

## AGENDA

AgriFoodTech Venture Investing Landscape

CEA and Alt-Protein

Specialty Crop Labor Challenge

Automation Solutions

Peru

Biological Solutions

Leadership in AgTech



## Western Growers – Walt Duflock

Western Growers – 2,000+ specialty crop growers in western US that grow over 60% of fruits, nuts, and vegetables for the country (+ exports)

5<sup>th</sup> generation family farmer (south Monterey County – cattle, wine grapes, and specialty crops)

25+ years at Silicon Valley startups (eBay +)  
(marketing/sales/BD roles)

9 years in AgTech – SVG-THRIVE Accelerator; SVP of Innovation at WG



## VENTURE INVESTING LANDSCAPE

- 2023 was challenging for VCs in almost all segments
  - SVB, lack of exits (8 in 2023Q4), LPs not writing checks
  - VC \$s down from \$242B in 2022 to \$171B in 2023
  - VC deals down from 17,592 in 2022 to 15,766 in 2023
  - Only bright spot was AI (\$50B in 2023 – almost 1/3 of total)
- Exits (IPO or M&A) needed for investors to come back
  - Venture returns underperforming traditional segment returns
  - IPO window has slammed shut and stayed shut (table)
  - Open Table re-opened the market in 2008-09 (not easy – A16Z | Jeff Jordan)
  - Instacart – did not re-open the IPO window

### Venture capital funding drooped in 2023 amid global economic slowdown

Crunchbase report says global startup investment fell 38% overall in 2023, despite increases in the AI, insurance, semiconductor, and battery sectors

### FINANCIAL TIMES

COMPANIES TECH MARKETS CLIMATE OPINION LEX WORK & CAREERS LIFE & ARTS HTSI

Venture capital investment [+ Add to myFT](#)

### US venture capital fundraising hits a 6-year low

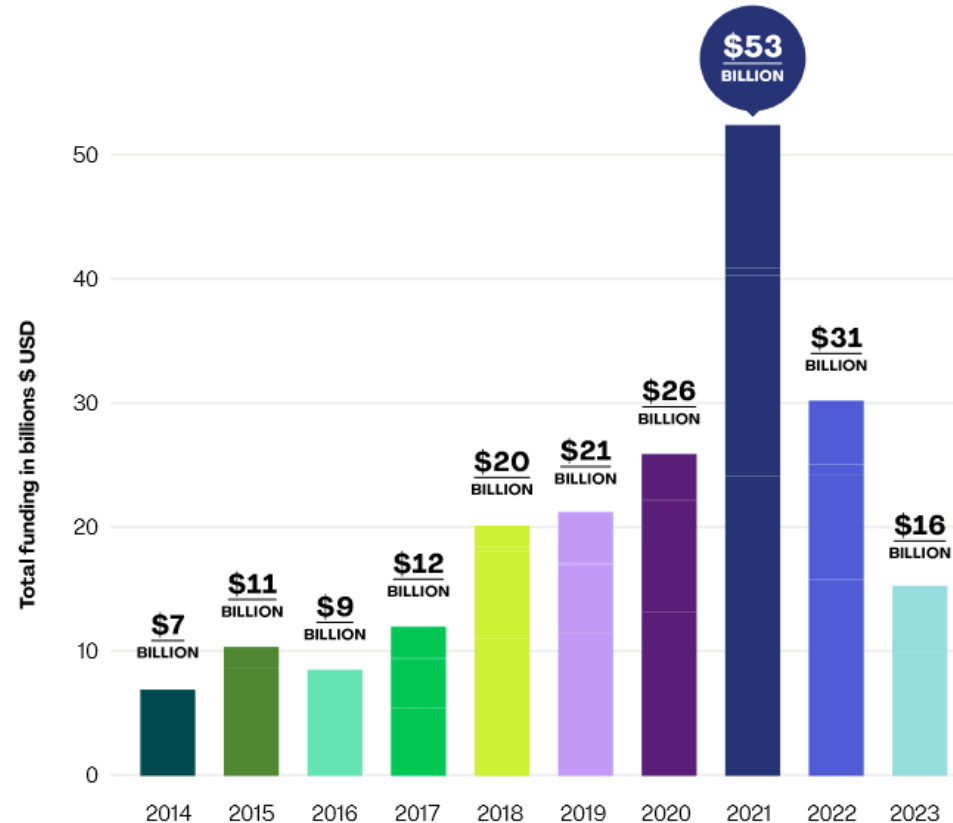
A 60% decline in 2023 from the year before sends a gloomy signal to funders and the start-ups that rely on them

