

# Getting Real Results with AI

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 ConnectedAI

LET'S TRANSFORM OUR ENTIRE BUSINESS  
USING THE GENERATIVE AI I JUST USED  
TO WRITE A POEM ABOUT MY DOG.

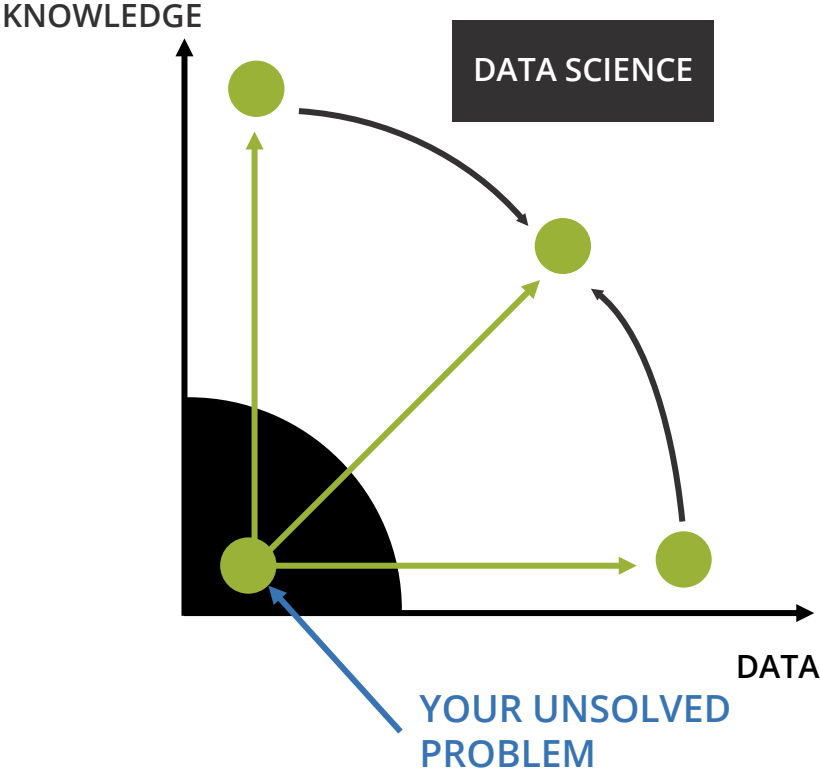


# Why Data Science (AI) is Important

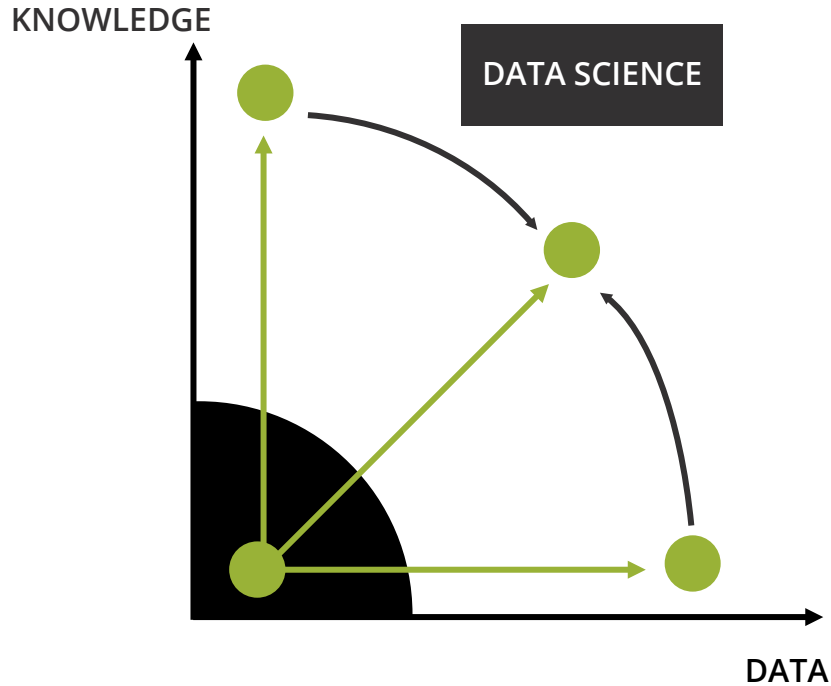
Maximize Competitive Advantage

Address Skill Shortages & Empower People

Boost Efficiency and Sustainability



# Desirable AI Properties



Provably correct

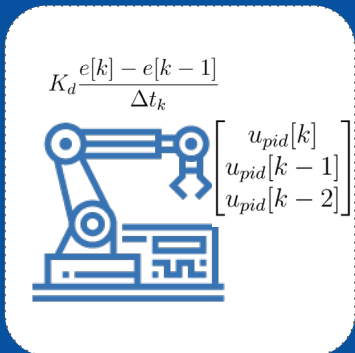
Traceable

General & Useful

Privacy Preserving

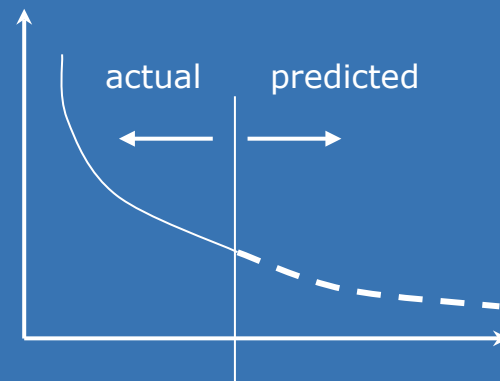
# AI for Machine Analysis

## ENGINEERING Knowledge-based



- + Easy to understand
- + Accurate
- ...but only viable for smaller components

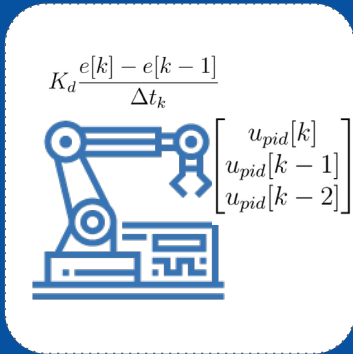
