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# Building a Global, Post-Harvest Quality Chain

September 2020

# Post-harvest challenges are costing the world $ 1 trillion

To sustainably feed the world's growing population we need to produce more and waste less. **$1 trillion of post-harvest loss is not tolerable.**

Climate change and physical shocks such as pandemics obviate the need for **supply chain resiliency,** protecting **abundance** and bolstering **food safety** and **traceability**

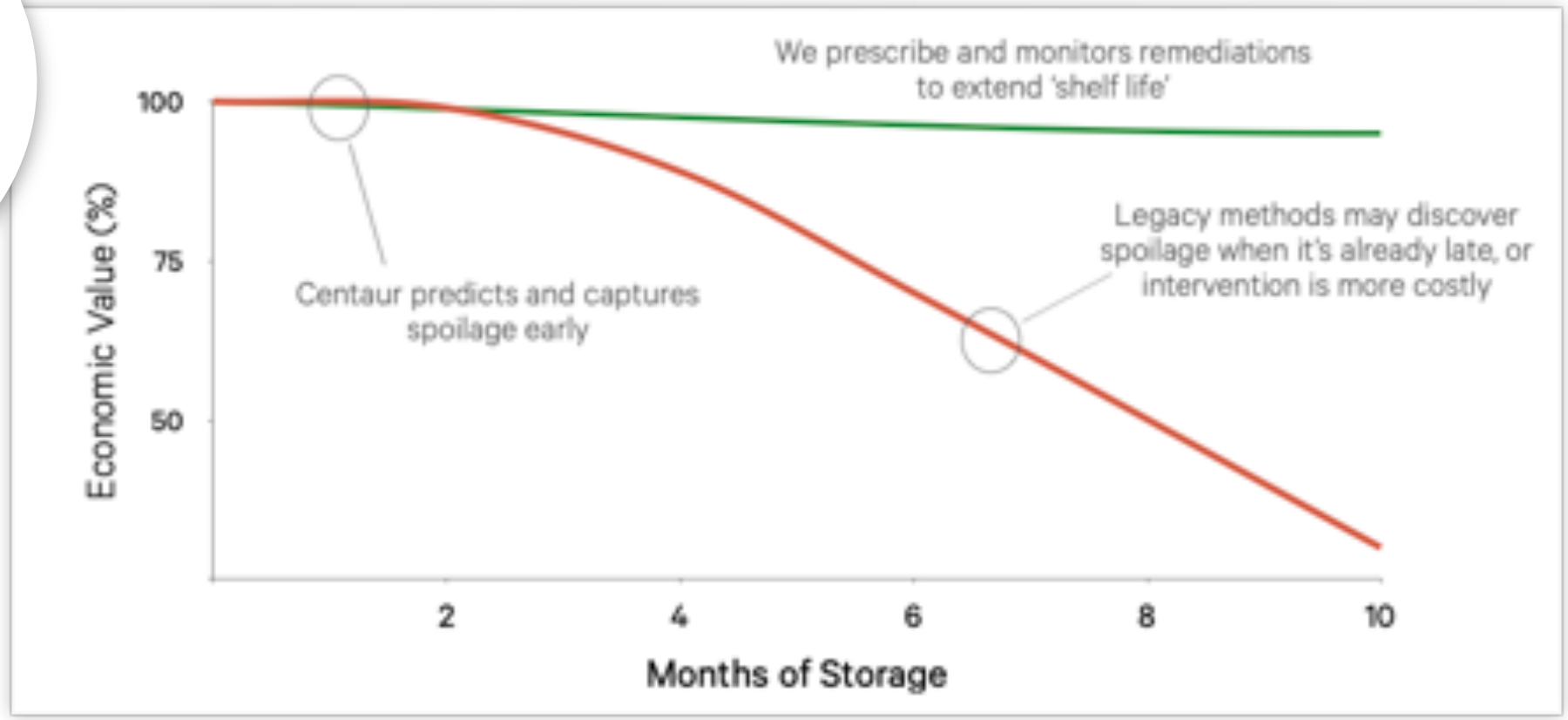
The solution lies in real-time, automated IoT monitoring and analytics that enable proactive intervention and prevent loss