# 10 years of agrifoodtech Global

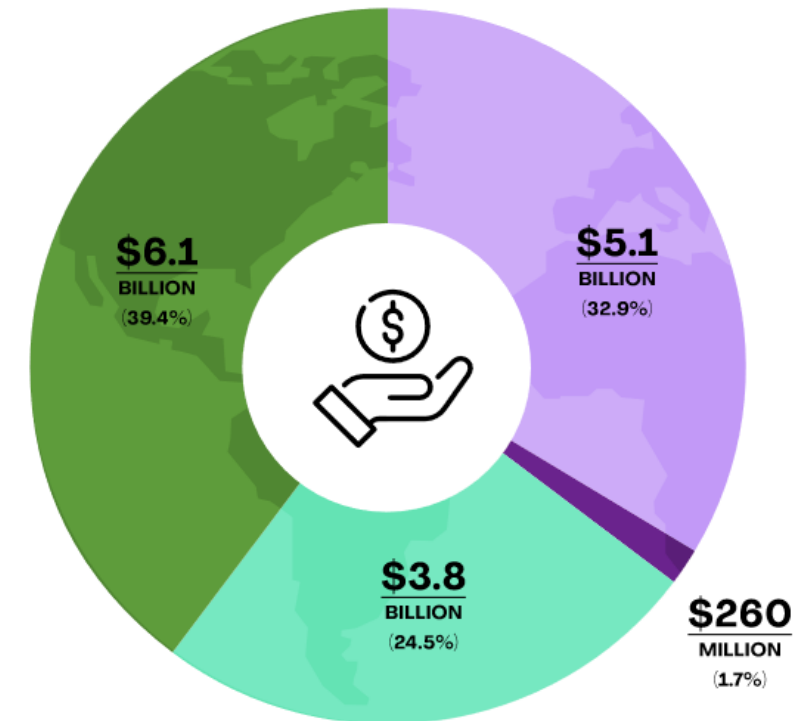
**\$15.6 billion**  
raised globally in 2023

**\$204.7 billion**  
raised globally since 2014

### Global agrifoodtech investment by year



### 2023 agrifoodtech funding by region



● Americas ● Asia ● Africa ● Europe



# Investments by category

2023 (\$ USD)

