



# Boeing Additive Manufacturing

## Digitalization and Sustainability

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## Boeing Global AM



- 20 Boeing AM Sites Worldwide
  - US
  - Canada
  - Australia
  - UK
- Multiple Innovation Cells Nationwide

## Flight Hardware



- 70,000+ AM Parts Flying on Enterprise Platforms
- Metal and Polymer
  - Commercial Aircraft
  - Defense Platforms
  - Vertical Lift
  - Satellites
  - Autonomous
- Complex Assemblies
- Building on decades of Experience in AM

## Value Stream Capabilities



- Printing, Post Processing, Inspection & Qualification
- Metal:
  - Laser powderbed, E-Beam Powder bed, DED wire, DED powder
- Polymer:
  - FFF, SLS, SLA, Large Area Polymer
- Flight Hardware, Production Tooling, Shop Aids, Rapid Prototyping, Mockups

## Digital Integration

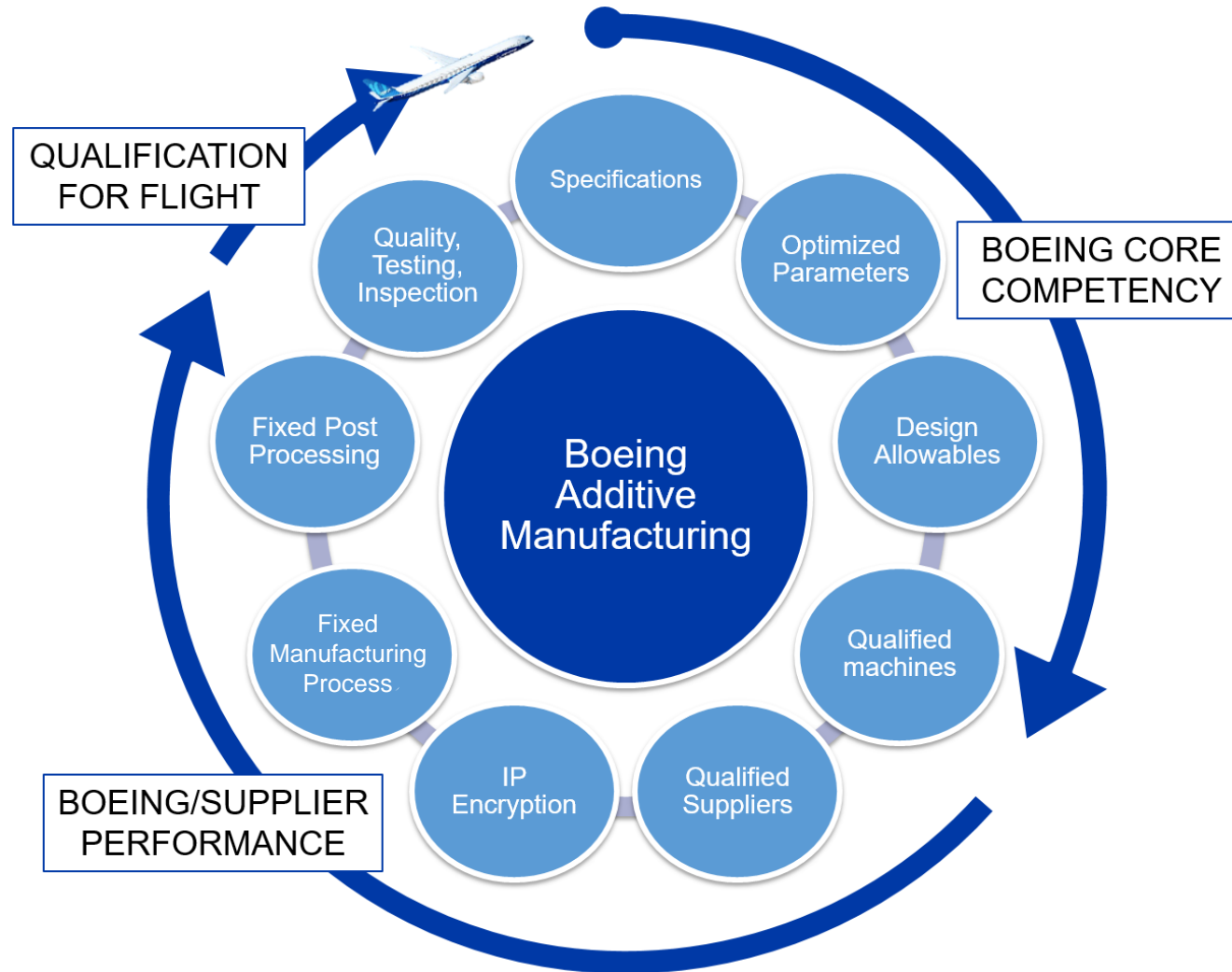


- End-to-End Value Stream:
  - Digital Twin, Digital Thread for quality and scale
  - Data analytics, Machine Learning