## DATA Empirical-based



- + Practical
- + For machines & large machine parts
- Not traceable

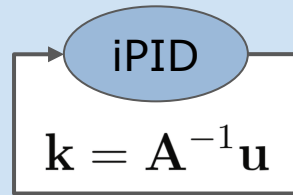
# AI for Machine Analysis

## ENGINEERING Knowledge-based



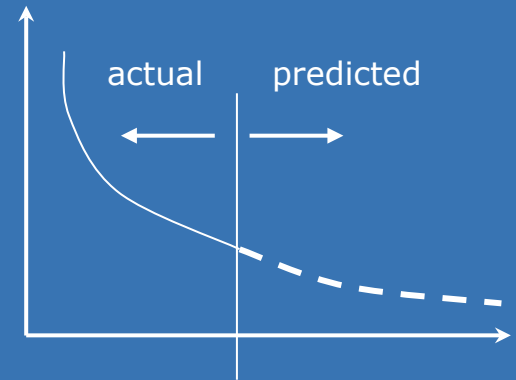
- + Easy to understand
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- ...but only viable for smaller components

## DATA-SCIENCE APPROACH Combination of Knowledge with Data



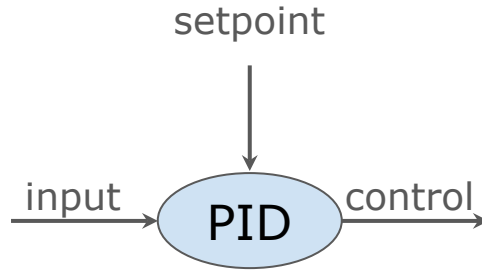
- + Standard approach today - traceable & useful
- Requires a custom development project

## DATA Empirical-based



- + Practical
- + For machines & large machine parts
- Not traceable

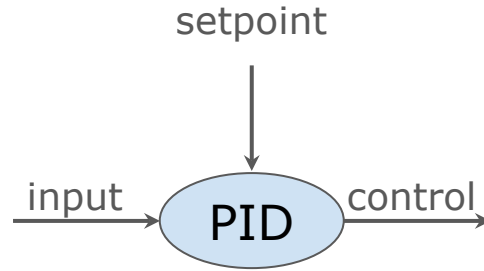
# PIDs Keep Your Machines Running



$$u_{\text{pid}}(t) = K_p e(t) + K_i \int_0^t e(\tau) d\tau + K_d \frac{de(t)}{dt}$$