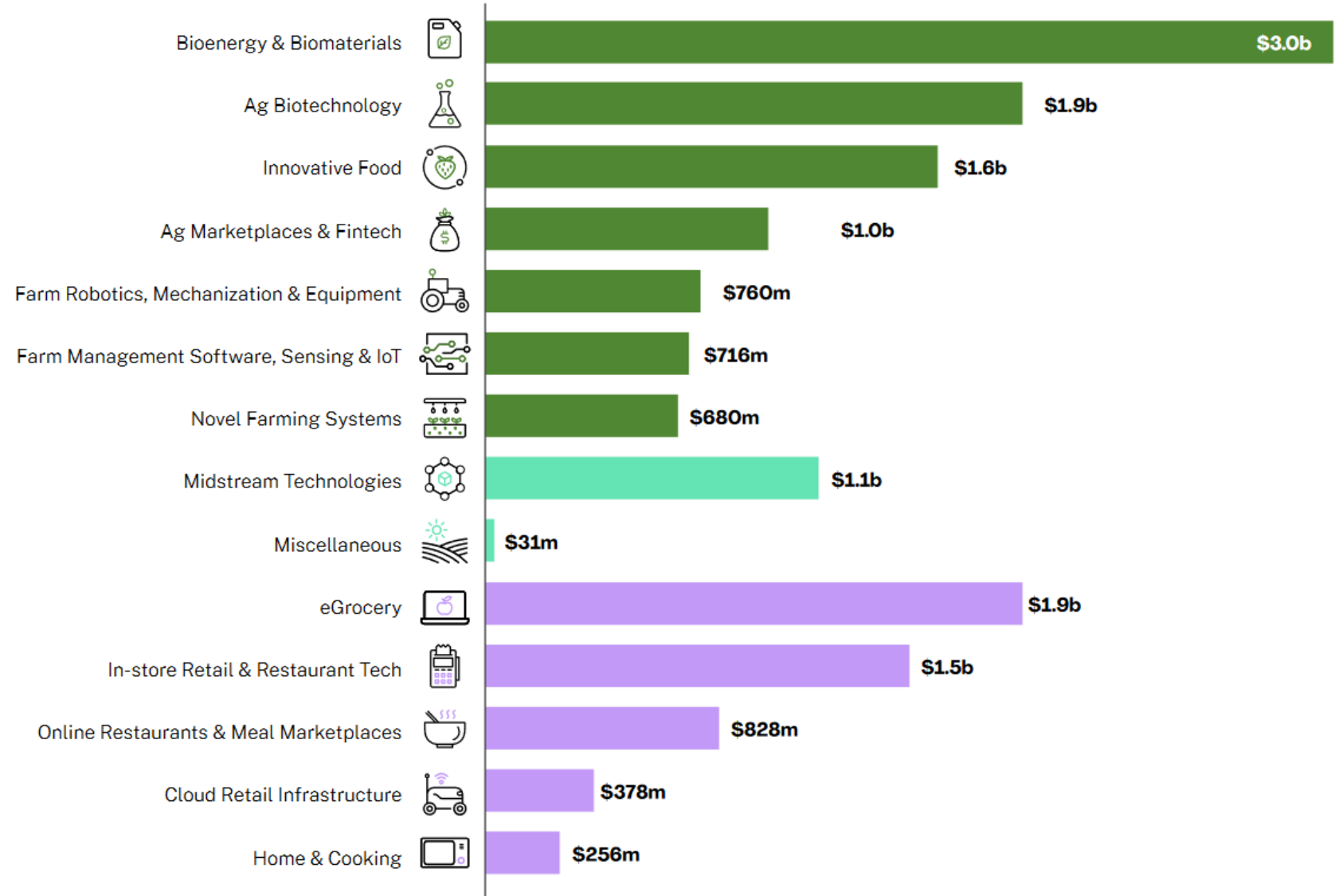
Two categories experienced year-over-year growth in 2023: Bioenergy & Biomaterials (+20%) and Farm Robotics, Mechanization & Equipment (+9%).

While there has certainly been additional innovation in alternative materials and fabrics, a large \$830m investment for Footprint somewhat skewed the picture.

Funding to Innovative Food startups (-50%), which includes the beleaguered alternative protein category, did not decline as much as most other categories; just Ag Biotech (-34%) and Ag Marketplaces + Fintech (-22%) fared better.



- Upstream
- Midstream
- Downstream



## AGRIFOODTECH VENTURE INVESTING LANDSCAPE

- 69% drop in funding in 2 years - \$50B (2021) to \$30B (2022) to \$15.6B (2023)
- Hardest hit segments – CEA, alt protein (42% of \$s in 2021)
  - How do we avoid ESG/carbon/sustainability becoming the next CEA/alt protein?
  - How do we optimize the now limited capital pool we have for AgriFoodTech?
- Many startups at risk (1,200+ biological 700+ automation – 90%+ will end badly)
  - How do we do acqui-hires and IP asset sales more efficiently and effectively?
  - How do we increase the conversion rate of fundraising pitches when capital shrinks?
- Leading indicator of more bad news – LPs sitting on sidelines with lots of dry powder
  - Capital to deploy – AgTech VC unable to compete for it effectively
- VC and PE and strategic VCs (John Deere, Bayer, Yamaha) may get active for different reasons
  - Financial v strategic returns
  - M&A as R&D alternative

## CEA (July 2023 update to WG Innovation Committee)

- From investor perspective, CEA remains challenging
  - Failed unit economics – facility and retail SKU
- Further investment in Vertical Farming 1.0 unlikely
  - \$7B total investment over 5 years
  - Down 91% YoY in 2023Q1 (\$879M/46 deals to \$75M/14)
  - Adam Bergman (Citi) – “almost all current entrants will fail”
- Early discussions of Vertical Farming 2.0 (sustainability) going nowhere, unit economics need to be the focus
  - Progress primarily in greenhouse
  - Primarily greenhouse
  - Plenty – Virginia launch, Driscoll’s partnership

