



**Session 1:  
Power and technology:**

# **The digital food chain**

What do we mean when we talk of digitalization of agri food systems?

The application of digital tools, strategies and business models to food and agriculture, especially the agrifood value chain.

The application of **digital tools**, strategies and business models to food and agriculture, especially the agrifood value chain.

## Some Definitions:

**Data:** Computer-readable form of information

**Big Data:** Computational Tools to analyse extremely large data sets to reveal patterns, trends, and associations.

# Automated decision-making (Artificial Intelligence or “AI”) :

Aka. “machine learning” or “deep learning” .

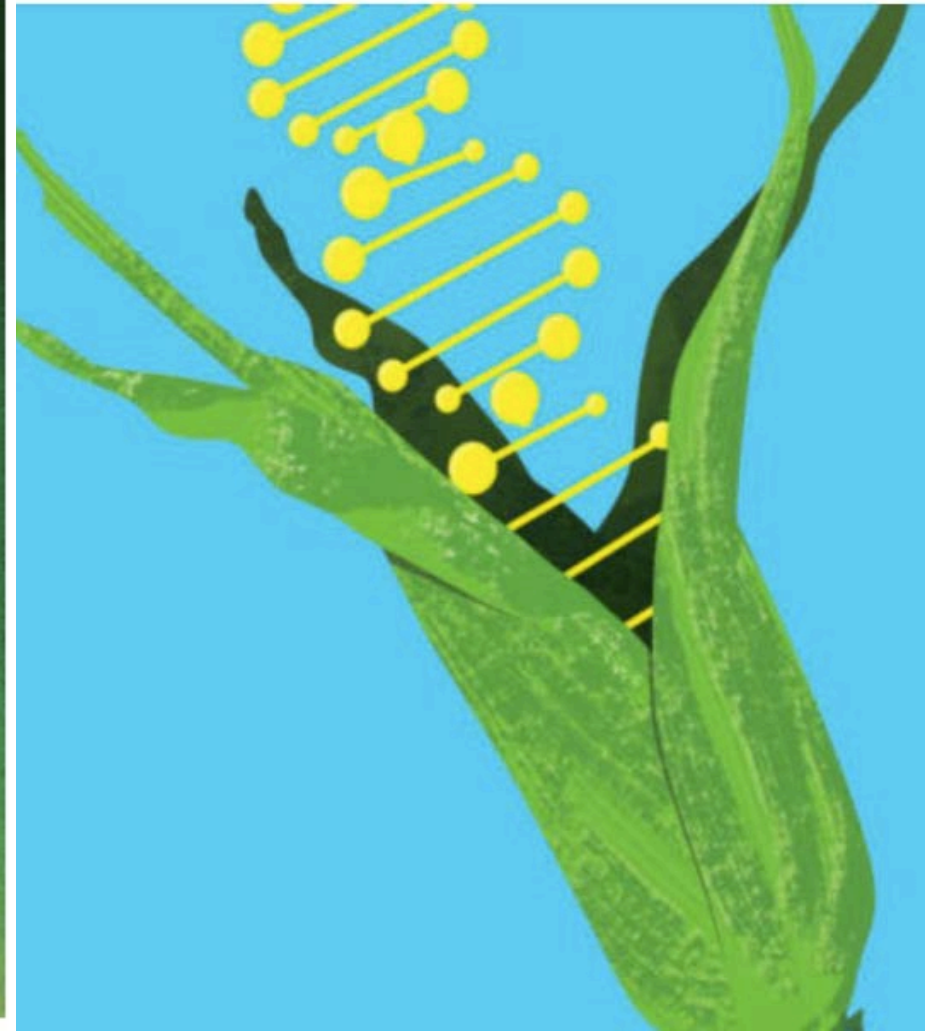
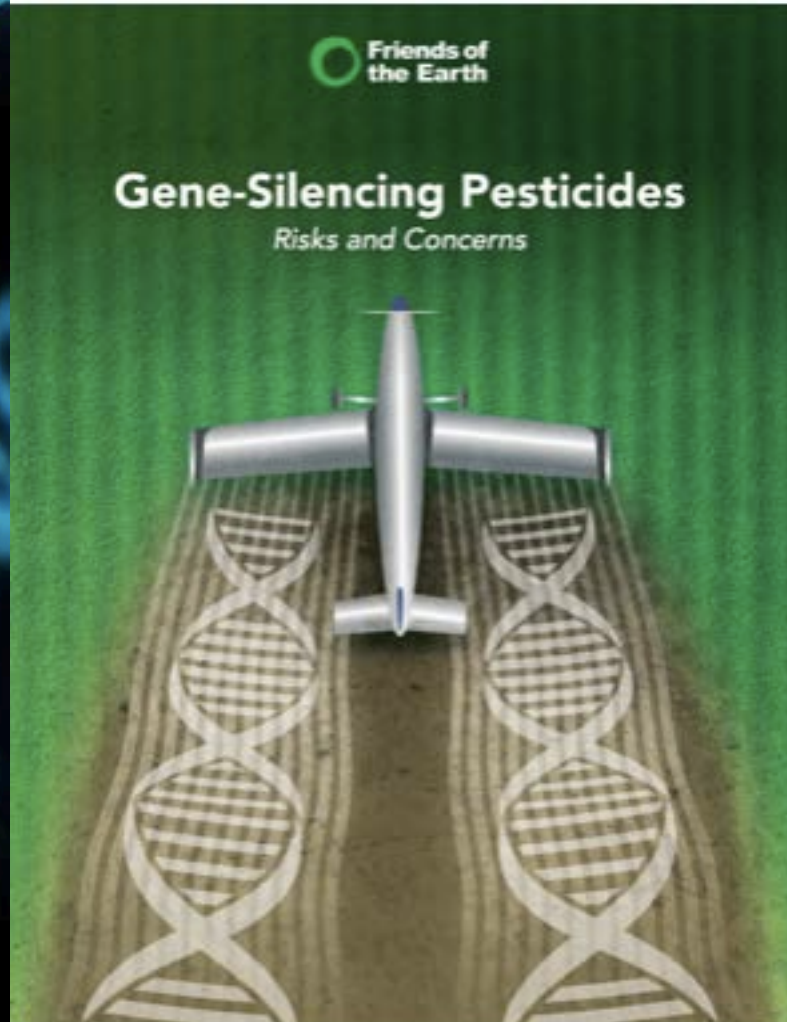
Use of algorithms and “neural networks” that sort data to identify and ‘learn’ patterns and make predictions for automated decision-making.

The application of **digital tools**, strategies and business models to food and agriculture, especially the agrifood value chain.

Examples: drones and robots, data-driven farming advice platforms, smart contracts, food delivery and online grocery shopping.

These in turn rely on widespread data sensors, data networks . blockchains

**Biodigital:** where big data and artificial intelligence tools enable biology to be manipulated.



The application of digital tools, strategies and business models to food and agriculture, especially **the agrifood value chain.**



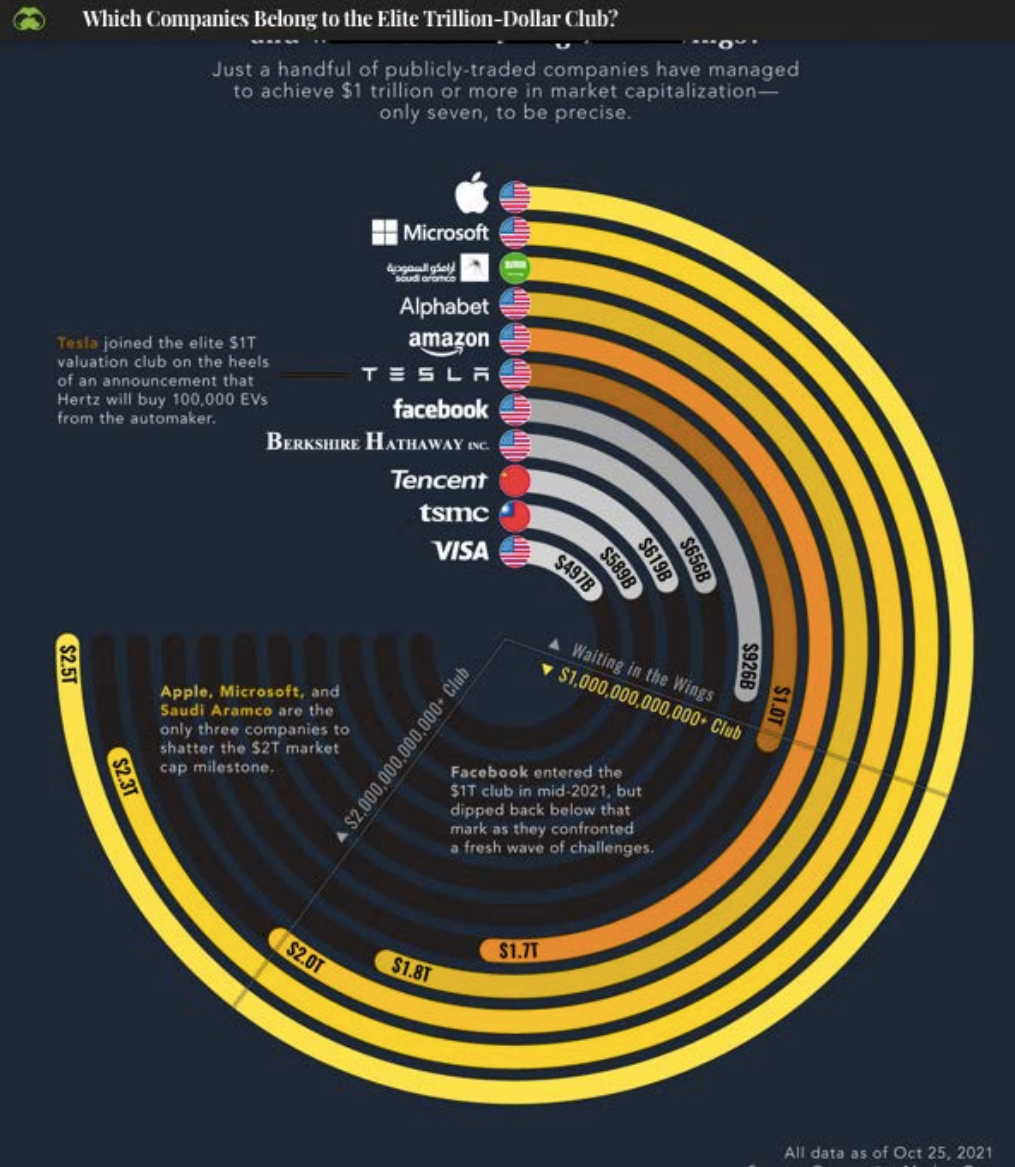








# The Digital Agri-Food Value Chain.



The application of digital tools, **strategies and business models** to food and agriculture, especially the agrifood value chain.