# Crop value loss and waste has broad impact

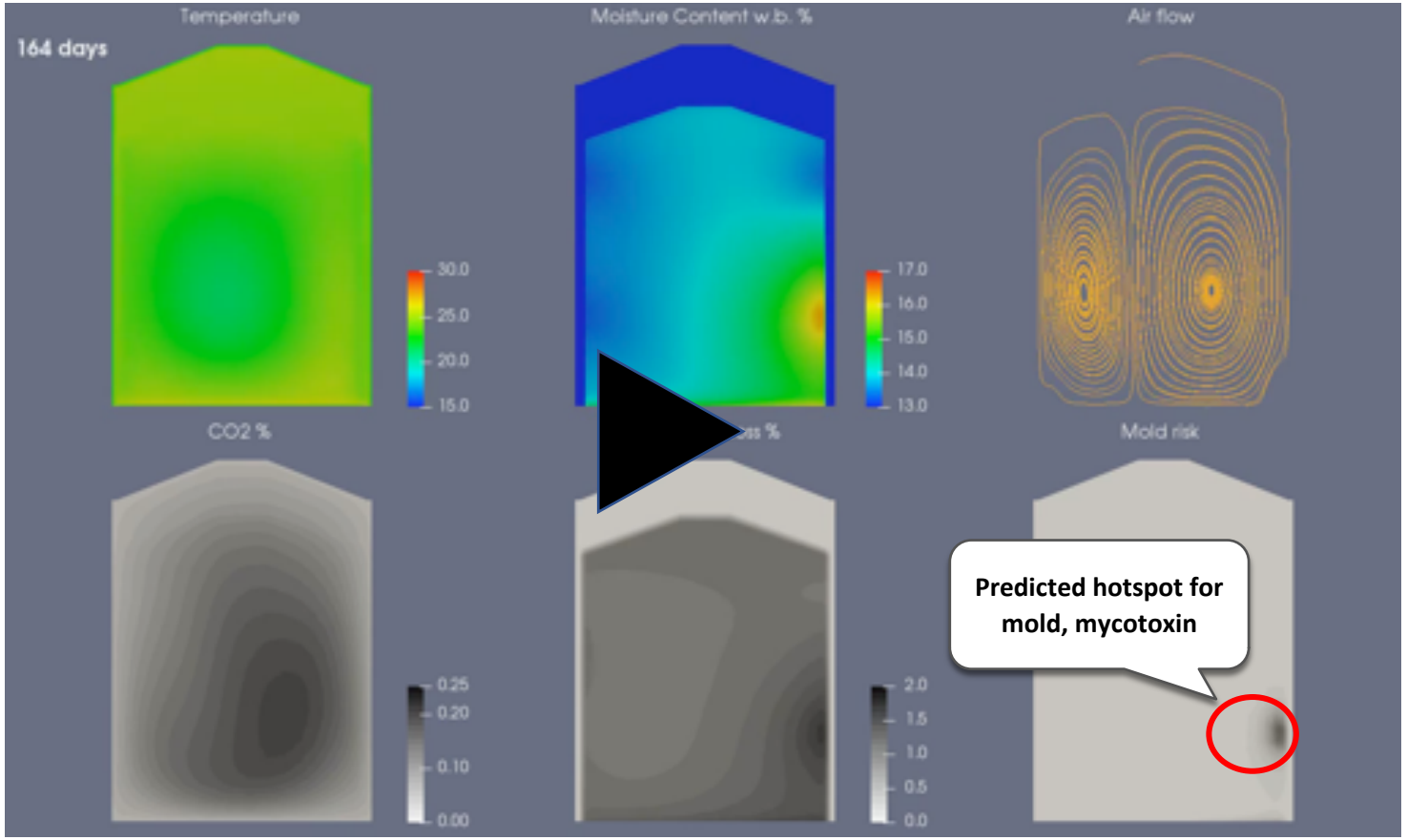
Over US $350 billion lost in developing countries alone

| Region | Crop | Post-Harvest Loss (farm to processor) | Reasons | Source |
|---|---|---|---|---|
| USA | Wheat | 3% | Storage conditions, insects | *Oklahoma State University (2019)* |
| Indonesia | Rice | 5.4% | Storage & Supply Chain Conditions | *FAO* |
| Brazil (RS) | Wheat | 11.8% | Storage & Logistics Conditions | *University of Sao Paolo, Brazil (2015)* |
| Brazil | Soybean | 2.7% | Storage Conditions | *FAO* |
| Côte d' Ivoire | Cacao beans | 3% | Storage & Supply Chain Conditions | *FAO* |
| Ecuador | Maize | 10-30% | Storage conditions, insects | *ADM Institute, U. of Illinois (2018)* |