### What Does AeroFarms' Bankruptcy Signal for CEA's Future?

HENRY GORDON-SMITH | JUNE 13, 2023



### AppHarvest's largest farm faces foreclosure

June 8, 2023 - General News, By Pamela Riemenschneider

PACKER TECH

### Vertical farmer Kalera files for Chapter 11 bankruptcy

### Q&A: Fifth Season's former VP on why it failed and how vertical farming must change

April 6, 2023 Jennifer Marston

### VC investment in indoor farms plummets 91%

By [Rosie Bradbury](#)

May 18, 2023 [View comment \(1\)](#)

## ALTERNATIVE PROTEINS

- Alternative proteins and vertical farming suffered from the same challenges (never green field opportunities)
- Fatal flaws: doesn't taste better, costs too much, cost structure too high
- Media hype led to consumer curiosity, founders building startups, investors writing checks (poor diligence)
- Beyond Meat and Impossible Burger both under huge pressure – they need to find a niche where they can win and current products are struggling to find and sustain consumer traction at scale

### **Beyond Meat and Impossible are introducing new burgers as fake meat tries to stay relevant**

Both Beyond and Impossible are trying to address flagging sales

By Marnie Shure / The Takeout | Published February 26, 2024

### **Can a Healthier Plant-Based Burger Combat Falling US Sales? Beyond Meat Hopes So**

Beyond Meat is revamping its signature plant-based burger, hoping that healthier ingredients will help it boost flagging U.S. sales

By [Associated Press](#) | Feb. 21, 2024, at 9:37 a.m.



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**Specialty Crops Labor Challenge**

Automation Solutions

Peru

Biological Solutions

Macro Trends



## California's Specialty Crop Labor Problem

- Increased regulatory costs
  - 8x lift from \$109/acre/yr (2005) to \$977/acre/yr (2017)
  - Food safety (LGMA/FSMA), health care (Obamacare), labor regs (minimum wage, OT, break rules)
- Reduced domestic workforce availability
  - 8x lift in H-2A from 48,000 (2005) to 378,000 (2023)
  - Adds AEW, housing and transportation costs
  - 2023 – H-2A growth slowed, CA and AZ decreased (unclear if automation, acreage shift, or other cause is driver)
- Cost increases create more pressure to automate or acreage will move to other states and countries



## Expected Result – Acreage and Farmers Leaving

- From 1997 to 2022 (USDA Census data)
  - CA lost 4.6M acres (28.8M to 24.2M) of ag land
  - CA lost 24,000 growers (87k to 63k)
- From 1997 to 2052 (my forecast)
  - CA will lose 8.3M acres (29% of total) to 20.7M
  - CA will lose 49,644 growers (56% of total) to 37k
- When acreage leaves, field, pack house, and AgTech jobs and GDP leave with it
  - Asparagus – 60k acres to 600 (NAFTA and CA regulations)



## California specialty crops needs 360 hours of labor per acre (Prof. Hamilton and McCullough)

- 252M hours needed for 700,000 acres (9 specialty crops)
- 75% harvest | 25% cultivation

Crop	Year	2022 Census Acres Bearing/Grown/Harvested	2022 Census Operations	Cultivation Labor (Million hrs)	Harvest Labor (Million hrs)	Total Labor (Million hrs)
Avocado	2020	44,195	3,397	3.580	1.824	5.40
Broccoli	2023	112,620	833	3.275	15.382	18.66
Lettuce (Iceberg)	2023	102,143	571	3.561	17.937	21.50
Lettuce (Romain)	2023	98,000	478	3.416	16.254	19.67
Orange	2021	161,107	3,202	3.081	5.901	8.98
Peach	2017	37,652	1,087	0.997	3.129	4.13
Plum	2016	11,093	713	0.716	0.305	1.02
Strawberry	2021	46,729	651	12.567	98.320	110.89
Table Grapes	2018	86,643	9,941	32.232	30.279	62.51
<b>Total</b>		700,182	20,873	63.426	189.331	252.76

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## How Is Automation Doing?