Digital capitalism, informational capitalism, data colonialism, surveillance capitalism, 4th Industrial revolution  
- also: Internet of things, Web 3.0



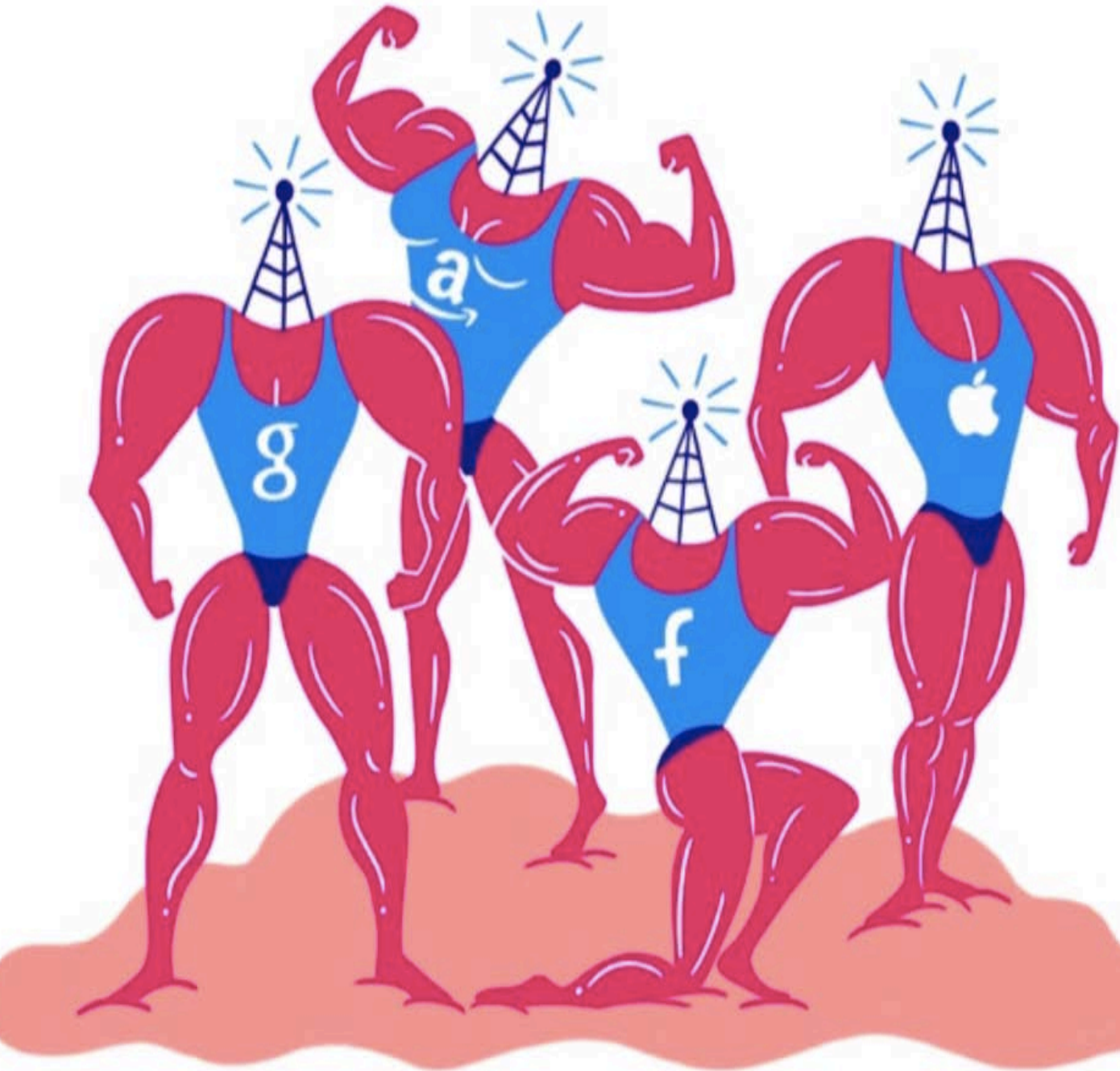
1		<b>Apple</b> AAPL	\$2.693 T
2		<b>Saudi Aramco</b> 2222.SR	\$2.265 T
3		<b>Microsoft</b> MSFT	\$2.103 T
4		<b>Alphabet (Google)</b> GOOG	\$1.689 T
5		<b>Amazon</b> AMZN	\$1.554 T
6		<b>Tesla</b> TSLA	\$1.037 T

# Trend 1: Major agribusiness players transforming themselves into data/digital players:

**“I could easily see us in the next five or 10 years being an information technology company,”** Rob Fraley. CTO Monsanto (2013)

***“We are transforming from a machinery company into a smart technology company,”*** - Martin Kremmer, director ETIC, John Deere European Technology Center.

**: “Before, we sold pesticides, seeds and fertiliser. Now we’re a farm services company – we sell service and technology...”** - Mao Feng, chief brand manager for Syngenta Group’s MAP



Trend 2 : Major tech titans stepping aggressively into food & agriculture: Amazon, Microsoft, Alibaba, Google, IBM...

# aws





# Microsoft to Collaborate with AGRA to Bring about Technological Solutions in Agriculture

Jodie Miller • September 13, 2019 Last Updated: September 8, 2020 1 minute read

**Microsoft**

**AGRA**  
Growing Africa's Agriculture

A large image showing a combine harvester and a tractor in a golden field under a blue sky with clouds. The Microsoft and AGRA logos are overlaid on the top left. A small logo with the letters 'CN' is in the bottom right corner.

Microsoft's

# FarmBeats



Our goal is to ensure that over the next 10 years, at least half of the smallholder farmers in our focus geographies have access to and are benefiting from digitally enabled services.