# PIDs Keep Your Machines Running



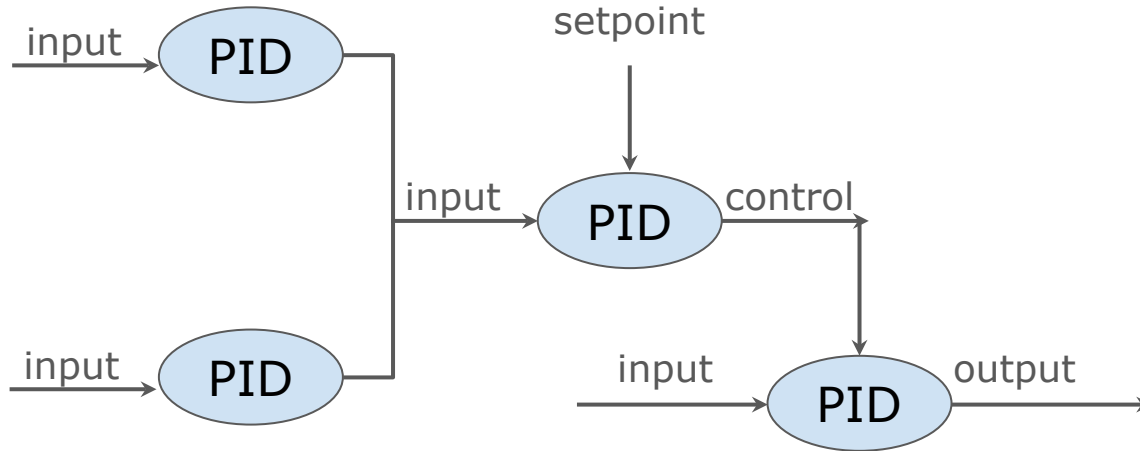
$$u_{\text{pid}}(t) = K_p e(t) + K_i \int_0^t e(\tau) d\tau + K_d \frac{de(t)}{dt}$$

Proportional Gain

Integrative Gain

Derivative Gain

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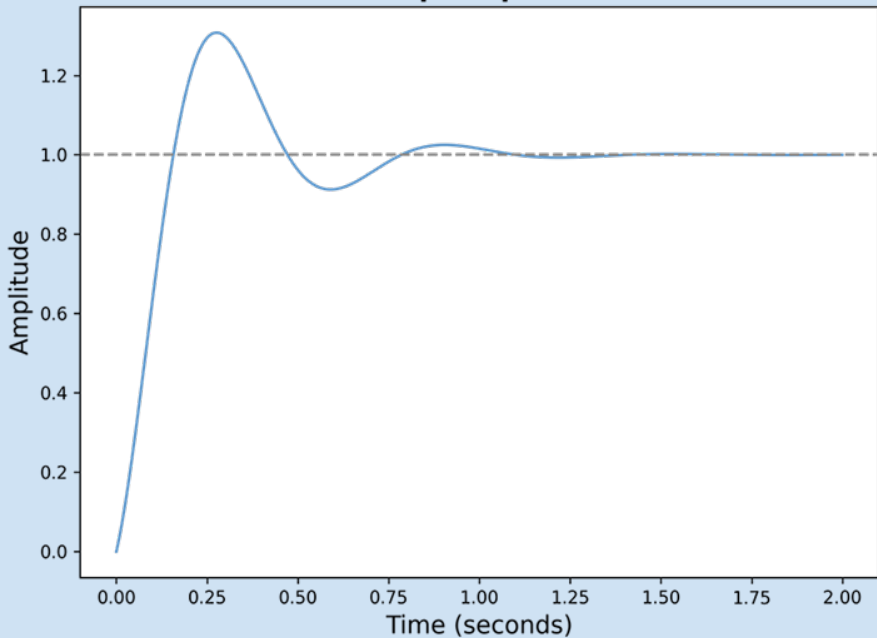
Proportional Gain