- \$100M in automation sales in 2024 (\$500M 2024-2026)
- Some emerging areas of success
  - Weeding – Carbon Robotics, Stout, Farmwise
  - Spraying – GUSS, Ecorobotix, Robotics Plus
  - Harvest Assist – Burro
  - DIY Platform – Farm-NG
- Very limited success with harvesting (75% of hours, time sensitive) – end effectors and operational integration hard
- WG Case Studies, economic templates, WG Assist



**Braga Fresh** →

↓  
**Triangle Farms**

2022 Domestic Hand Labor Costs		vs	2023 Combined Domestic Labor + Laser Weeder				
Crop	Hand weeding Cost (\$/Acre)		Hand weeding Cost (\$/Acre)	Laser Weeder Cost (\$/Acre)	Combined Weeding Costs (\$/Acre)	Net Savings (\$/Acre)	Total Combined Weeding Costs
Spinach	\$900.00		\$282.28	\$267.72	\$550.00	\$350.00	\$1,292,500.00
Cilantro	\$900.00		\$282.28	\$267.72	\$550.00	\$350.00	
Arugula	\$900.00		\$282.28	\$267.72	\$550.00	\$350.00	
Swiss Chard	\$900.00		\$282.28	\$267.72	\$550.00	\$350.00	
Baby Kale	\$900.00		\$282.28	\$267.72	\$550.00	\$350.00	
Red Spring Mix	\$900.00		\$282.28	\$267.72	\$550.00	\$350.00	
Green Spring Mix	\$900.00		\$282.28	\$267.72	\$550.00	\$350.00	
Mizuna	\$900.00		\$282.28	\$267.72	\$550.00	\$350.00	
<b>Totals =</b>	<b>\$2,115,000.00</b>						

2022 Using Contracted H2A Hand Labor				vs	2023 Combined Contracted H2A Hand Labor + Laser Weeding				
Crop	Acres Planted	Contracted H2A Hand Weeding Cost (\$/Acre)	Total Weeding Costs		Contracted Hand weeding Cost (\$/Acre)	Laser Weeder Cost (\$/Acre)	Total Combined Weeding Costs (\$/Acre)	Net Savings (\$/Acre)	Total Combined Weeding Costs
Spinach (Organic)	78	\$1,000.00	\$78,000.00		\$135.00	\$448.73	\$583.73	\$416.27	\$45,530.94
10-Line (oak & Salinova) (Organic)	350	\$1,800.00	\$630,000.00		\$120.00	\$448.73	\$568.73	\$1,231.27	\$199,055.50
Arugula (Organic)	80	\$700.00	\$56,000.00		\$0.00	\$448.73	\$448.73	\$251.27	\$35,898.40
Romaine (Direct seed) (Organic)	600	\$500.00	\$300,000.00		\$140.00	\$448.73	\$588.73	-\$88.73	\$353,238.00
<b>Totals =</b>	<b>1,108</b>		<b>1,064,000</b>						<b>633,723</b>

**Triangle Farms Costs to Run a Laserweeding Program (per Machine)**

	\$/Acre	Hard Costs
3-Bed Laser Weeding Implement	\$216.61	\$1,200,000 (Dep Over 5 Yrs on 1,108 Acres/Year)
Tractor	\$27.07	JD 6-175 \$2,500/month Lease on 1,108 Acres
Hardware + OTA Service Plans	\$74.91	\$83,000 per Year
Fuel	\$28.57	4.5 gal/hr @ \$5/gal
Operators (Loaded) (2x)	\$48.57	Qty: 2 Operators @ \$24.29 ea
Supervisor (Loaded) (1x)	\$33.00	
Operations (moving)	\$20.00	Transport Trucks, Fuel etc
<b>Cost per Acre to run Laserweeder</b>	<b>\$448.73</b>	

- Comparisons between the two different situations and organizations

- Factors: Acreage Covered (Machine Speed/Weed Density), Tractor Cost/Purchase Situation

**Braga Costs run a Laserweeding Program (Per Machine)**

	\$/Acre	Hard Costs
Implement	\$102.13	\$1,200,000
Hardware & OTA Service	\$37.45	\$88,000
Tractor	\$17.45	\$205,000
Fuel	\$20.57	4.6 gal/hr at \$5/gal
Operators (Loaded) (2x)	\$70.12	2 operators at \$25/hr
Logistical Operations (moving)	\$20.00	Trucks, Trailers, Etc
<b>Total per acre cost =</b>	<b>\$267.72</b>	



## Measuring The Health of CA Agriculture

- UC Davis leaders continue to insist CA ag is fine – 2 metrics
  - GDP – continues going up but (much of increase is inflation)
  - Number of workers hired (850k workers – 425k FTE)
- CA ag is not fine – there are better metrics to use
  - Net margin (expenses growing faster than revenues)
  - Number of hours needed per acre (example – SGMA loss of nut trees to rotational crops to mitigate water risk)
- Working with Cal Poly on determining a FICO like scoring platform for measuring quality of ag acreage opportunities between international regions (US v Peru v ??)