  - Model Based Engineering
  - Build File Development & Simulation

## A Holistic View of BAM

Content created by Boeing Additive Manufacturing

# Boeing Additive Manufacturing: It's All About the Data



Content created by Boeing Additive Manufacturing

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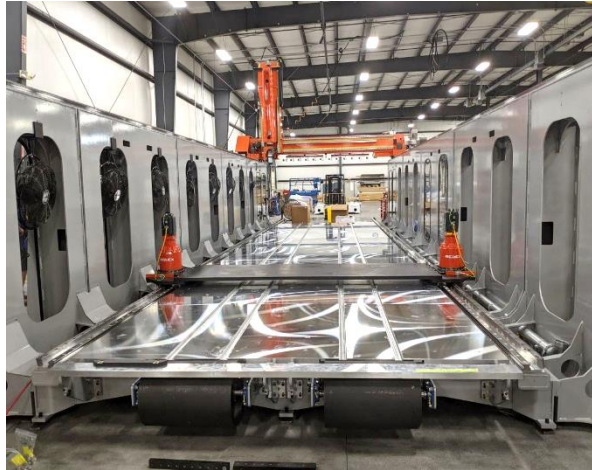


# Boeing Additive Manufacturing Capabilities

## Metal Printing



## Large Polymer Printing



## Polymer Printing



## Post Processing



Metal Powder-Bed & Wire Feed Additive Printing

Large Scale Additive Thermo Plastic

Fused Filament Fabrication

Post Processing, Testing, & Inspection

Engineering

Fixed Process

manufacturing

Post Processing

Traceability

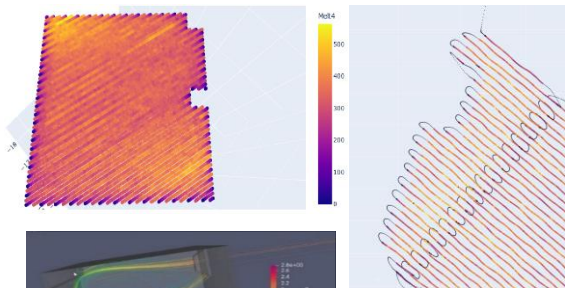
Quality

FAIR

# Leveraging Digital to Accelerate AM Adoption

## Process Development

- Accelerate AM process development through data access → **New found insight**

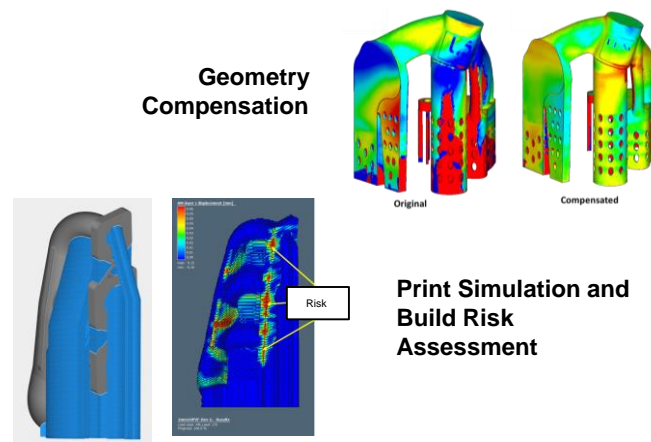


Melt Pool/Scan Path  
(Top)