Integrative Gain

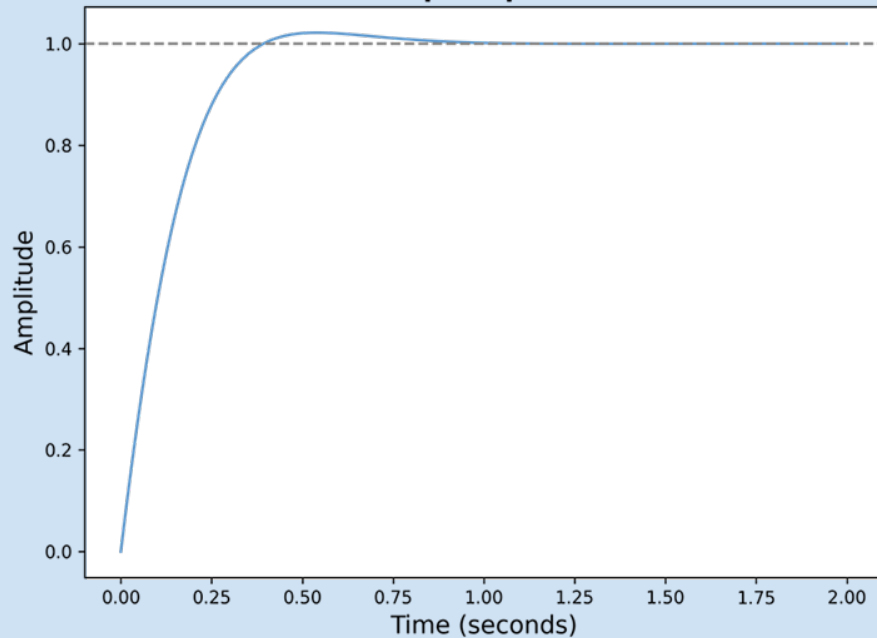
Derivative Gain

# PID: $K_p$ , $K_i$ , and $K_d$ define the behaviour of the systems

**Step Response**

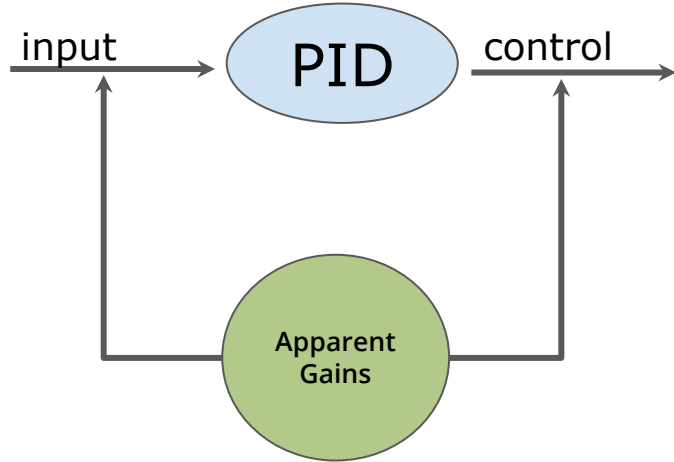


**Step Response**

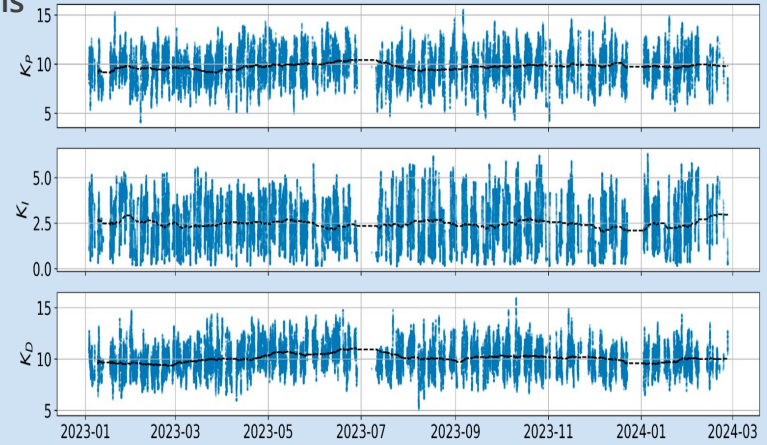


# iPID

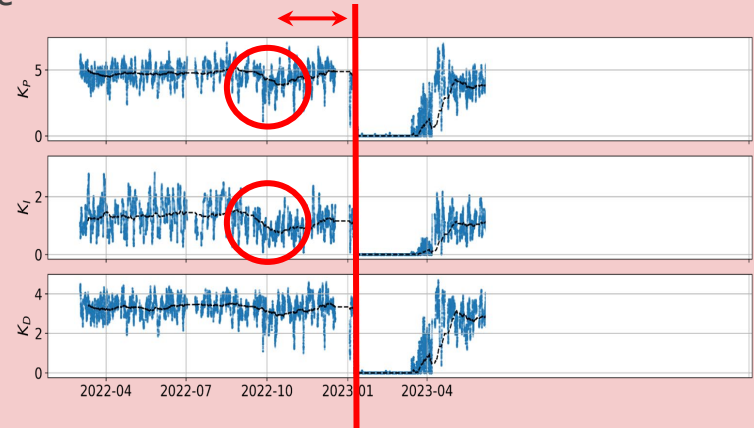
Inverting the loop to reveal changes in the controlled system