## Where would the acres go? Hello Peru!

- Western Growers delegation went to Peru in January
  - Saw world-class avocado, table grape, and blueberry acreage and production facilities (Lima, Pisco, Trujillo)
  - Mix of WG and Brazilian growers
- Peru is competing with South America and US for acreage
  - South America represents 10% of global ag exports
  - Peru's ag exports grew from \$465M (2000) to \$10.6B (2022)
  - Can take all of 1M acres CA likely to lose to SGMA
- Predictions
  - We will not run out of food or acres to farm or soil
  - **The battle will be over who gets to farm the acres we need and who gets the local economic benefit of that farming**



## Mythbusters – Peru Style

- Peruvian government does not invest in ag
  - Nationwide water storage investment (private and public)
  - \$1.3B port with China Belt and Road
- American growers are not welcome in Peru
  - Two economic development areas – ag and tourism
- Agriculture in Peru is under-capitalized
  - We saw hundreds of \$M invested; more on the way
  - There are issues with some roads
- Peru growers use outdated practices
  - South America leads in biological solutions
  - We saw acreage and production facilities that look just like the ones in the US



## Biological Solutions

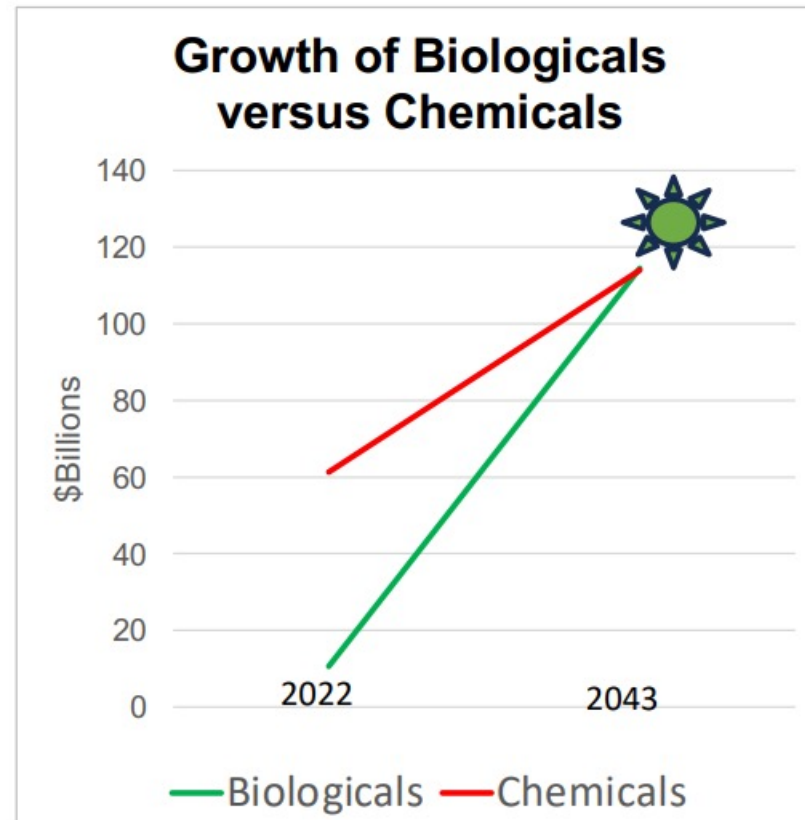
- Problem – 20-40% of global crops lost to pests annually (\$220B disease and \$70B pests)
- Massive regulatory pressure on chemical inputs (Western Europe, DC, Sacramento)
- Reduced efficacy of chemical inputs
- Strategic buyers (Bayer, Syngenta, et al) realize that R&D ROI is harder than strategic investment + M&A
- Known IP paths and valuation models
- Established channel partners – Bayer et al, CAPCA



## Biology = Chemistry (in \$ in 2043)

- Shane Thomas estimates segments will have equal revenue in 2043 (\$114B)
- Accelerated regulation or biological efficacy would reduce that timeframe