Gas Flow Simulation  
(Bottom)

## Part Development

- Improve designs with **process-informed** DFAM rules
- Increase producibility leveraging **simulation**



Print Simulation and  
Build Risk  
Assessment

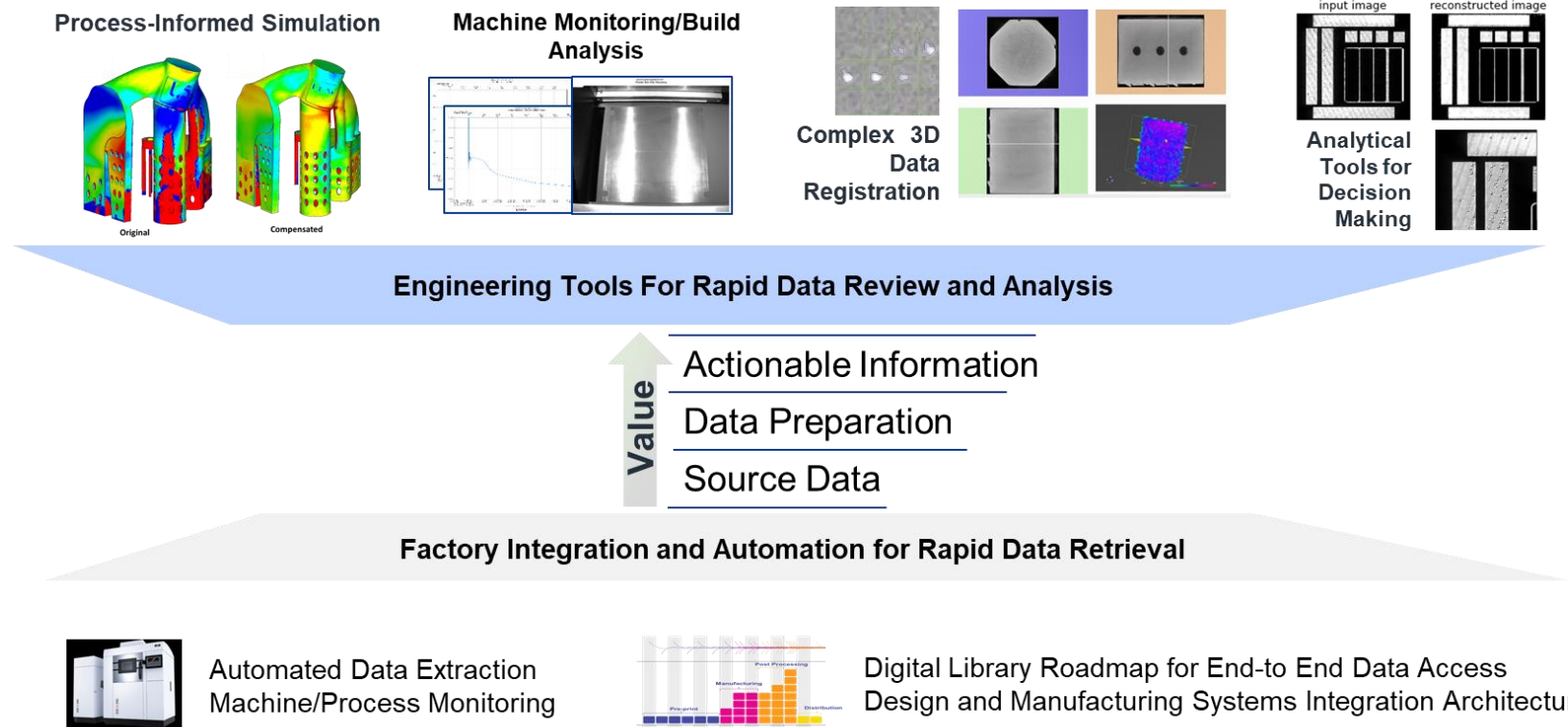
## Production

- Improved operational efficiency | ↓ **cost, lead time**
- Integrated technical data packages to support **accelerated** part acceptance



