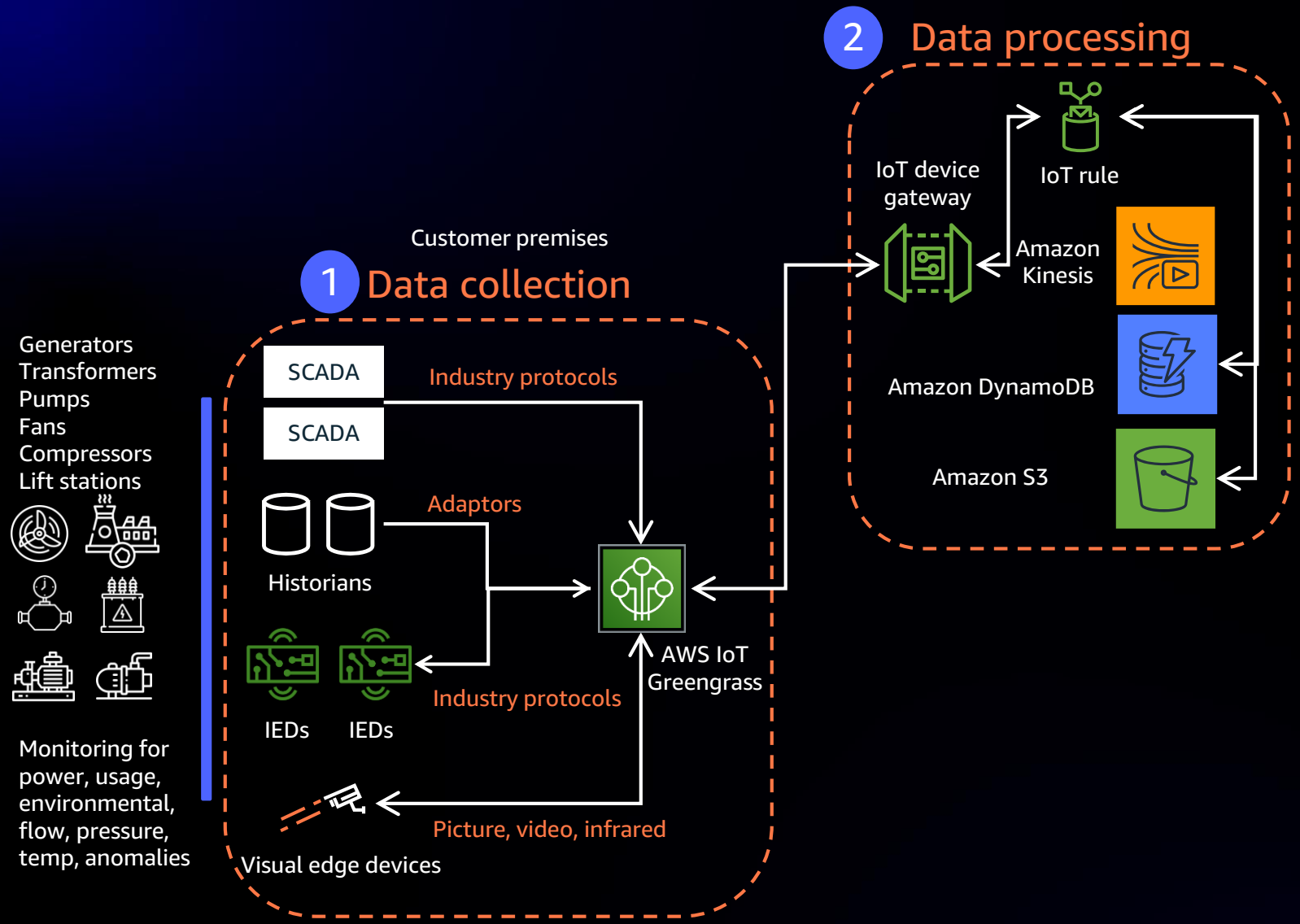
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Predictive maintenance

DATA GATHERING → DATA PROCESSING & PREPARATION → ML INTELLIGENCE → TAKE ACTION

- Edge data processing using AWS IoT Greengrass and local time series database
- Batch data transforms using Lambda
- Varying asset operation states – batch data since its last process