BILL & MELINDA  
GATES *foundation*





Data is the new oil

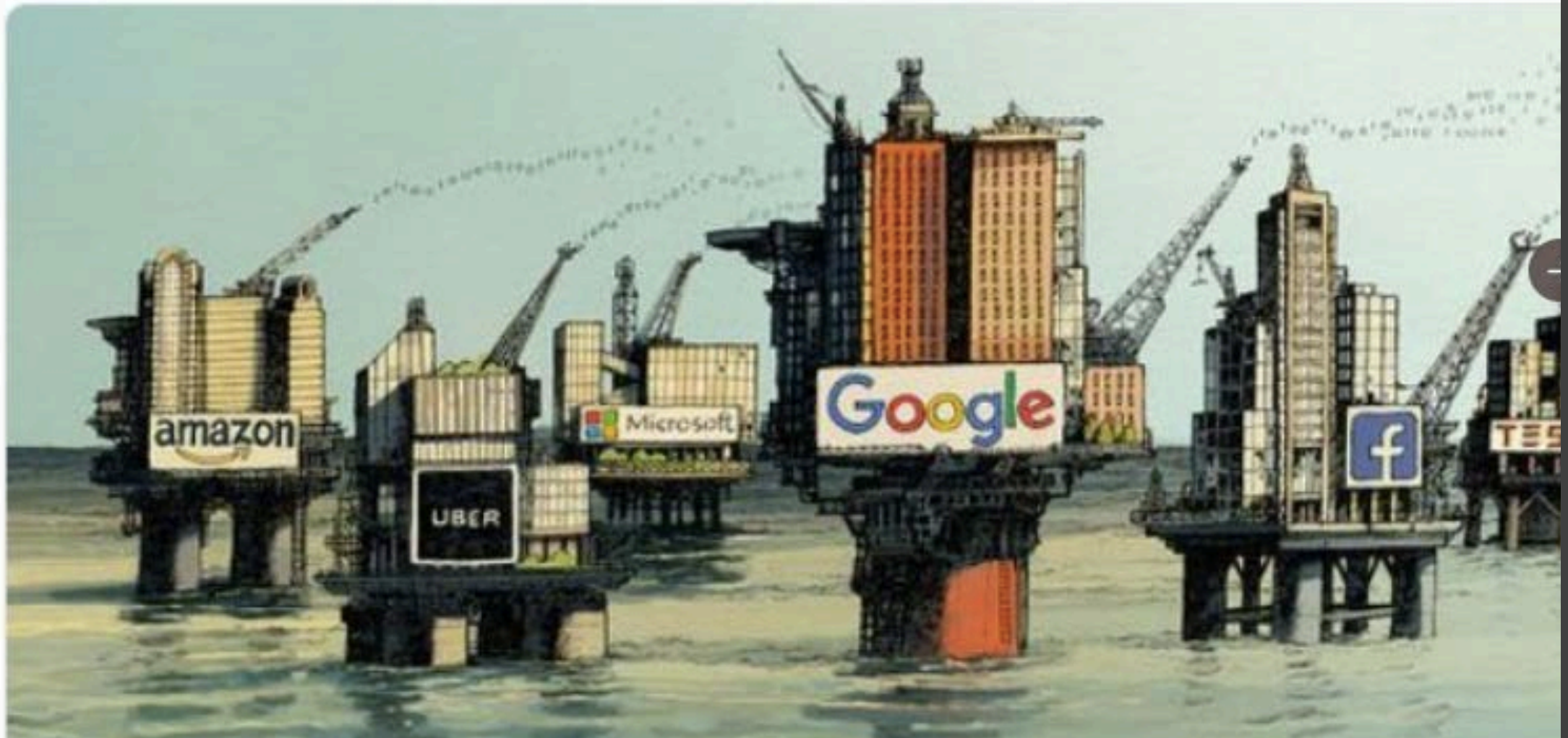
Surveillance Capitalism

Digital twins, Control loops and Nudges



**The Economist**  @TheEconomist · 2h

The world's most valuable resource is no longer oil, but data



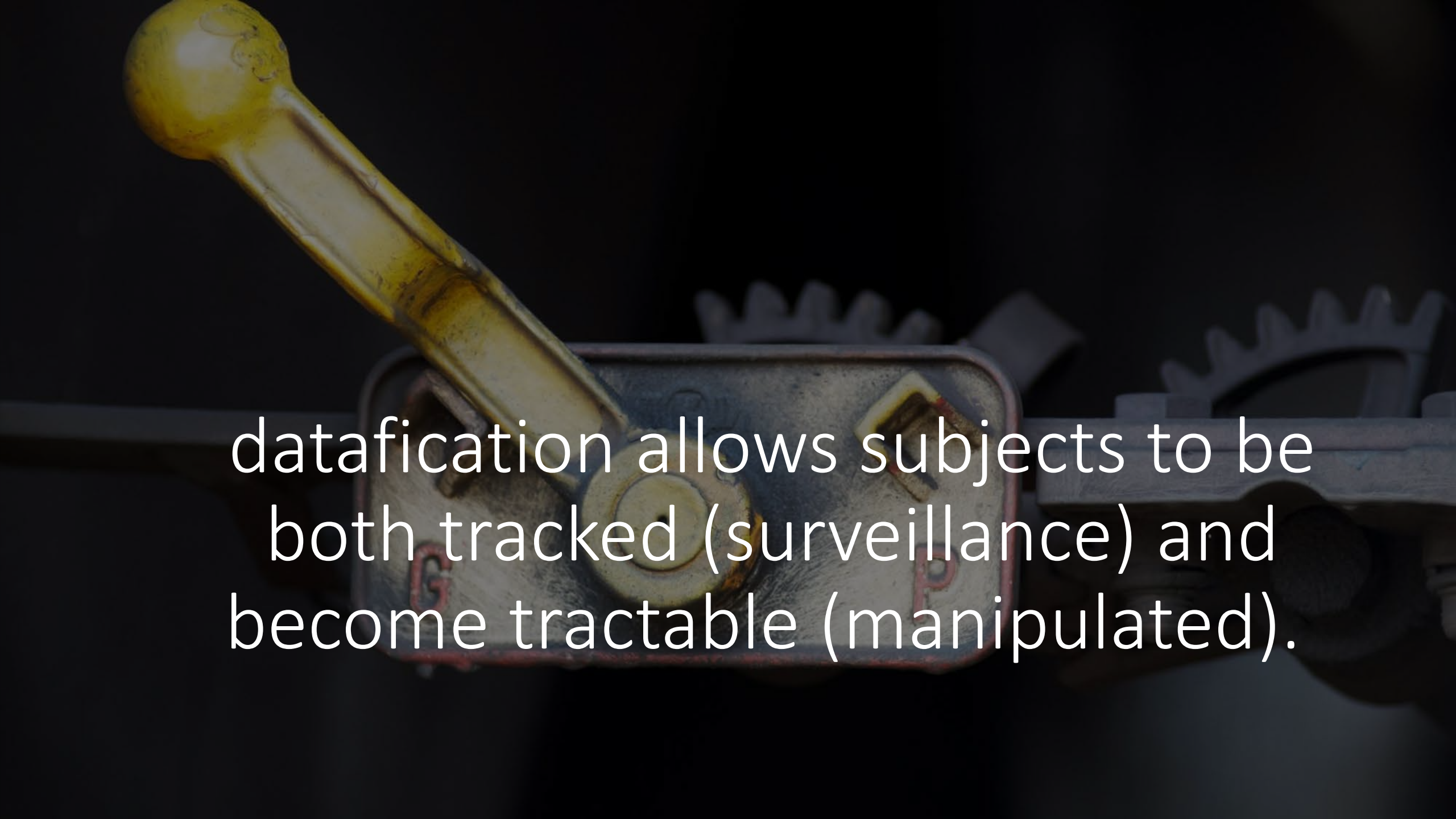


hospital  
appeared out  
banner of the Spanish

Like the Caribbean people, we  
something truly unprecedented.

Once we searched Google, but  
now Google searches us. Once we  
thought of digital services as free,  
but now surveillance capitalists  
think of us as free.

then there's the "inevitability"  
technological  
ids.

A close-up photograph of a mechanical lock mechanism. A yellow handle with a rounded end is inserted into the lock. The lock body is metallic and shows signs of wear. In the background, several interlocking gears are visible, suggesting a complex mechanical system. The lighting is dramatic, highlighting the textures of the metal and the handle.

datafication allows subjects to be  
both tracked (surveillance) and  
become tractable (manipulated).

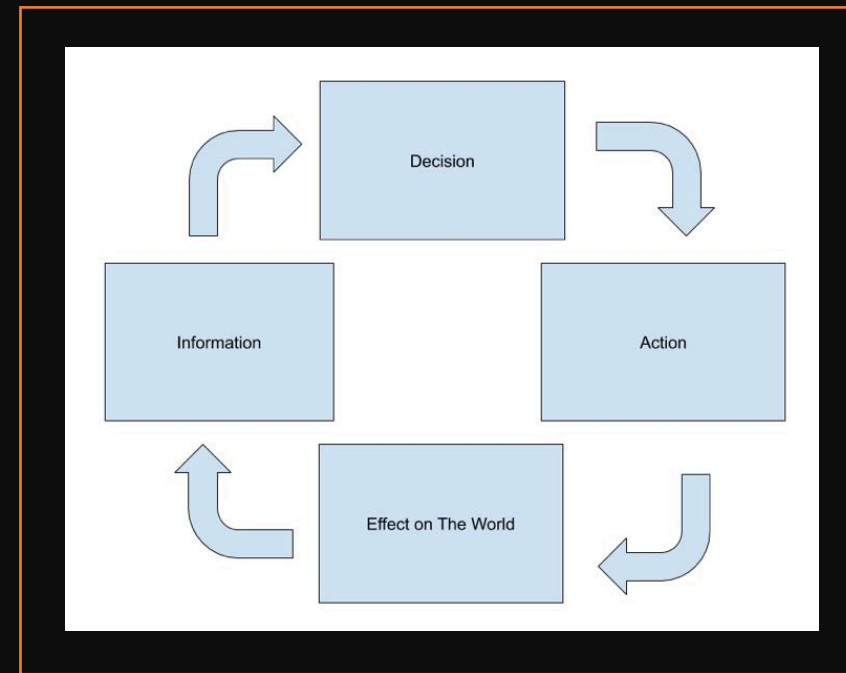


## Digital Twins – “Digital Voodoo Dolls”

- Tristan Harris explains how video service youtube worked to retain users: “[I]n the moment you hit play, it wakes up an avatar, a voodoo doll- like version of you inside of a Google server. And that avatar, based on all the clicks and likes and everything you ever made “those are like your hair clippings and toenail clippings and nail filings that make the avatar look and act more and more like you so that inside of a Google server they can simulate more and more possibilities about if I prick you with this video, if I prick you with this video, how long would you stay?”

- **Cybernetics:** the study of communications and controls of any system by using technology. Comes from the greek word meaning “The art of steering”

- **Control Loop:** a self correcting system which senses, analyses, decision-makes and adjustment and then actuates towards a goal



# Bayer **Climate Field View** has over half of Digital Agriculture Platform market

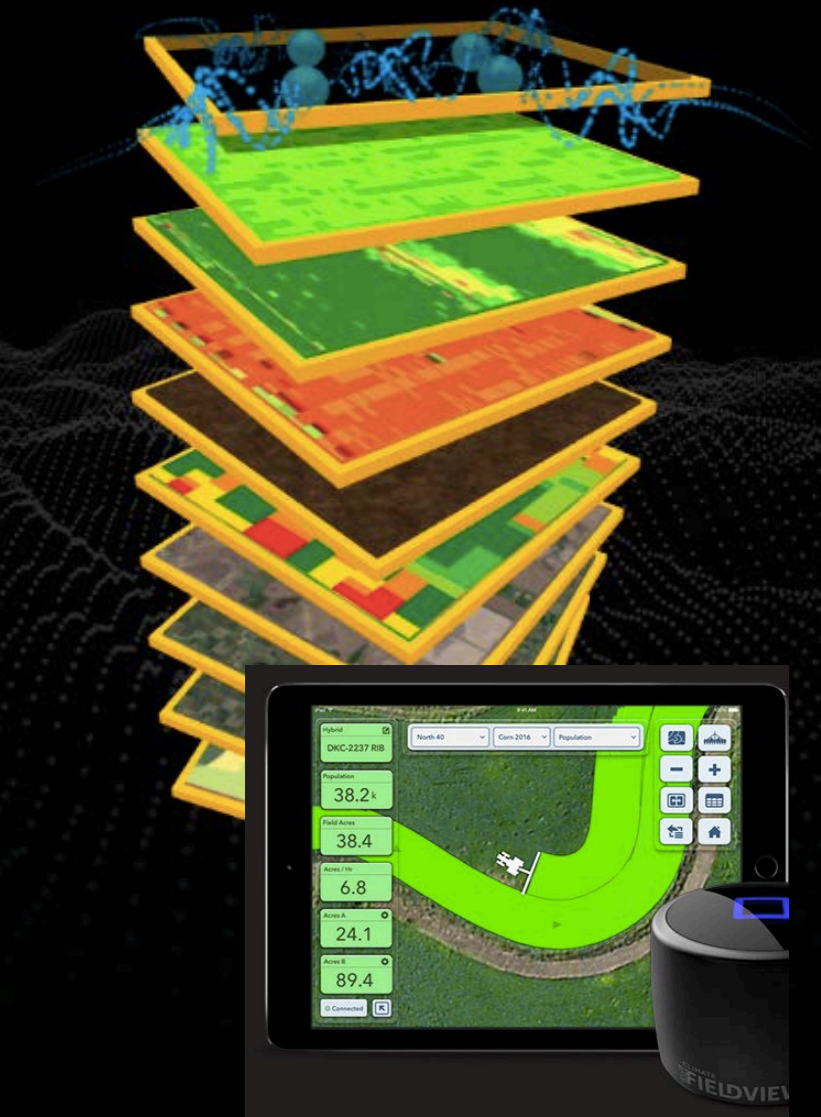
180 million acres - 23 countries - 70 partners – 87.5 billion data points



## No Datapoint Is Too Small

Down to the most minuscule of details, we test our assumptions on the grandest of scales. Searching an immense library of genetic data all the way to the speed of a tractor driving across a field. Before a recommendation is ever sent to your tablet, it's been analyzed with advanced, predictive science-driven algorithms. Because close enough is not good enough.


Climate FieldView™ exists to enhance what you know about your fields. Filter through every layer of data to arrive at measured and objective insights. And discover exactly what you need to make each acre more profitable.





# Lock –Ins...

Get FieldView™ free for one year when you enroll in BayerValue



[SIGN UP FOR FIELDVIEW](#) [LEARN MORE ABOUT BAYERVALUE REWARDS](#)



## 50% off FieldView Hardware

Purchase products from a minimum of two BayerValue segments and save 50% off the cost of your Climate FieldView hardware as a rebate on your BayerValue cheque\*

\*Offer applies to hardware purchased on the Climate FieldView order portal only and receive up to a maximum of \$2,000 rebate

## DAY

Normal Camera for



## MARKETING

October 24, 2021

Added to gains . Mike  
Updated: 02-24-2021

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## BAYER MOVES AHEAD WITH OUTCOME-BASED PRICING MODEL

THIS BUSINESS MODEL SELLS A YIELD GOAL INSTEAD OF PRODUCT.