# We deploy sensors and A.I. to eliminate loss, unlock profit



# Digital Twin for Smart, Resilient Grain Storage




**Example digital twin visualization**

- Sensors track temperature, moisture content, air flow, $CO_2$, dry matter loss and other relevant factors for grain storage quality
- A digital twin model powered by proprietary computational fluid dynamics is updated on the fly, Critical areas are detected before any damage or value slippage

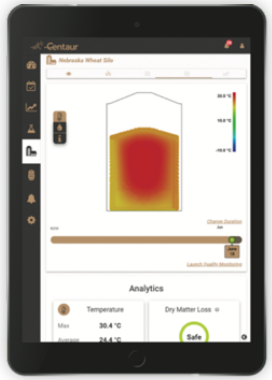
**A Digital, Post-Harvest Quality Chain**

- Digital certificates of quality are issued upon request, in our industry-first, digital-twin traceability platform
- Quality and objectivity proven by analytics are paving the way to supply chain transparency
- Blockchain-ready solution

Get Certificate

# The Intelligent Silo

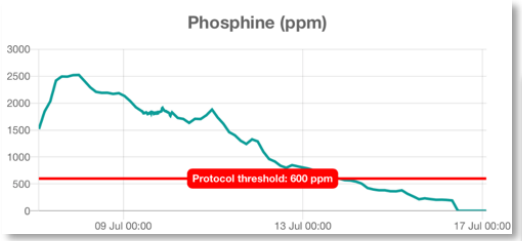
Enhanced traceability, quality and marketability for grain