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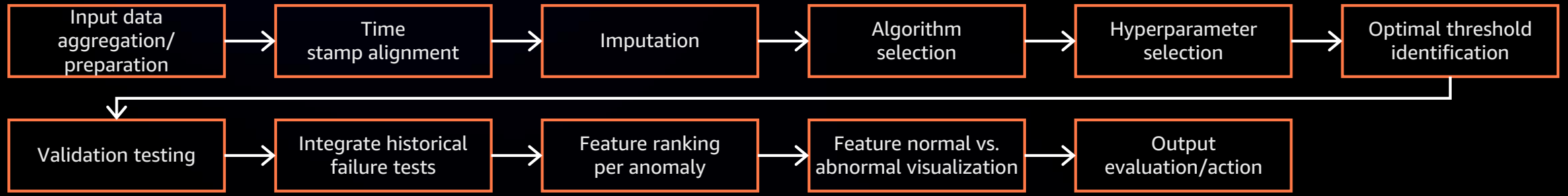


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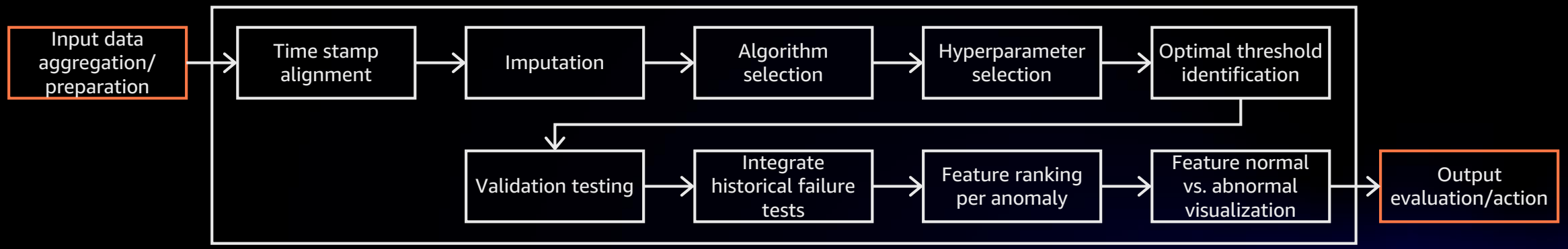
Predictive maintenance