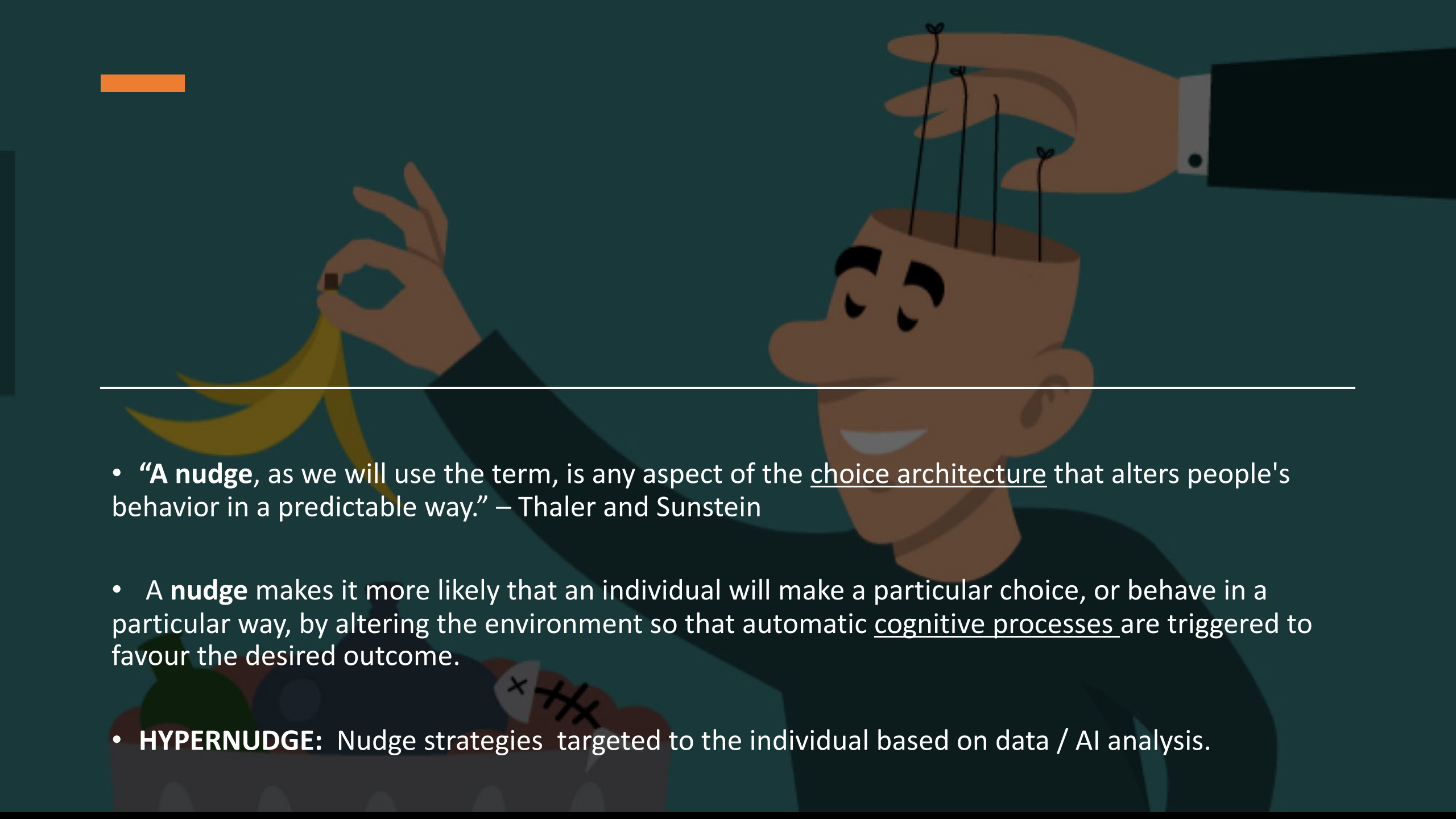
By [Gil Gullickson](#)  
10/7/2019

Bayer Crop Science is moving ahead with its outcome-based pricing model that it has piloted with several U.S. corn farmers this year.

“Today, we get paid for the inputs we sell,” says Liam Condon, president of Bayer Crop



Rather than pay a flat rate for seeds or agrichemicals, the program sells products based on a performance guarantee, such as a specific crop yield or level of weed reduction. If the product doesn't deliver, Bayer will refund part of the cost. But if the product exceeds expectations, Bayer will take a portion of farmers' additional profits, perhaps as much as 50%, [according to one report](#).

- 
- An illustration of a man with a plant growing out of his head, symbolizing cognitive processes. The man is smiling and has his eyes closed. A hand is shown holding a small plant stem, ready to be placed in the man's head. Another hand is shown holding a yellow ribbon, which is being tied around the man's head. The background is a dark teal color.
- “A **nudge**, as we will use the term, is any aspect of the choice architecture that alters people's behavior in a predictable way.” – Thaler and Sunstein
  - A **nudge** makes it more likely that an individual will make a particular choice, or behave in a particular way, by altering the environment so that automatic cognitive processes are triggered to favour the desired outcome.
  - **HYPERNUDGE**: Nudge strategies targeted to the individual based on data / AI analysis.

## Shaping Europe's digital future

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[Home](#) > [Policies](#) > [The Digitisation of the European Agricultural Sector](#)

# The Digitisation of the European Agricultural Sector

The digital transformation of agriculture will facilitate cooperation across the value chain, support farmers, and offer opportunities for innovative SMEs.

Technologies, such as artificial intelligence (AI), robotics, the Internet of Things (IoT), Edge Computing, 5G, blockchain and supercomputing, all have the potential to make agriculture more efficient, sustainable, and competitive.

Nevertheless, as in other sectors and society as a whole, the digital transformation of agriculture poses the risk of a digital divide. For example, between connected and disconnected farms and economically small and large farms.



## Agriculture Innovation Mission (AIM) for Climate: Europe notably absent in supporting USDA and Gates backed technology driven initiative to increase investment in climate-smart agriculture

United States Department of Agriculture | October 7, 2021



Credit: AIM f



Trend : A common thread throughout the full agrifood digitalization push end to end is **climate narratives** - that digital ag will sequester carbon, that biodigital design will create climate smart seeds and breeds, that digitalization will shorten supply chains and design plant-based, supposedly low carbon, foods



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**BAYER** Global  
This is Bayer / Health / Agriculture / Products / Innovation / Sustainability / Media / Investors Career

Home > News & Stories > Shaping Agriculture > Carbon Capture against Climate Change

## How Agriculture Can Capture Carbon

# Why Farming Superpowers Are Critical in the Fight Against Climate Change

The illustration depicts four characters representing different aspects of modern farming technology. At the top, a man in a yellow suit with a blue cape flies through the air. To the left, a woman in a green suit holds a golden trident. In the center, a man in a dark suit with a red harness and a tablet looks at a device. On the right, a woman in a plaid shirt and blue cap stands with her hands on her hips. The background shows a farm with a barn and silos under a blue sky.

# What Bayer says to Investors:



## Digital Unlocks Scalable Climate-Smart Business Models

Carbon Markets Valued at >\$200bn/year<sup>1</sup> and Growing with Consumers' Demand for Sustainability

**FIELDVIEW** has the potential to streamline the way carbon is measured, verified and reported, to enable scalable, climate-smart business models

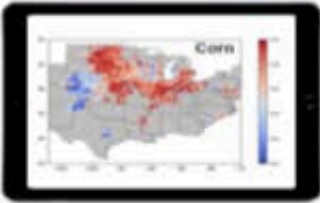


Quantification



CO<sub>2</sub>e Total

Verification & Reporting



Crop Rotation by Field

### Carbon Initiative

**~2,500** participating farmers in Brazil and the U.S. alone      **10** countries covered      **1.5m** acres globally

- Long-term program providing annual incentives to Climate FieldView enrolled growers for verified and validated climate-smart practices like no-till and cover cropping
- Ranked **#1** in the U.S., scoring very high in terms of grower trust<sup>2</sup>

### Enables 3 Expected Downstream Revenue Opportunities

Carbon Services

Product sales

Carbon assets

- Project Carbonview, collaboration with Bushel, The Andersons, and built on Amazon Web Services cloud infrastructure, expected to track carbon emissions across ethanol chain
- CHS Inc., largest Ag Coop in the U.S., agreed to be our carbon program provider, providing advice to growers moving to sustainable practices.

<sup>1</sup> Source: <https://www.reuters.com/article/us-carbontrading/turnover/global-carbon-trading-turnover-at-record-214-billion-last-year-research-idUSK6N12N1BN>; <sup>2</sup> Forward Group Research Carbon Credit Program Perceptions & Evaluation, July 2021



PepsiCo began using iCrop 2.0 in Spain and piloted combining it with irrigation scheduling technology, which led to **water irrigation accuracy improving from**

**48% ▶ 92%**

in the following growing season.

seen some strong results. PepsiCo began using iCrop 2.0 in Spain and piloted combining it with irrigation scheduling technology, which led to water irrigation accuracy improving from 48% in 2017, prior to deployment, to 92% in the following growing season.

We have been using our iCrop technology with farmers over the past number of years to capture data across 48,000 hectares of potato production in 16 markets in Europe. We track over one million crop data points and share this with our farmers to help them understand more about crop performance and the correlation between soil type, weather, irrigation and water usage. We have already



**PEPSICO**



**Tropicana**





Data = Electrons = Energy (+ Data Infrastructure )

This article is more than 1 year old

# 'Tsunami of data' could consume one fifth of global electricity by 2025

Billions of internet-connected devices could produce 3.5% of global emissions within 10 years and 14% by 2040, according to new research, reports [Climate Home News](#)

*Climate Home  
News, part of the  
Guardian  
Environment  
Network*

Mon 11 Dec 2017  
13.27 GMT





# Farm Data is VERY Big (and energy hungry) Data

IBM estimates that PA [precision agriculture] generates 500,000 data points per farm each day.

It has been estimated that **up to 7GB of data per acre** may be collected . Looking at the **93 million acres of corn** in the United States that is **651 petabytes of data** – equal to more than 145 million DVD's of data annually - just for US Corn.