## Biologicals Market Could Equal Chemicals in ~20 Years!



Growth rate (CAGR)		12 %
Number of periods	Biologicals	21
Initial value		10,600,000,000 \$
Final value		114,520,791,603.36 \$

Growth rate (CAGR)		3 %
Number of periods	Synthetics	21
Initial value		61,300,000,000 \$
Final value		114,036,057,245.79 \$

Source: Shane Thomas, Upstream Insights

## BUSINESS MODELS

- Biological solutions have some major advantages
- Cost structure and time to market are very different
- There is a place for each as biological solutions get proven and can get to scale
- Source – Pam Marrone

## Chemical & Biological: Very Different Business Models

### Average Chemical Pesticide

Discovery ~12 Years & ~\$300 Million Development Time & Cost

Launch

- Massive upfront capital
- Thousands of global field trials on many crops and pests
- Global launch with large marketing spend; Peak sales in 3 years

### Biopesticide

Discovery

Launch

3-5 Years & <\$10 Million

- Capital efficient but peak sales take longer
- EPA registration granted with small number of pests & crops on label
- Commercial development continues while selling

EPA submission of Version 1.0 (MVP)

V 1.0 Sales with early adopter customers

V 2.0 developed while waiting for 1.0 approval

V 2.0 placed with existing and new customers

## AGRIFOODTECH LEADERSHIP

- Everyone has to help AgriFoodTech media and investors do better decisions and write smarter checks
- Help the startups on the field commercialize and get to scale so they can deliver exits to bring \$s back to space
- Help other startups exit gracefully and transition IP effectively to the next owner(s)
- Peru (South America) leading in ag economic development – investing to help ag succeed
- Many Western Growers Board Members leading in regenerative ag, organic, and sustainable operations and economics



## TECH AND BUSINESS LEADERSHIP – POLICIES HAVE CONSEQUENCES

- Historically CA has led in innovation because of capital, talent, great weather, and wide range of great scenery (from SF to LA to Orange County)
  - Last 20 years increasingly leadership is moving to other places for multiple reasons
- Energy – crypto-currency and data centers locating where cheap energy is abundant
  - Eastern Washington (hydro) and Middle East
  - AI could create demand greater than Japan in 3 years – where will they locate?
- Regulatory framework – low touch, business friendly approaches are winning
  - Autonomous vehicles – Arizona aggressively pro-autonomy (Raven, Uber, Lyft)
- Pro-business policies – Peru investing in private and public water storage infrastructure
  - CA shutting down acreage with SGMA, aggressively pro-Union, and won't reform PAGA
- Better economics – next-gen aviation leader Joby chose Dayton over CA (fall 2023)



## STAYING ON TOP OF THE SPACE

Newsletters – Upstream Ag; Software is Feeding the World

Podcasts – Business of Ag; AgTech So What; Modern Acre

Tech podcasts – All In; BG2; A16Z

Online – AgFunderNews; LinkedIn (Newsletters + Groups)

Events that matter – World Ag Expo (Feb), World Agri-Tech (March), Salinas Biological Summit (June), FIRA USA (Oct)

LinkedIn – [linkedin.com/in/waltduflock](https://www.linkedin.com/in/waltduflock)





# 2022 CROP ROBOTICS LANDSCAPE



NEW TECHNOLOGY.

## AUTONOMOUS MOVEMENT      CROP MANAGEMENT      HARVEST

ROW CROP      SPECIALTY FIELD      ORCHARD-VINEYARD      INDOOR

### Navigation/ Autonomy

### Small Tractor/ Platform

### Indoor Platform

### Large Tractor

### Scouting

Robotic solutions placed in other task/product categories on this landscape may have scouting capabilities in addition to their primary function.

### Indoor Scouting

### Preparation & Planting

### Drone Application

### Indoor Drone Protection

Companies appear only once, though some may offer multiple or multi-use robots; they are placed according to primary function. Some segments span multiple crop systems as solutions may be applicable across crops. Logo positions are not necessarily indicative of crop system applicability.