DATA GATHERING → DATA PROCESSING & PREPARATION → ML INTELLIGENCE → TAKE ACTION

Typical ML workflow steps

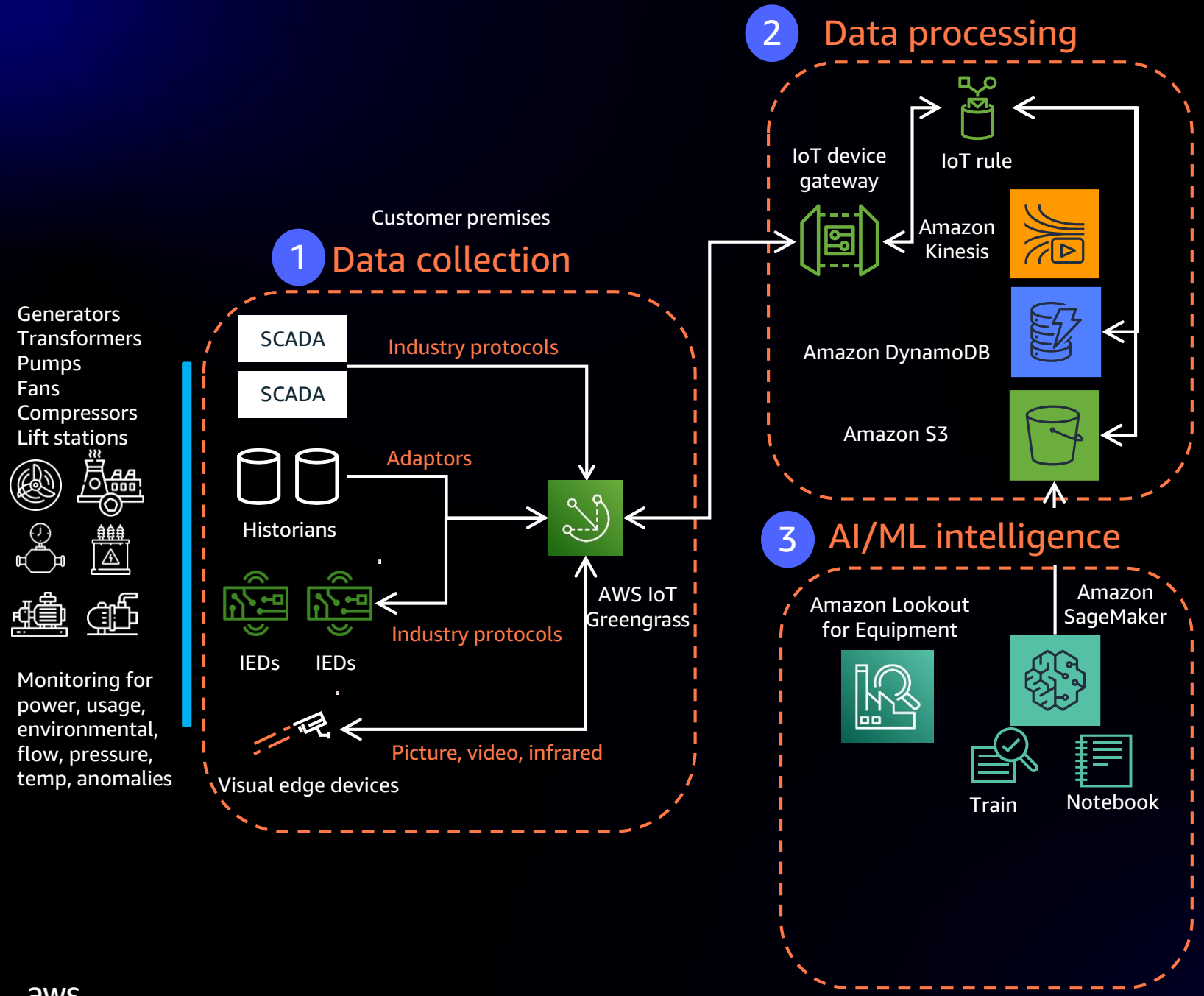


Amazon Lookout for Equipment