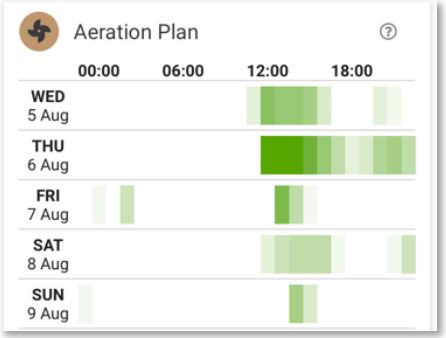

Monitoring & Predictive Analytics

Volume Monitoring for Traceability

Aeration Auto-Pilot



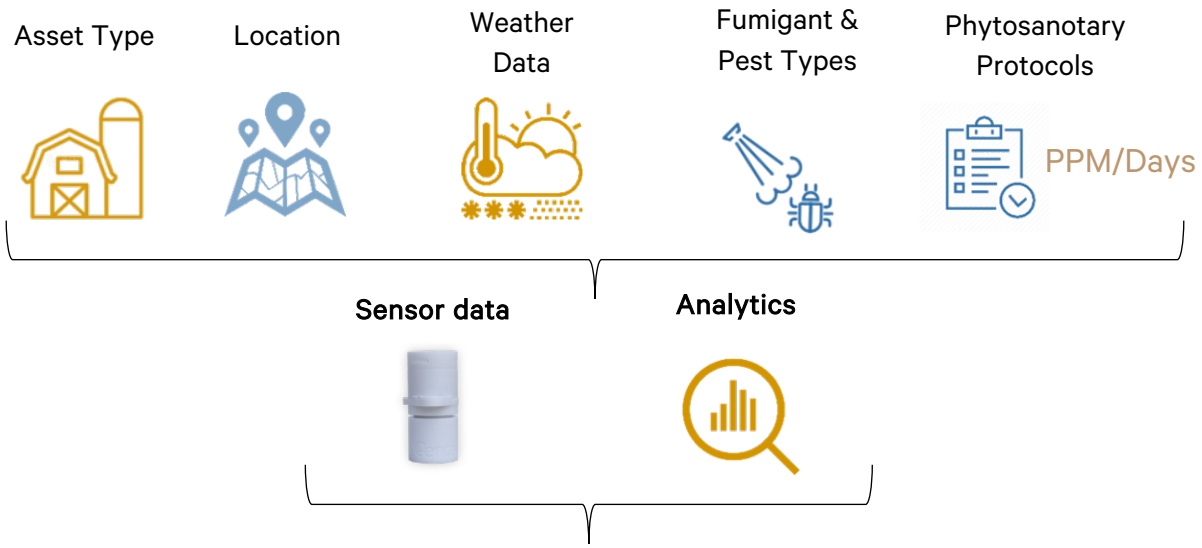

Cognitive Pest Control



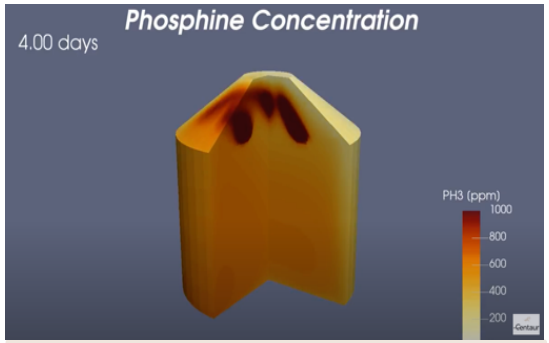
# Precision Fumigation

## Sustainable and efficient pest control

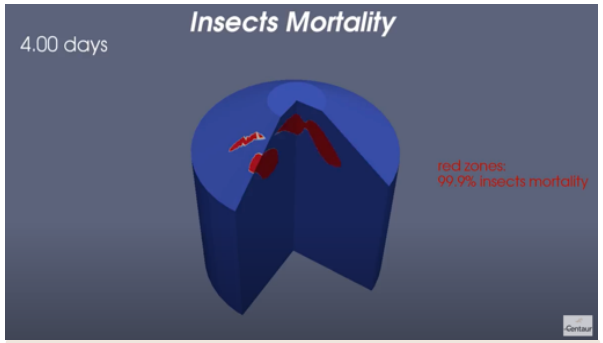
- 99.9% pest mortality in controlled atmosphere and heat treatments
- 24/7 online monitoring of fumigant levels and product condition with early-warning capabilities
- Ability to proactively mitigate insect tolerance, with tailored treatment plans
- Installed in minutes, relieves from time-consuming and labor-intensive monitoring work
- Coming with excellent world-class engineering, agronomic and day-to-day expert support on fumigant leakage, sorption and other risks




**Fumigant concentration & pest kill rate predictions (Digital Twin)**




Video link: https://youtu.be/iISBS7eoWb8

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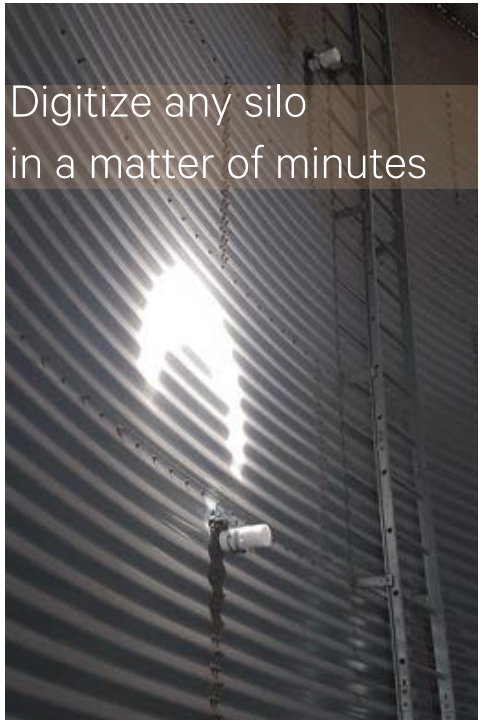
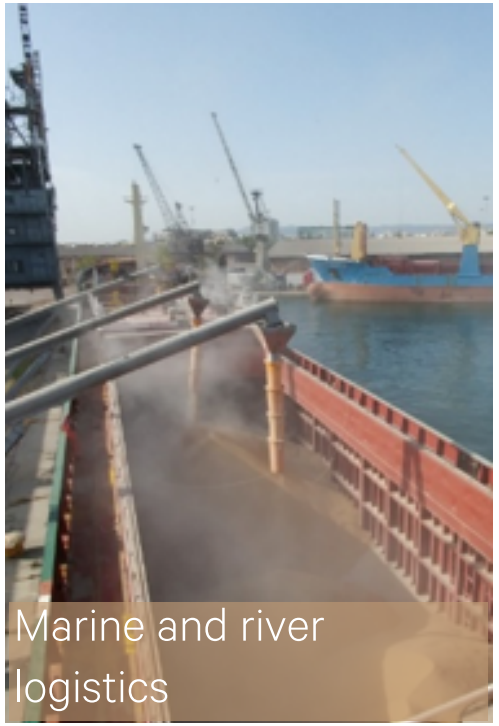
# Sensors digitize all modes of storage and logistics






# Smart Crop Protection Sensors

Multi-sensory device, combines gasses ($CO_2$, $O_2$, $PH_3$) with product temperature and moisture