## Normal Operations

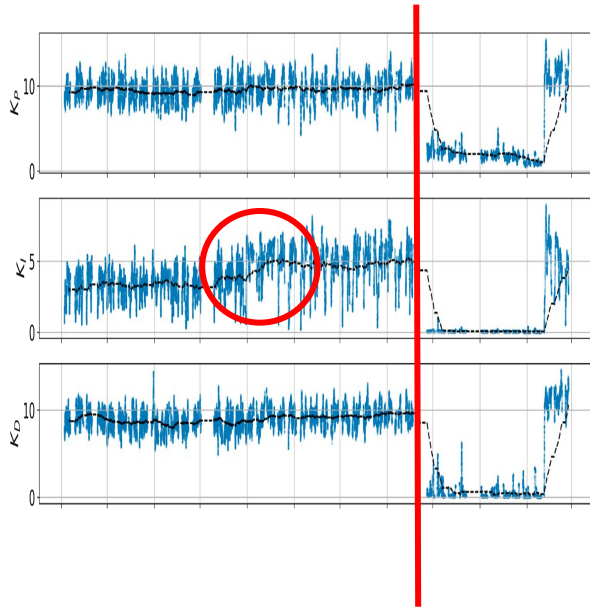


## Component Failure

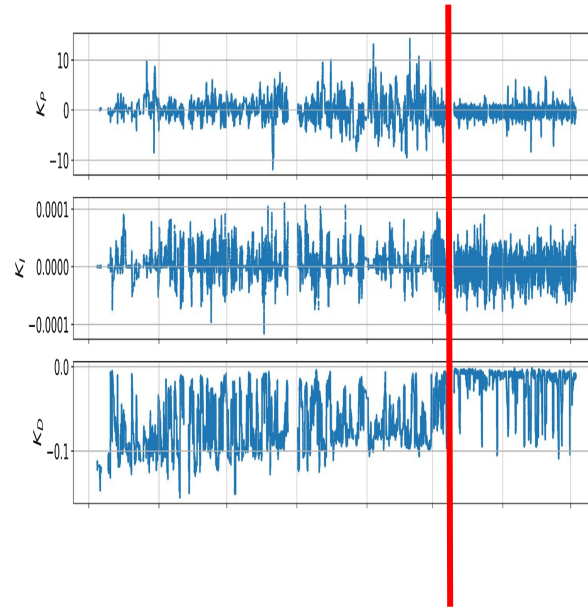


# Changes in Apparent Gains Reveal Changes to the Controlled System

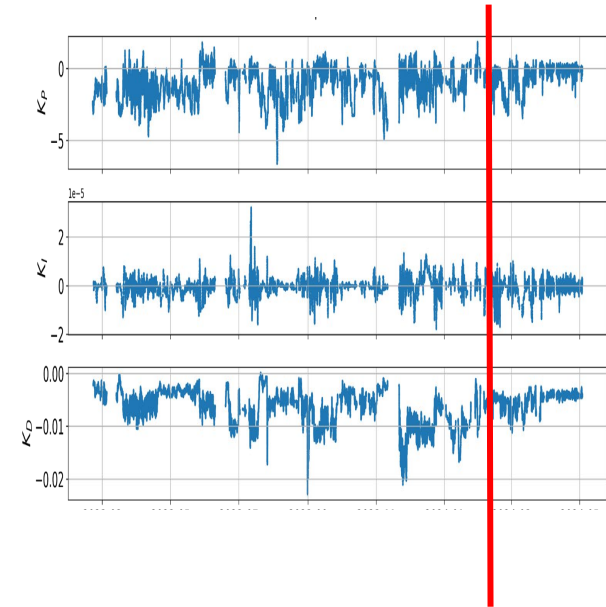
## Heating Element Failure



## Screw Tip Failure

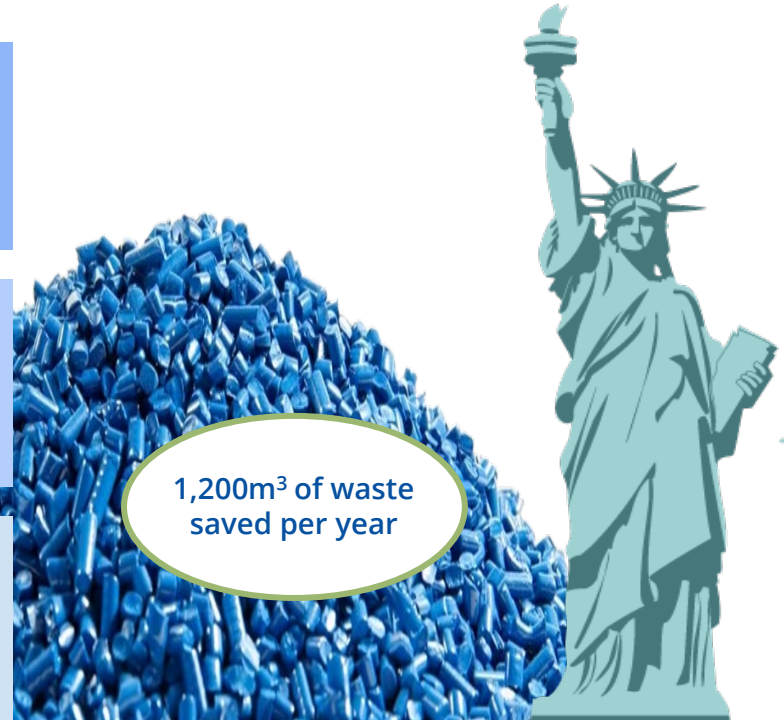


## Plasticizing Screw Failure



# A Well Balanced Machine Maximizes Efficiency, Quality, Cost Savings and Sustainability

- ↓ Reduced scrap rate by 23%
- ↓ Reduced unplanned downtime by 10%