Internet uses average of **about 5 kWh to support the utilization of every GB of data**, which equates to about \$0.51 of energy costs. Only 38% of those costs are borne by the end-user, while the remaining costs are thinly spread over the global Internet through which the data travels;

So **3.33 billion kWh** of energy to collect corn data in USA alone (ie **3.3TWh**)

**US Corn Data = about electricity use of Senegal**

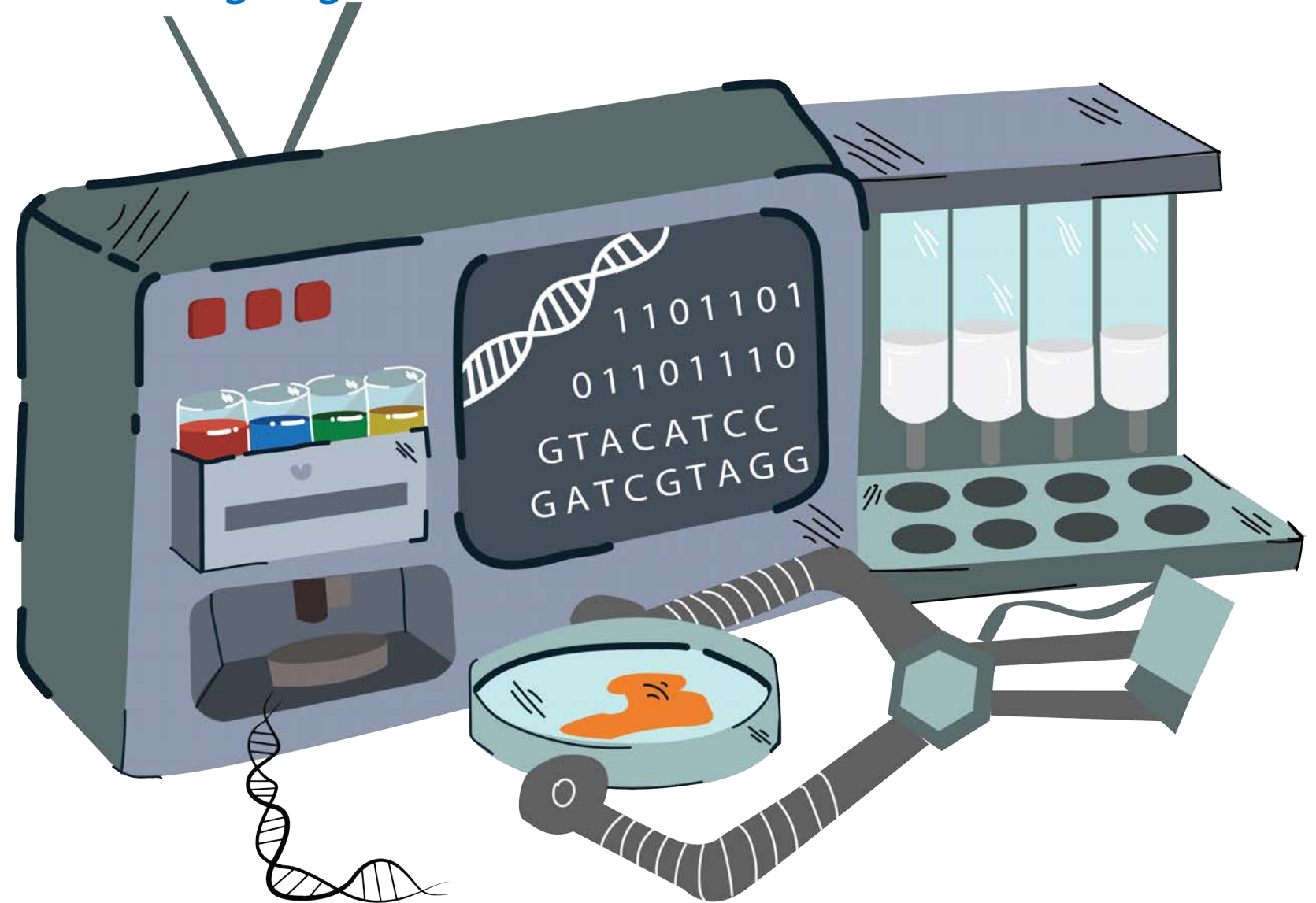
(add Soy? Cotton? Canola? Wheat? Canada? Rest of World etc)

# The Digital Agri-Food Value Chain.

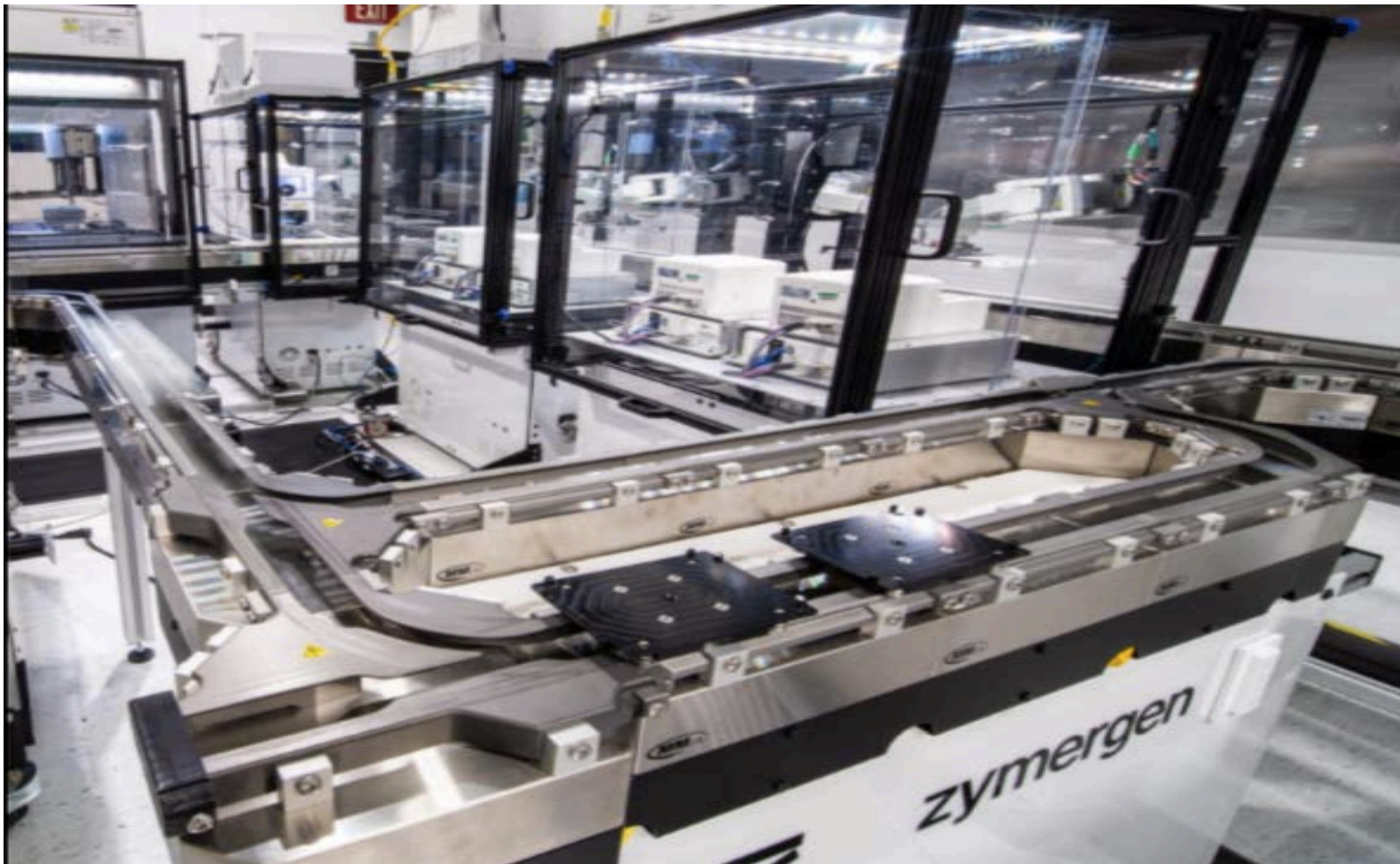


# 1. Biodigital Breeding and Genetics ..

*Synthetic Biology, Gene Editing Digital DNA*

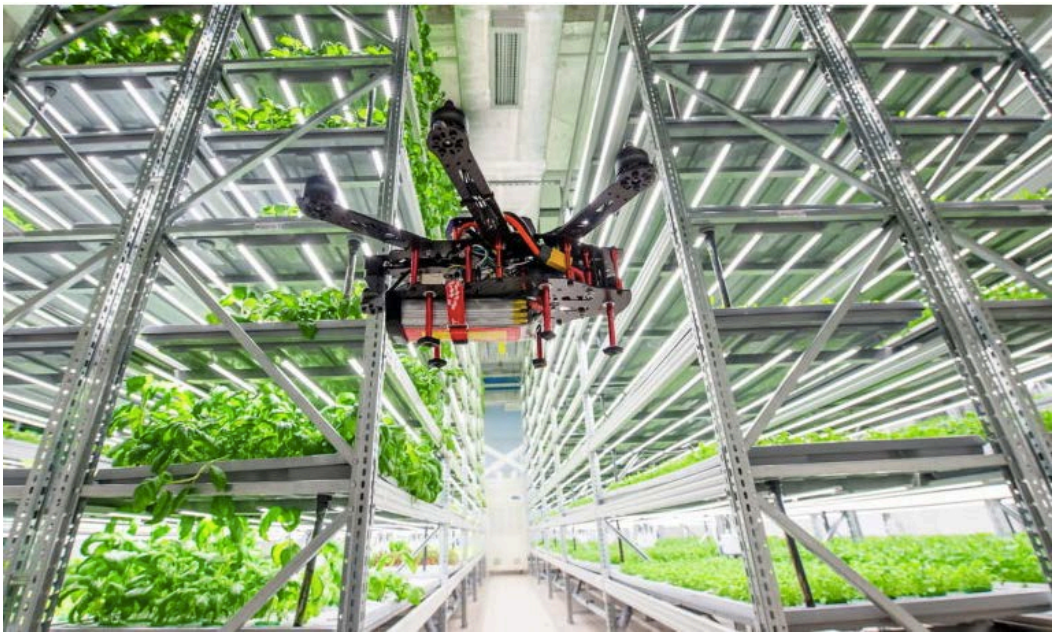


“Zymergen’s algorithms suggest making 1,000 or so changes to the microbe’s genetic material . Then the robots take over, injecting the suggested DNA snippets into the specimens, testing their properties, collecting data and feeding that information back into the data trove.” - Bloomberg