Transmission from confined spaces (silos, warehouses, ship holds, containers)

Multi-year Battery Lifetime

Cloud connected over 3G/4G or WiFi networks

Patented design. Field-serviceable device, 100% protected from corrosion and gas ingress

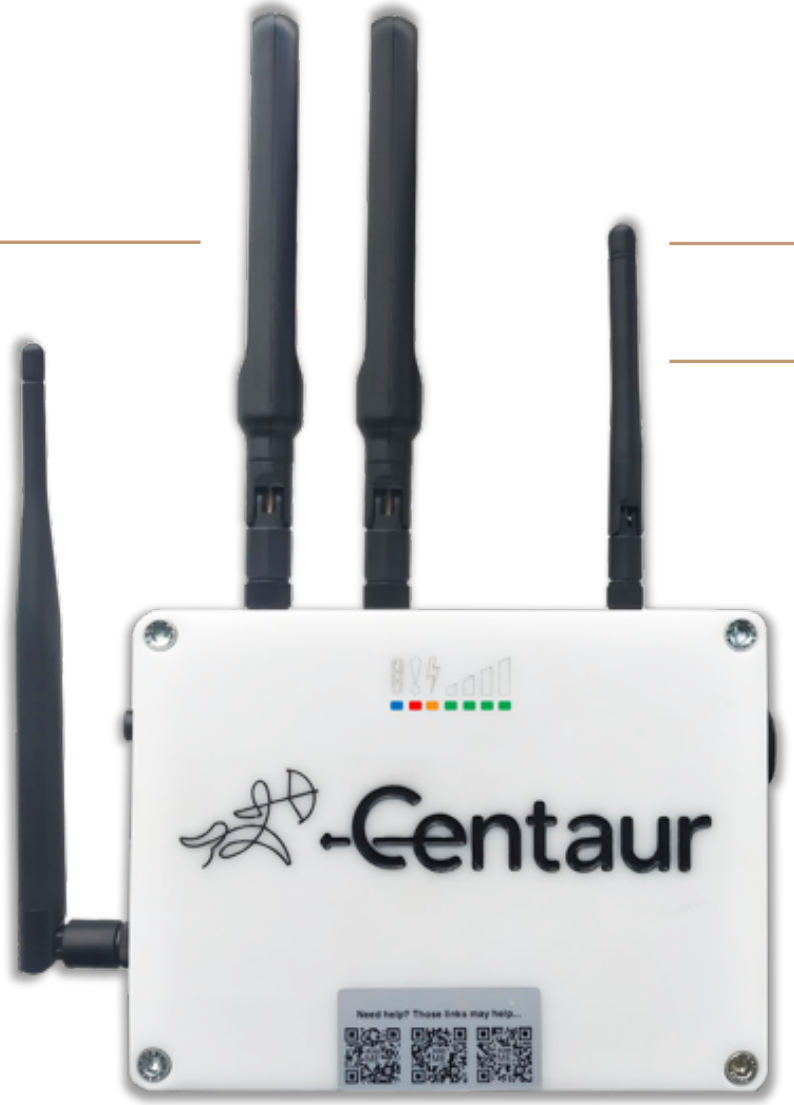
# Monitoring your assets on the cloud: The IoT Gateway