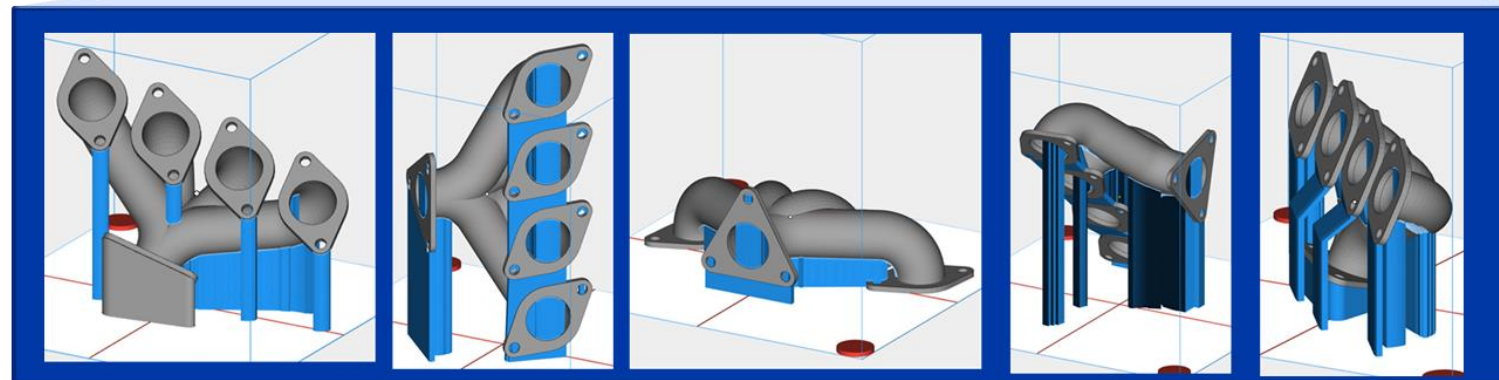
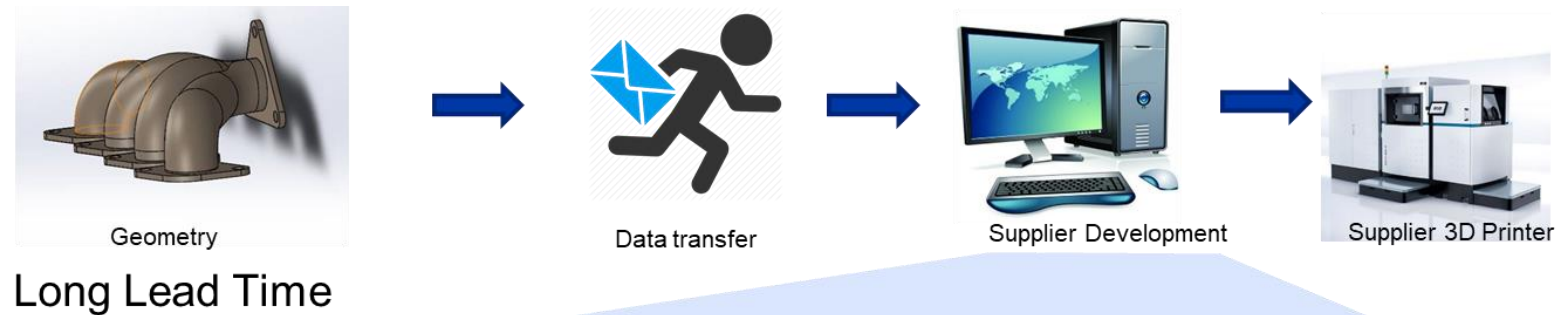
Machine Health Diagnostics