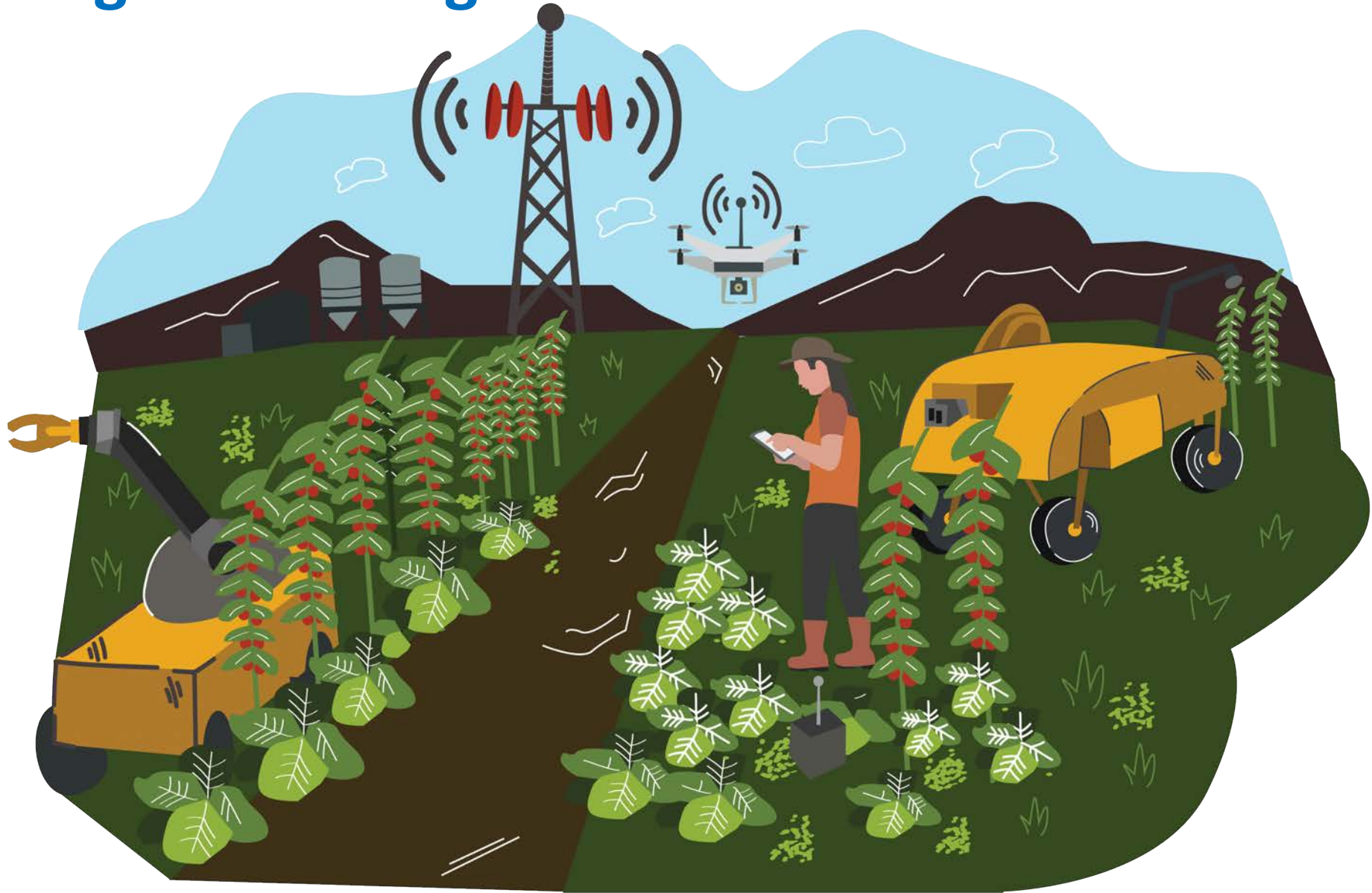


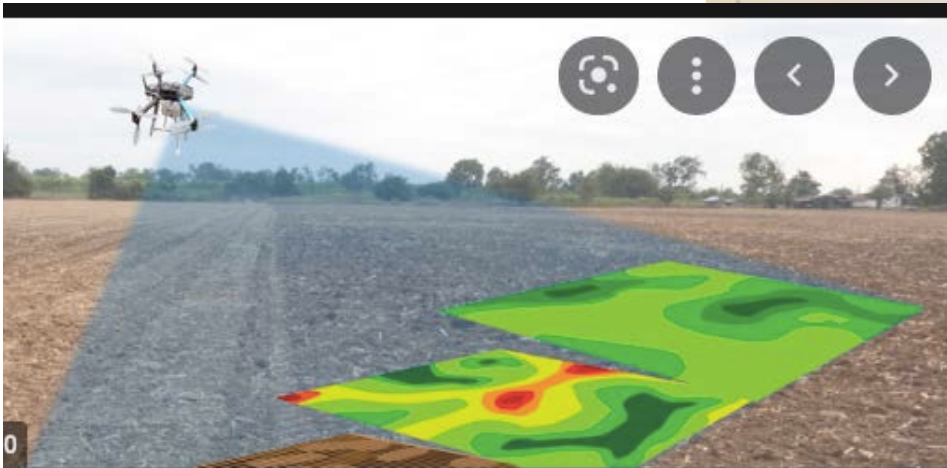
## 2. The Digital Greenhouse/ vertical farms





### 3. Ag 4.0: Digital Farming





Customized Insights for Decision Making

- View Field Data in Real Time
- Compare Data Layers
- Analyze Crop Performance in Season
- Manage Nitrogen Applications
- Create Seeding Prescription



**Smart Farming 4.0**  
The future of agriculture

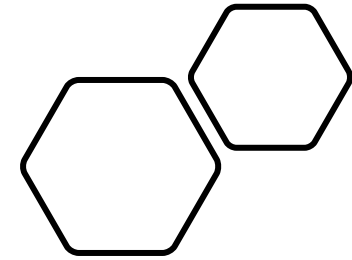




**encirca**<sup>SM</sup>  
VIEW



**atfarm**



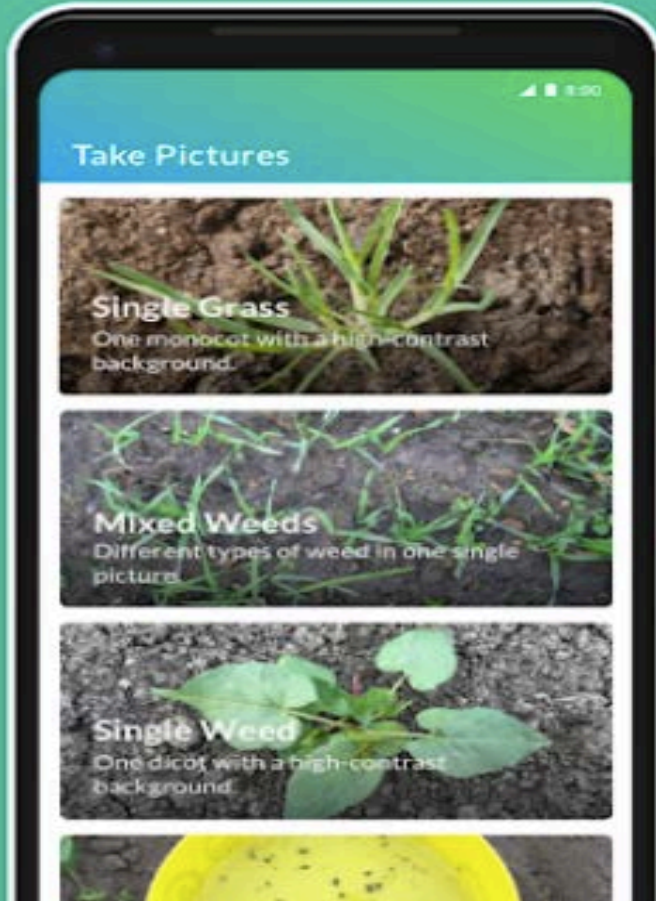
“They are basically in a race to gather as many total acres of data, ingest it into the system,

They know if they’ve got it, they’re in control. It’s a giant land grab.”

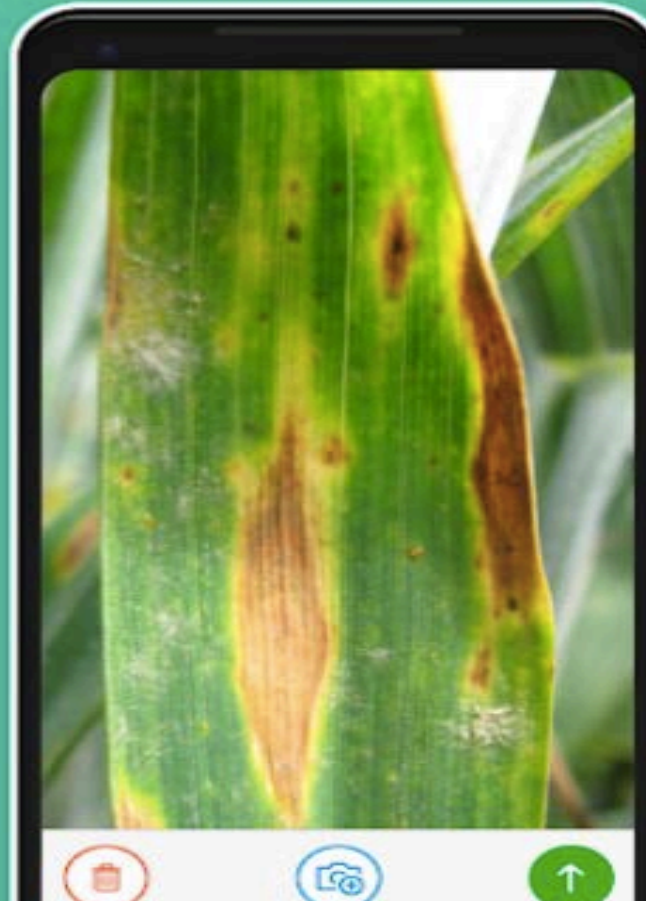
**Steve Crubbage - Farmobile**

Bayer's **FieldCatcher** is an artificial intelligence app that enables farmers to use smartphone images to identify weeds, pests, and diseases. "By using image recognition, we provide farmers with access to a virtual agronomist that helps with the often difficult task to identify the cause of crop issues."