## Wireless & IoT Interfaces

4G LTE

Wi-Fi

GPS




Zigbee 868/915MHz

MQTT

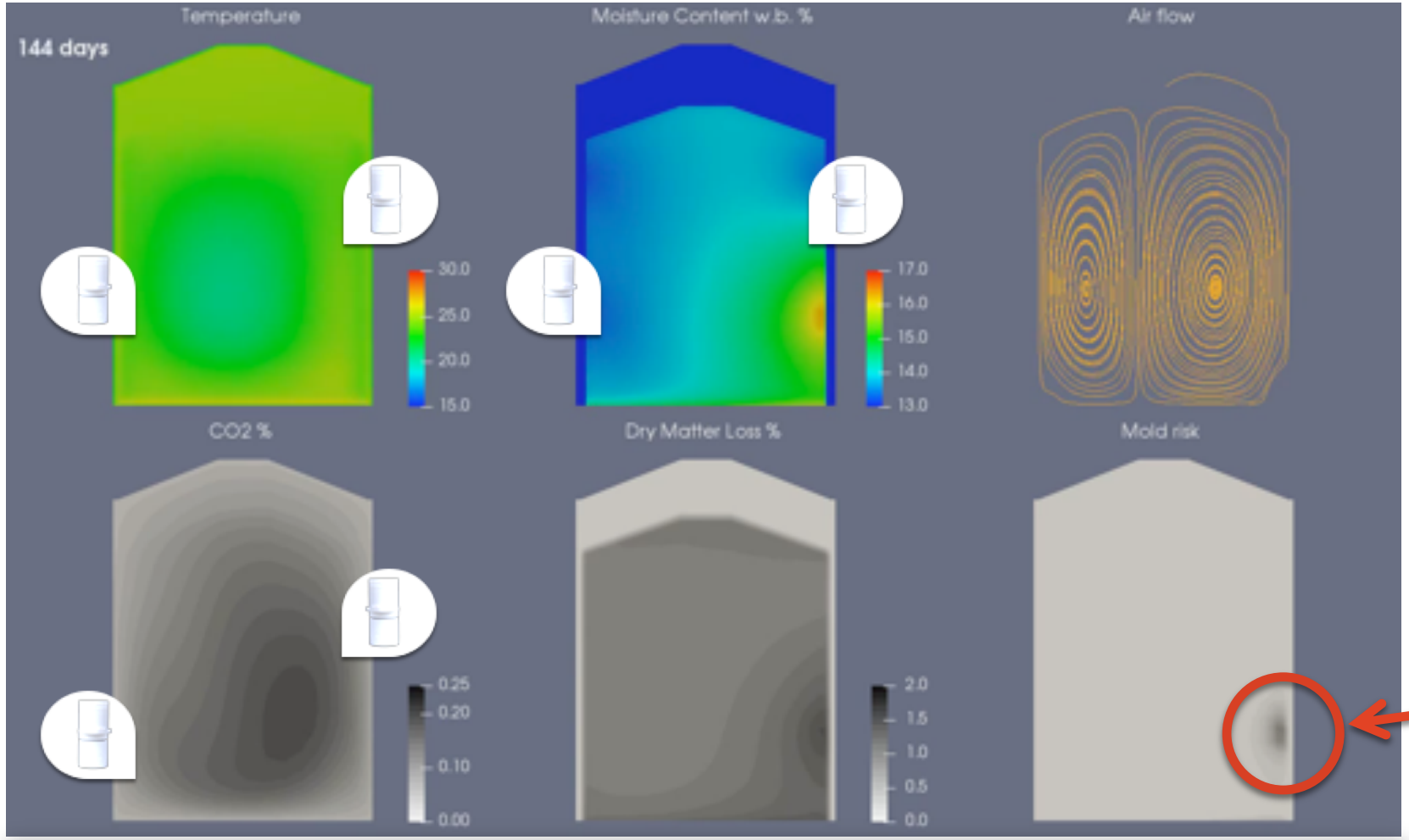
## Other Interfaces

Ethernet

USB

ModBus

# Industry first, cognitive and predictive grain analytics




predicted hotspot for mold, mycotoxin!

Sensors track temperature, moisture and gas byproducts to enable detailed predictions. Our ML-trained, Computational Fluid Dynamics (CFD) simulations capture quality and food safety incidents months ahead. Further techniques prescribe remediation activities and fully automate storage management.

# Making farmers happy, and the world a better place


- Brad is prolific grain grower who keeps his harvest in multiple steel silos, spread across 4 locations.
- Brad had to travel on weekly basis 200-400 miles to do on-site inspection of his stored crops in order to take decisions about when it is good time to sell.
- Quite often, he discovered spoiled grain and had to sell fast, usually at a discount ☹

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- Thanks to the Internet-of-Crops®, Brad can now **inspect grain condition remotely** and receive insights on quality metrics, as well as safe storage time.
- Brad loves this technology because he can **inspect his grain from home** and **can trust his old silos again**.
- Offering transparency through 3rd-party data, Brad makes his product more competitive and **can sell his product to mills, at best farmgate prices**.
- In one such case, a large CPG company is incentivizing its suppliers to use **waste and carbon-reduction techniques**. The CPG buyer is financing Brad to expand his system, in exchange for data from the Internet-of-Crops®.
- Brad is a happy customer of Centaur, and his good customers are very happy too ☺

# Bringing trust back to the fumigation business

- PestCo is a well managed fumigations company, who built a name for trustworthy service. Zero bugs, guaranteed. Their competitors though, let's say, had set a low bar.
- PestCo needed to deliver a scaleable fumigation service, to lock the lucrative business of demanding tobacco companies.
- But this meant having people running around taking thousands of phosphine samples per day, in a busy container terminal ☹