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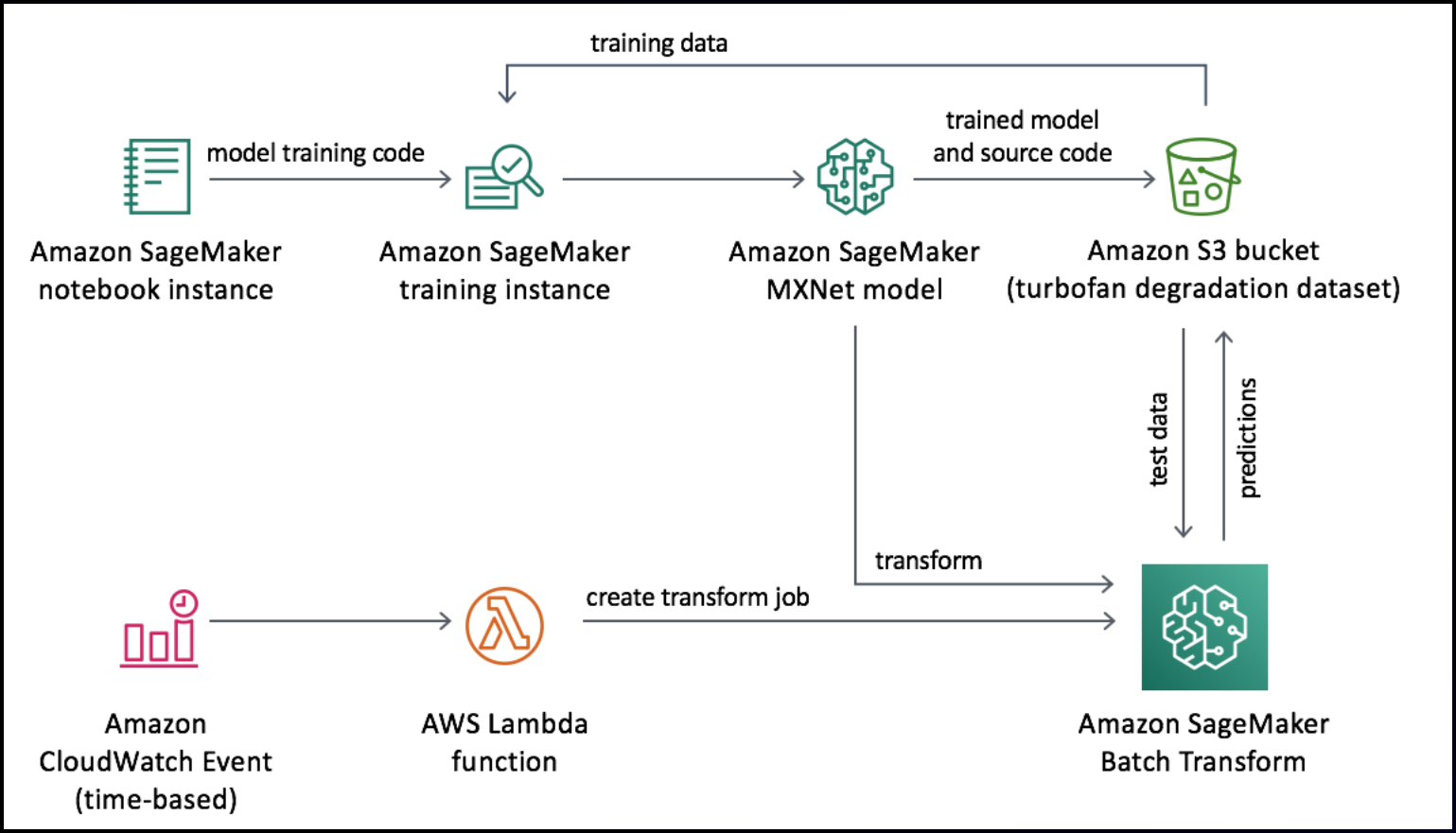
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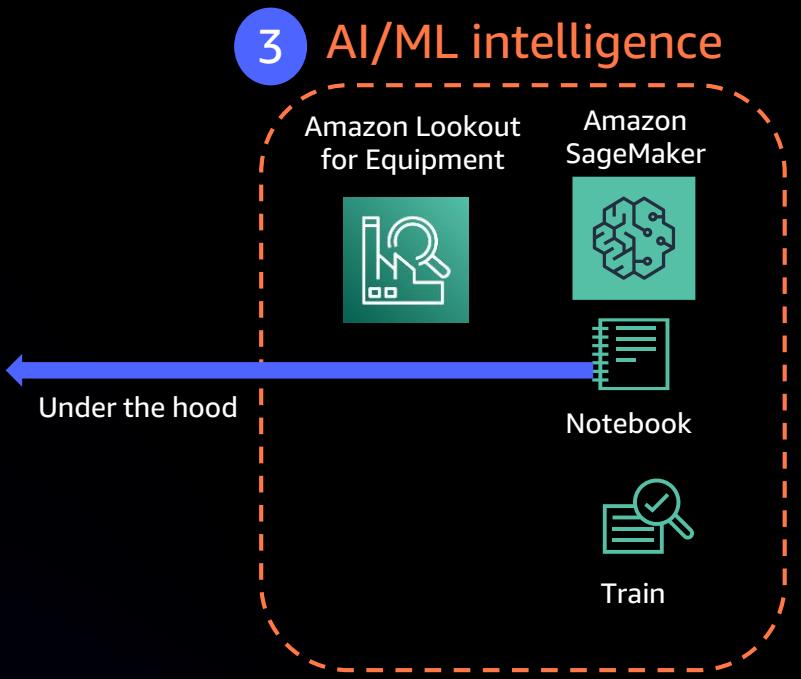