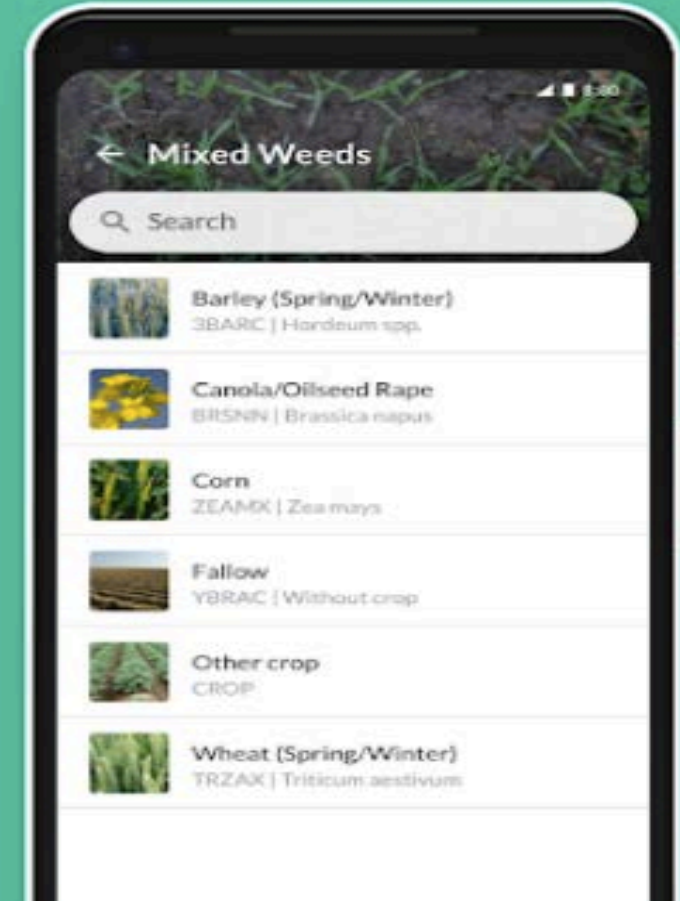
### Simple image collection



### Easy upload



### Fast annotation



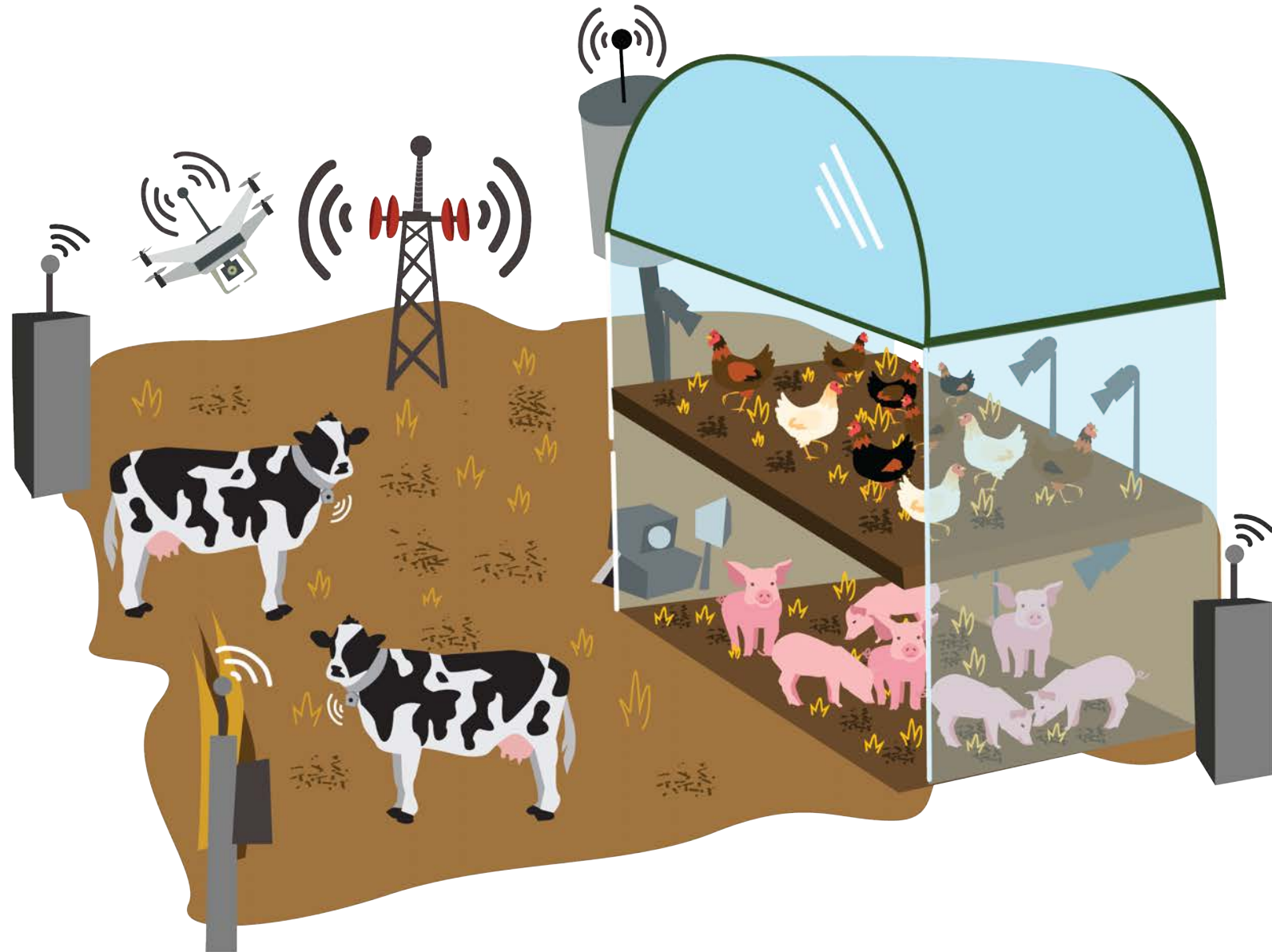


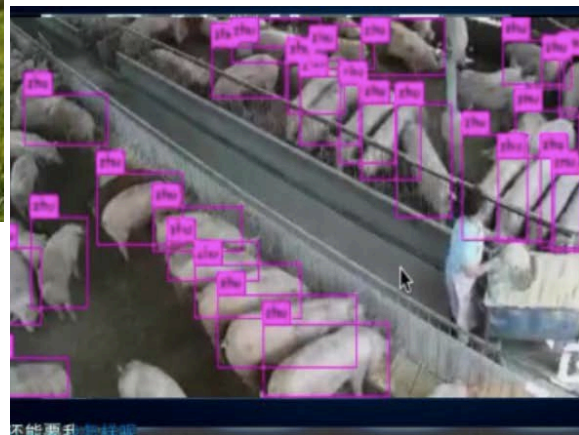
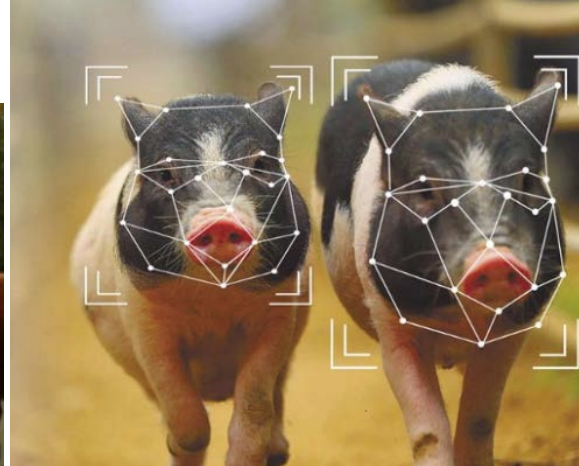
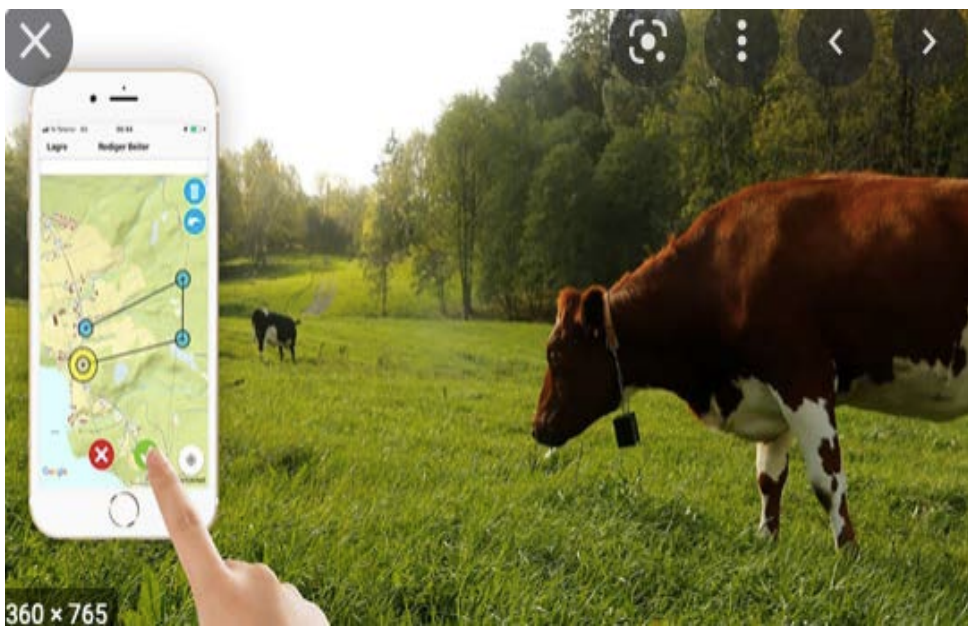
“Mental mechanization of labor has been going on for decades—essentially seeing workers as robots and demanding higher and higher productivity with less and less regard to their human condition. So for them to flip the switch into actual robots is hardly a groundbreaking decision. It’s just the next phase in the process.”