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- Thanks to the Internet-of-Crops®, PestCo can now monitor fumigations on the cloud and be alerted if corrective action is needed, such as fumigant top-ups.
- PestCo loves this technology because they can avoid wasted fumigant and meet their promise to their customer who demands zero bugs.
- Offering data besides fumigations, PestCo is able to sell their service at a 25% premium. Their customer is willing to pay extra for a digital certificate.
- PestCo is a happy customer of Centaur, and their good clients are very happy too ☺

# Rice

## Solution

- IoT Platform for Quality Control of paddy rice in silo storage, logistics
- Remote monitoring and control of moisture, Aw, spoilage activity ($CO_2$)
- Precision Fumigation shields crop against infestations from pests such as sitophilus oryzae (rice weevil)

## Benefits

- Hit moisture targets precisely and extend safe storage time by several months
- Slash pest remediation costs and eliminate infestations
- Enhance marketability with premium quality, traceability and sustainability benefits

**+7**
**months shelf-life extension**

**40%**
**cost reduction in pest treatments**

**75M**
**tons of GHG in annual offsets***

*global scale potential

# Wheat

## Solution

- IoT Platform for Quality Control of milling wheat and flour ingredients
- Remote monitoring and control of moisture, Aw, spoilage activity ($CO_2$)
- Precision Fumigation shields crop against infestations from pests such as tribolium

## Benefits

- Control storage quality and prevent spoilage, insects, mycotoxins and odor in stored wheat
- Slash pest remediation costs in wheat as well as flour
- Enhance marketability with premium quality, traceability and sustainability benefits