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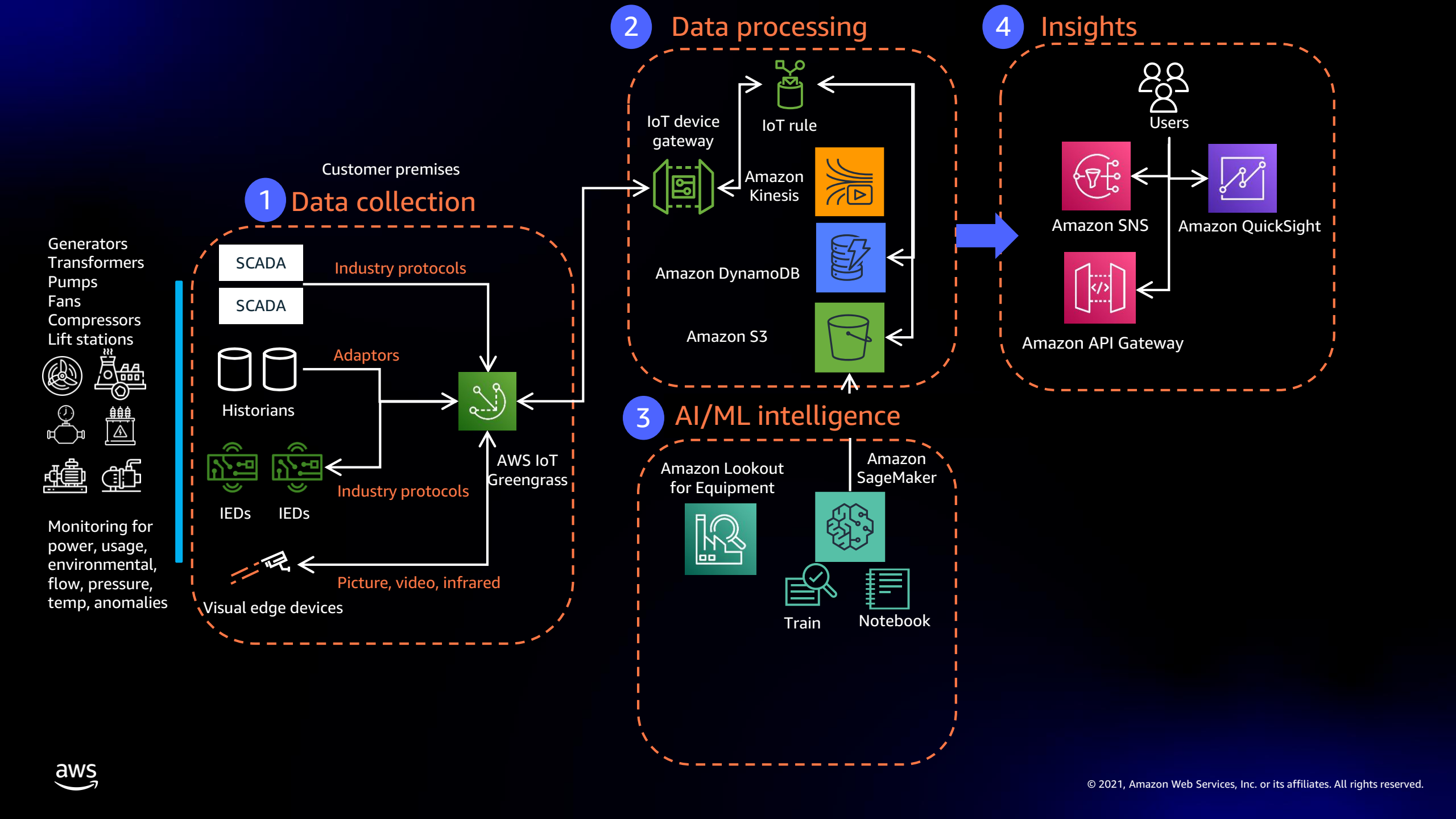
Predictive maintenance