Greg Asbed, of the Coalition of Immokalee Workers,



## 4. Digital livestock farming





## 4. Digital Grain and Commodity Traders





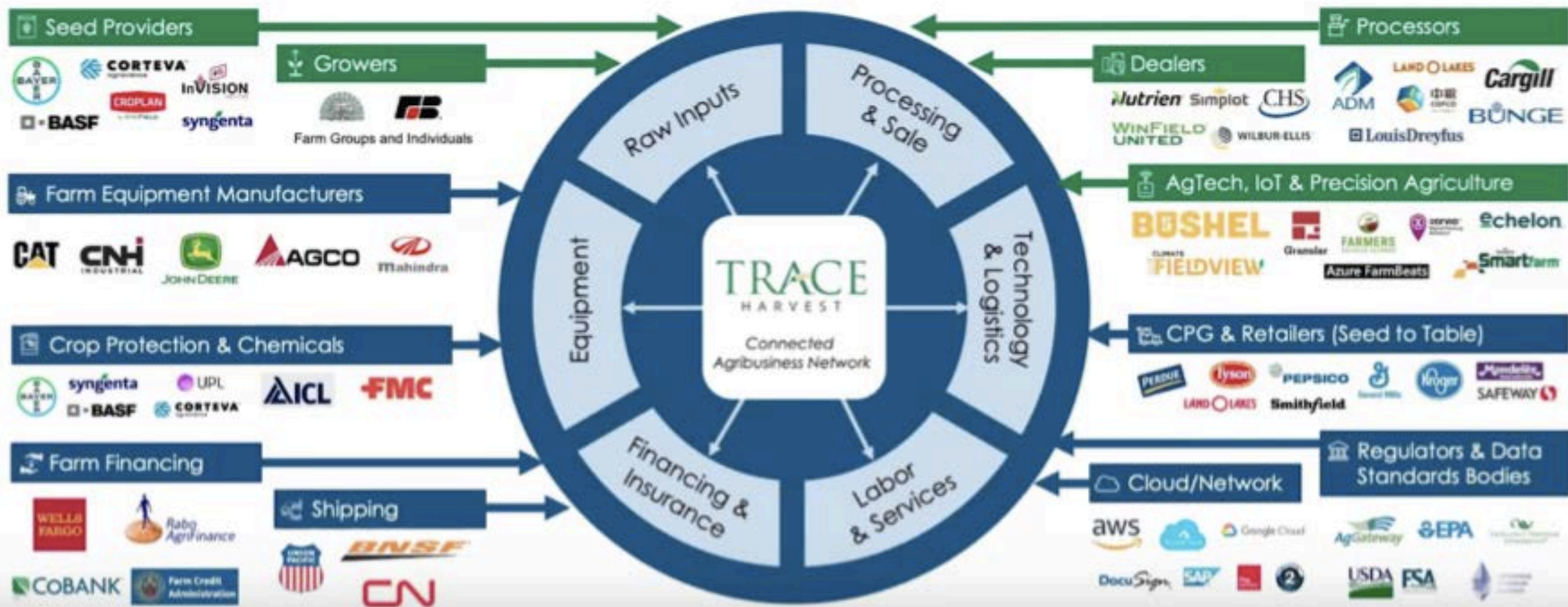




# Future Vision of the TraceHarvest Network



Connect the deep and expansive agribusiness world for scalable, shared benefit



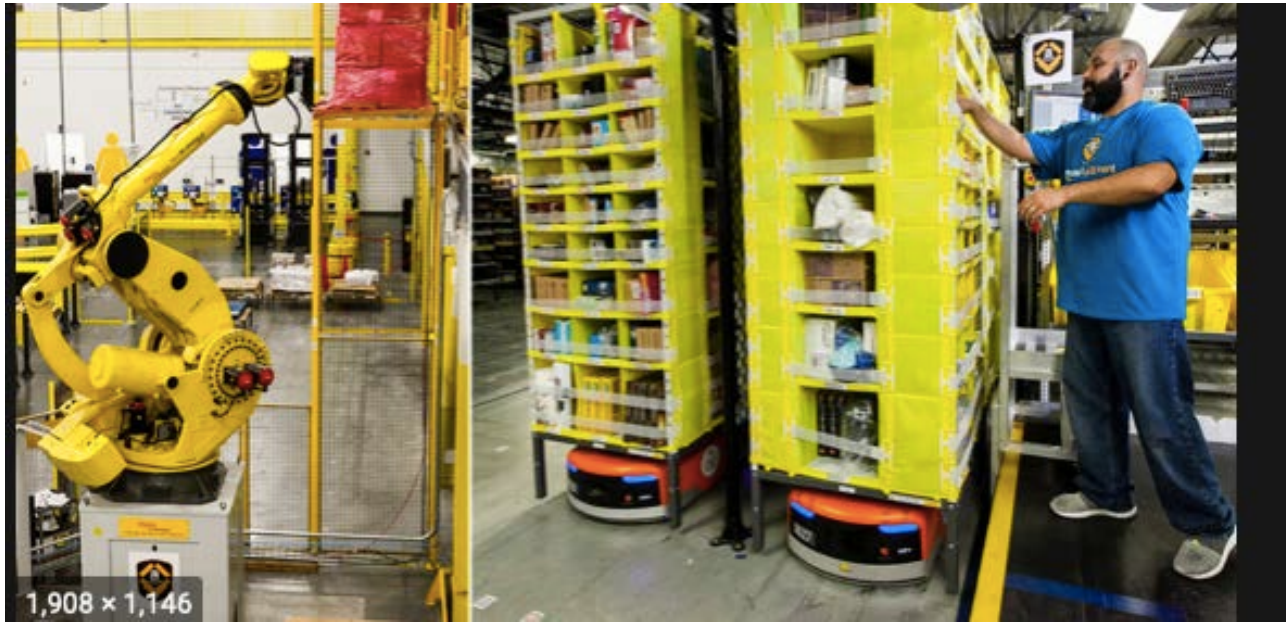
# 5. Digital Food Processing and Production





## 6. Logistics internets, digital distribution





## Amazon patents wristband that tracks warehouse workers' movements

Bracelet, which can vibrate to point an employee's hand in the right direction, would further increase surveillance of work environment



## Lessons from other industries...

- introduction of robots means production quotas for workers in the warehouses have increased, putting more strain on the workers and increasing the injury rate.
- One worker in a warehouse with robots said workers previously were expected to process 100 items an hour but that the number rose to 400 after robots were introduced.
- workers said the robots ferrying items through the warehouse meant they were now confined to workstations, standing still and repeating monotonous tasks.
- Internal documents show that facilities with the robots have injury rates about 50% higher than those without,



# 7. Digital Grocery







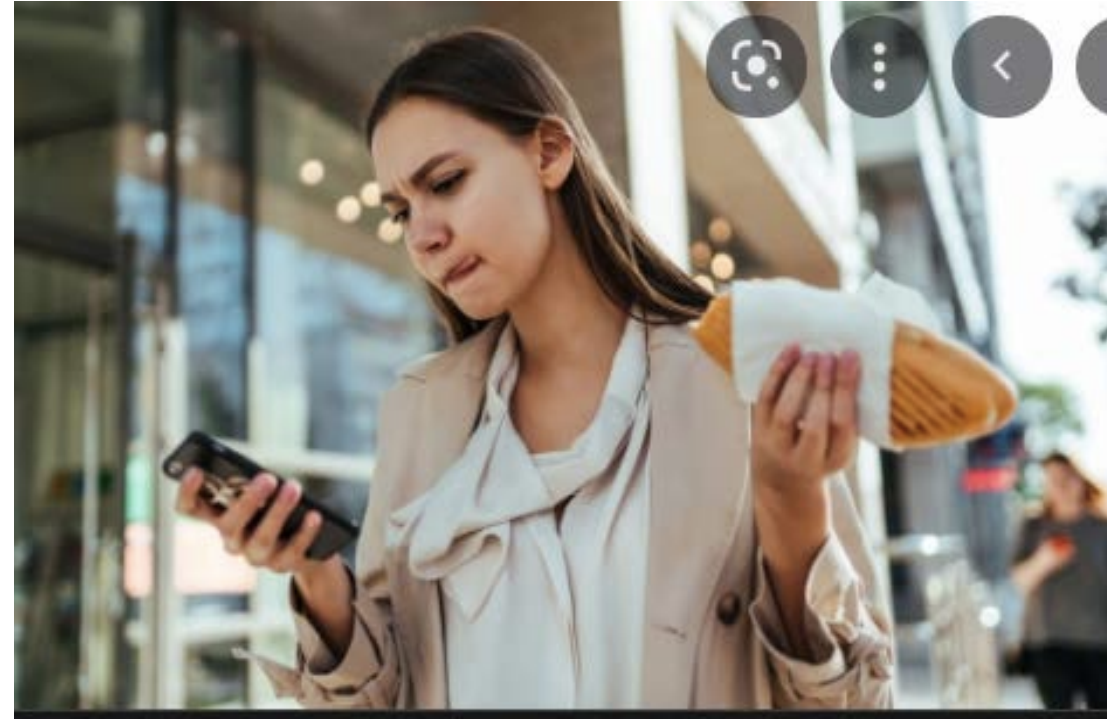
## 8. Digital Food Delivery





## 9. The Digital Food Consumer





Three Existential  
questions for a digitally  
dependent food system.

*All of these new technologies rely on a secure Internet to perform properly, and any disruption to even one device could trigger a domino effect, adversely impacting farm production & potentially jeopardizing the entire U.S. food supply.*



'Ripe for the Picking' by Hackers

...y have forced the majority of industries to adapt and  
...exception.

...s (IoT) weaves its way into the farming process and the  
...ers throughout the supply chain be aware of their  
...aster than the very crops that sustain this ind'

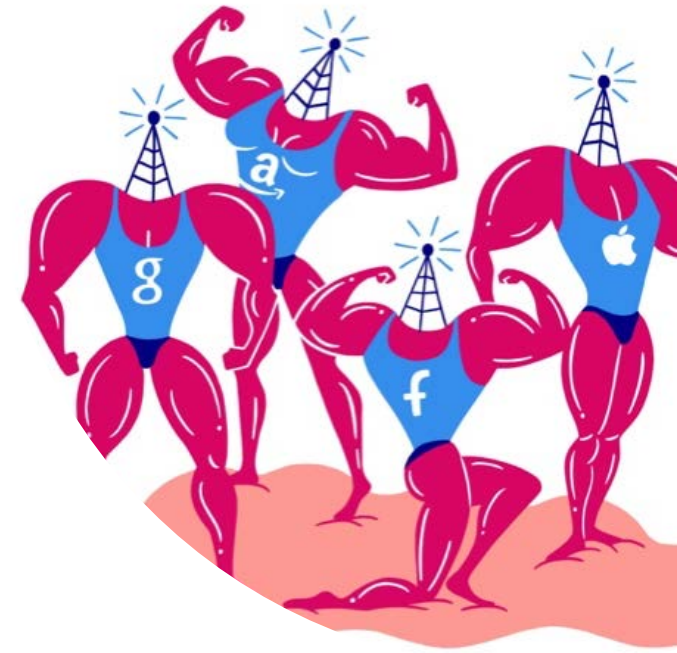
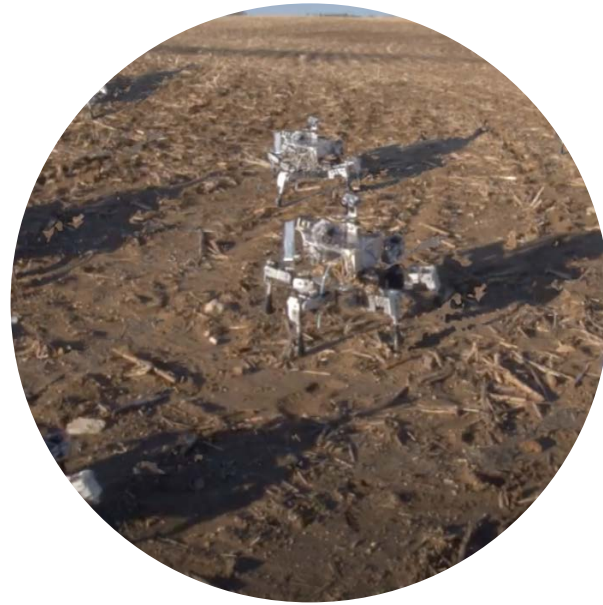


1. What if it is hacked or the internet goes down?



2. What if it goes unexplainably wrong?





ONSAN'

3. How does this square with Food Sovereignty?, Climate justice? Digital Justice?