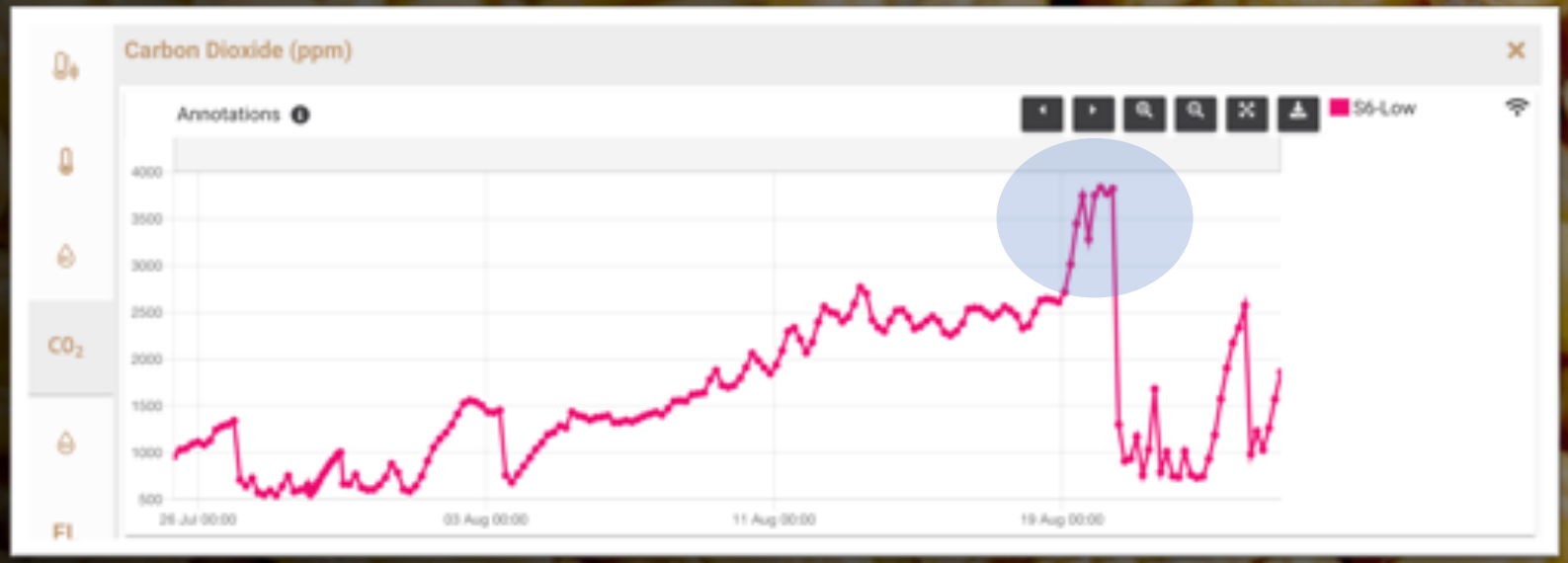
**+12**
**months shelf-life extension**

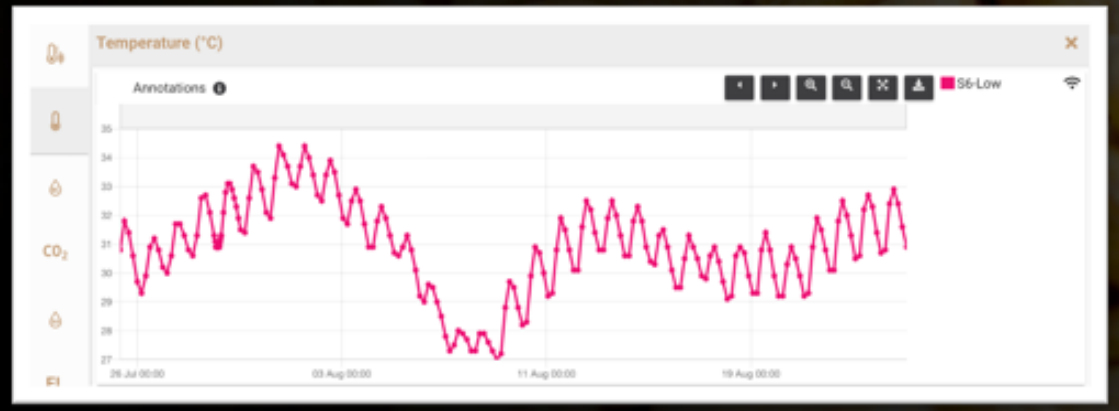
**40%**
**cost reduction in pest treatments**

**20%**
**milling wheat price premiums**

# Grain Quality

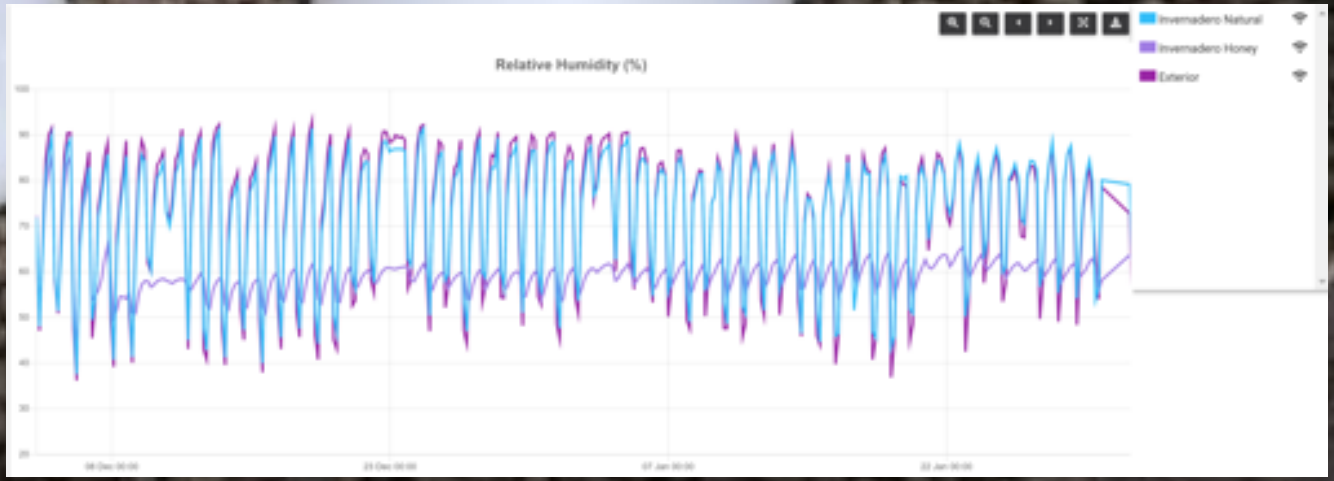
- Wheat stored in a mill silo for several months, showed steady increase in $CO_2$
- The operators were alerted and salvaged $500K worth of grain!




# Specialty Coffee

- 24/7 Outdoor and in-silo weather conditions monitoring
- Immediate response in case of a weather change
- Water activity monitoring
- Securing quality for premium coffee roasters, such as Nespresso



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