### Application

### Indoor Application

### Weeding & Thinning

### Orchard-Vineyard Weeding & Pruning

### Indoor Deleafing

### Specialty Field Harvesting

### Orchard-Vineyard Harvesting

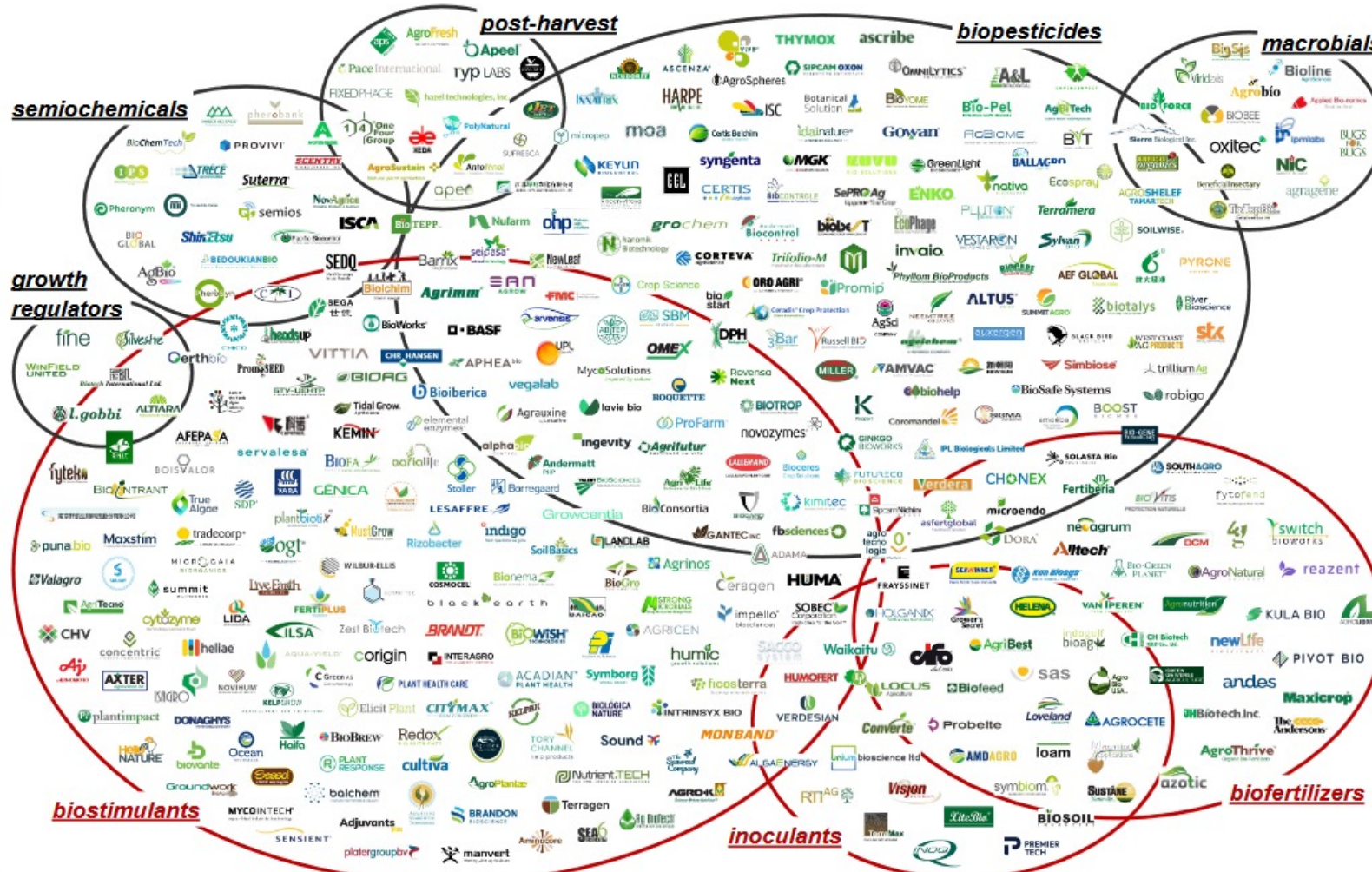
### Indoor Harvesting

**2023 AG BIOLOGICALS LANDSCAPE**

The Mixing Bowl  
CONNECTING INNOVATORS IN FOOD, AG & IT

BIO-BASED SUBSTANCES

LIVING ORGANISMS



2023 Ag Biologicals Landscape

1,200 startups IDed (400 vetted)

2 Major categories

- Bio-control (bio-pesticide)
- Bio-stimulant (yield)

One of the largest AgTech opportunity segments