- ↓ Cut monthly maintenance spend by 8-12%



# Summary

- General tool to create useful insights
- Based on a sound mathematical basis - therefore traceable
- Negligible cost - no sensors needed

# What's the Future?

- Analytics needs to be rooted in engineering, science, or engineering
- Generative AI for UI and knowledge management

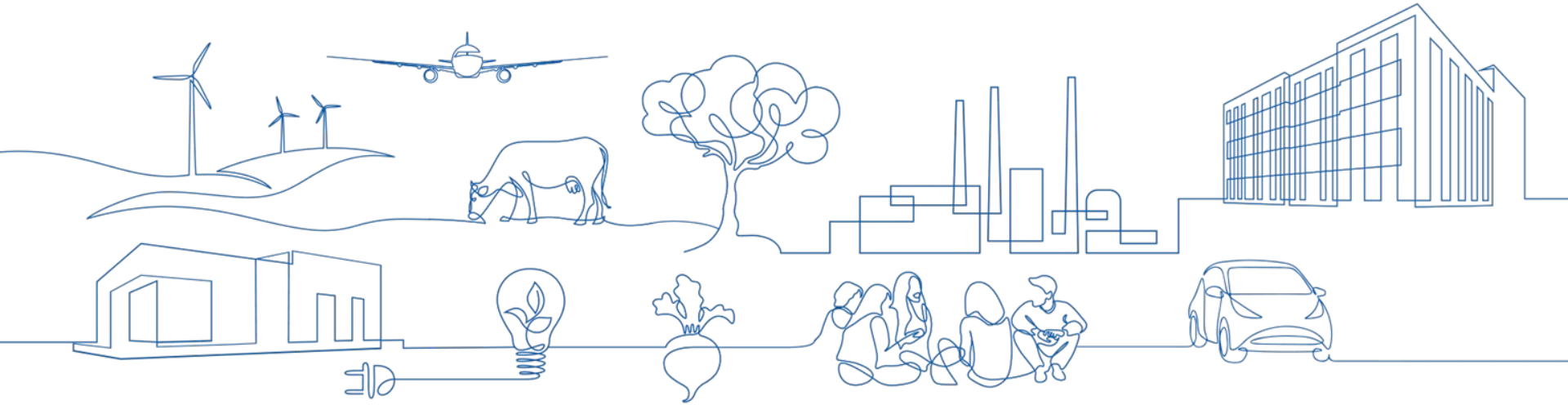
## THANK YOU!

We believe in the triple win:  
Manufacture sustainably,  
at the highest quality,  
and lowest cost

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