# AM Data Integration Framework



**Tools and Capabilities So Engineers Can Focus on Decisions**

# Supply Chain Scale- A Traditional AM Model

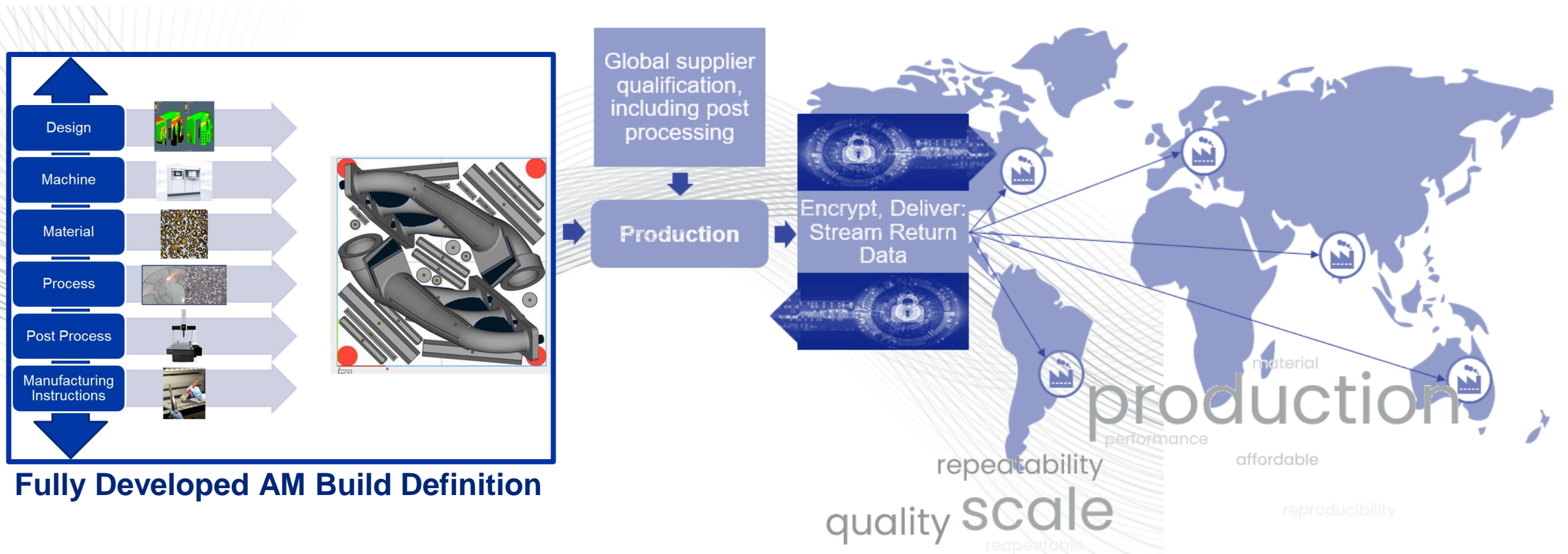


Process Variability Leading to Quality Inconsistency

**Additive Manufacturing Needs A Distributed Production Model to Unleash Its Full Potential**



# A Distributed Manufacturing Model





2050



# Our four strategies for decarbonizing aviation



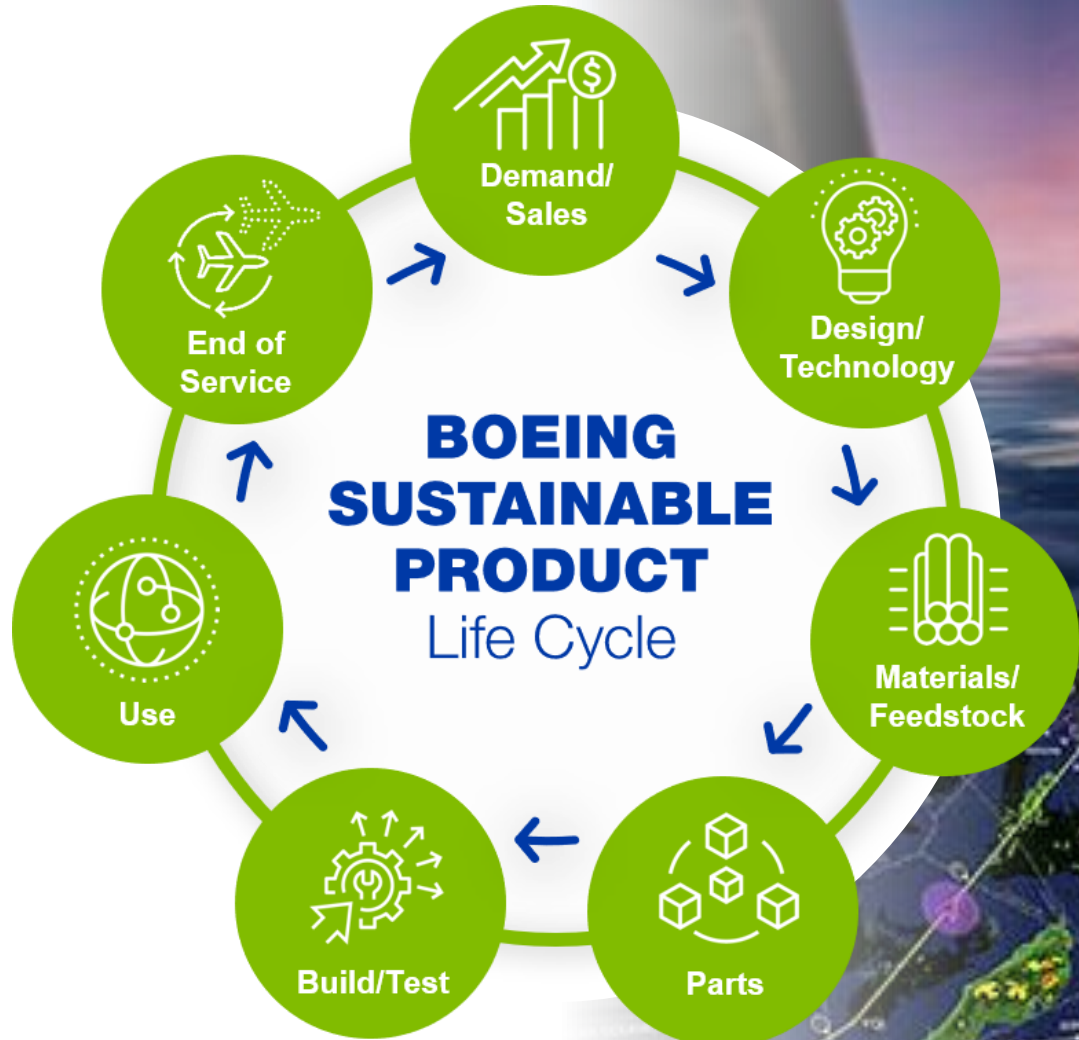


Fleet  
renewal

Operational  
efficiency

Renewable  
energy

Advanced  
technology





# AM Sustainability at Boeing

## Boeing Enterprise Sustainability Goals

- Boeing actively supports industry goals to decarbonize aviation through continued advancements in technology, operations and infrastructure, sustainable aviation fuels and carbon offsets
- Boeing is committed to reducing (within its operations by 2025, compared to 2017 levels)
  - greenhouse gas emissions by 25%,
  - water consumption and solid waste to landfill by 20%,
  - energy use by 10% and
  - hazardous waste by 5%.

## Objective

- Develop strategies for sustainable AM aligned with BAM mission and vision, aligned with Enterprise Sustainability Goals
- Identify implementation opportunities by evaluating competitive landscape
- Quantify and validate business value

# EVERYTHING FOR ZERO

SUSTAINABLE AEROSPACE TOGETHER



Diolch  
σας ευχαριστώ  
köszönöm Dėkuji  
ありがとうございました  
go raibh maith agat Дякую  
Danke धन्यवाद Xièxiè  
متشكراً  
**Thank You**  
grazie dank je Merci  
gracias 감사합니다  
Dziękuję Ci Takk skal du ha  
tack תודה Спасибо  
Salamat shukraan lakum  
cảm ơn bạn Хвала вам  
teşekkür ederim