DATA COLLECTION → DATA PROCESSING & PREPARATION → ML INTELLIGENCE → TAKE ACTION





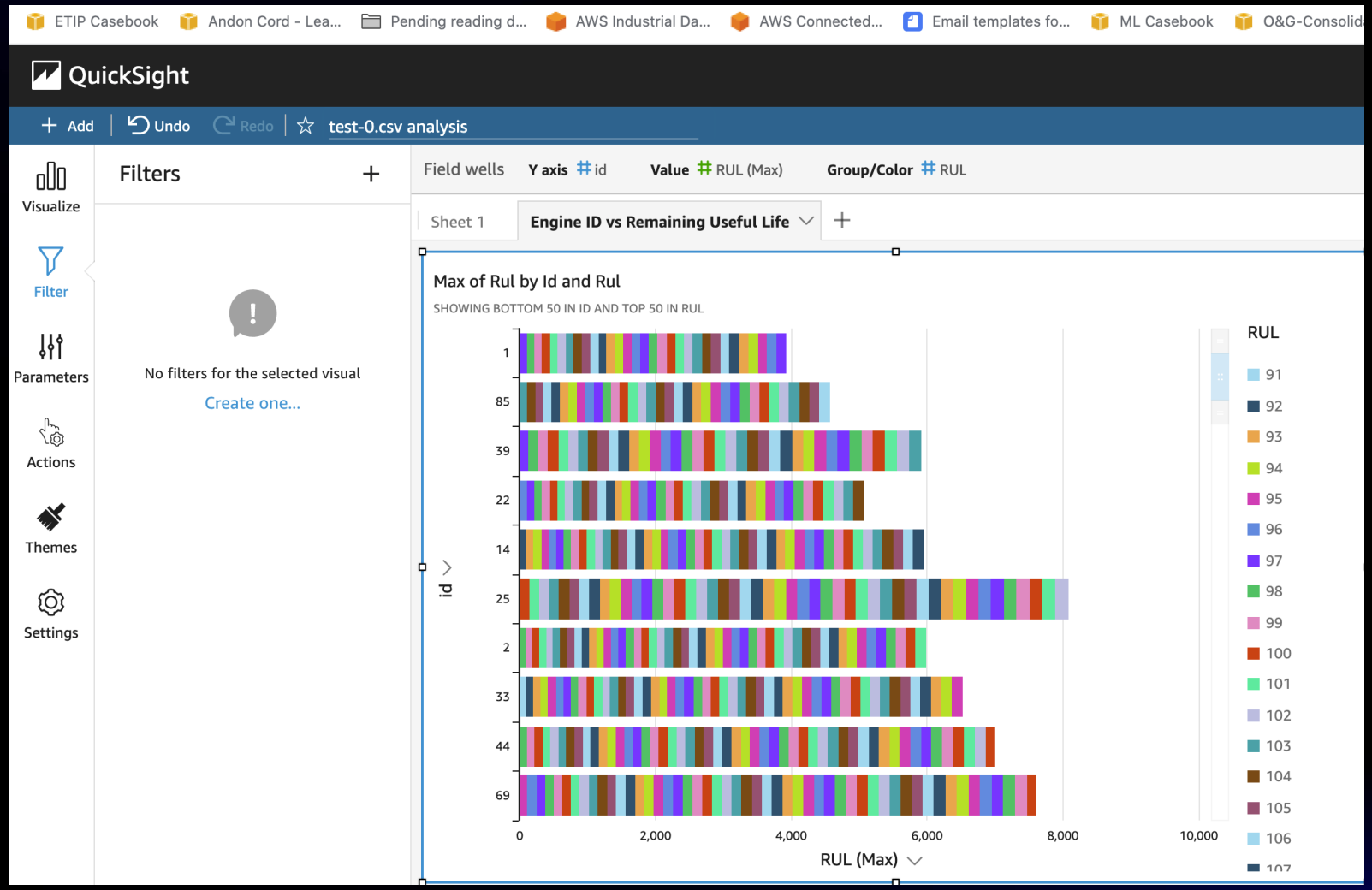
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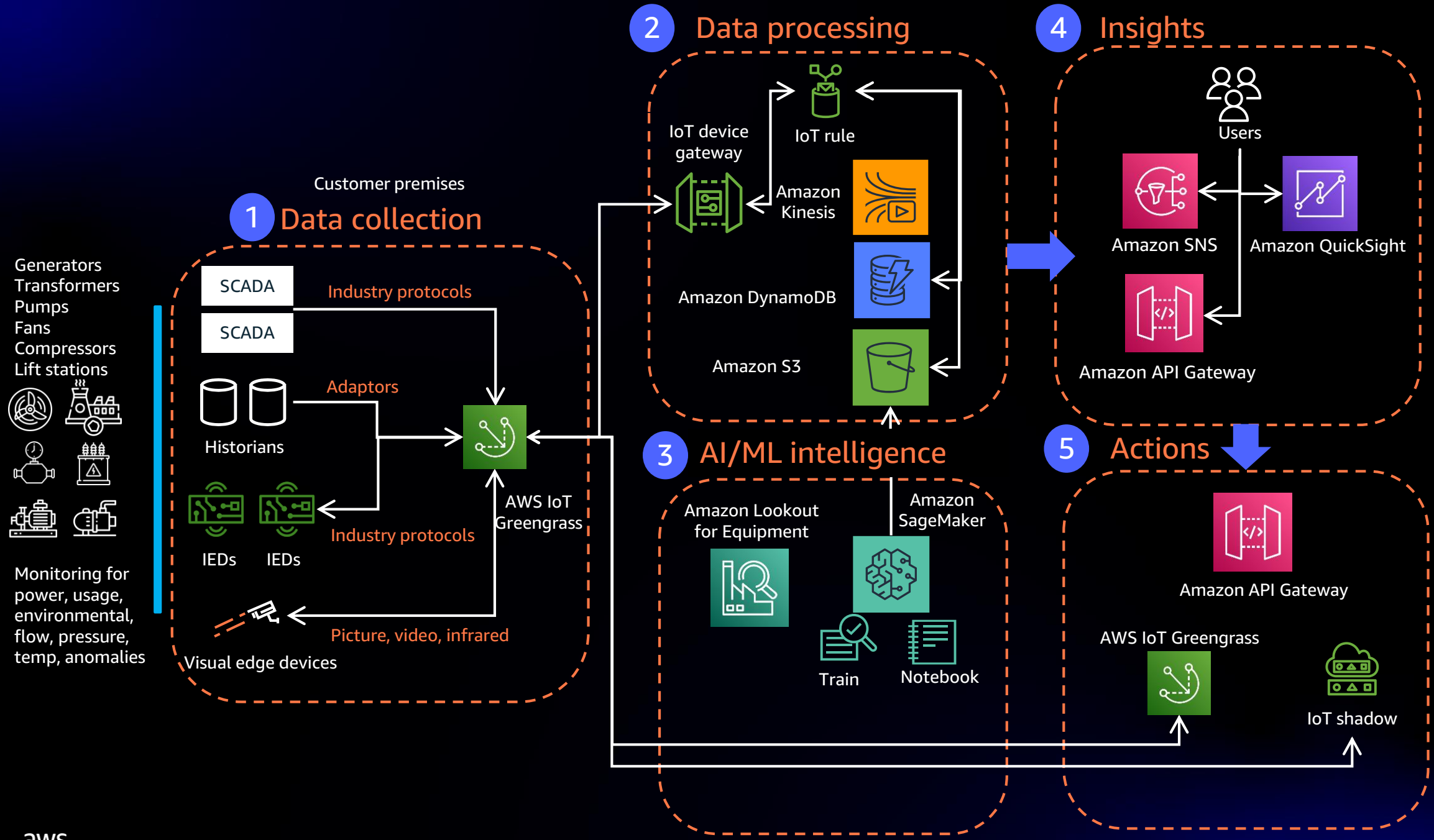
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Predictive maintenance

DATA GATHERING → DATA PROCESSING & PREPARATION → ML INTELLIGENCE → TAKE ACTION



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Predictive maintenance

DATA GATHERING → DATA PROCESSING & PREPARATION → ML INTELLIGENCE → TAKE ACTION

- Integration with maintenance logs, scheduling tools
- Digitize and provide the solution

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Thank you!

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