



TAKACHAR

AI-enabled, decentralised bioeconomies to reduce crop residue burning and build climate resilience

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January 2026

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Problem statement

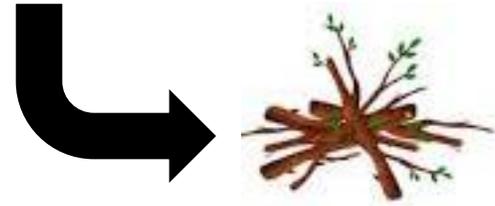
Crop/forest residues (**biomass**) are loose, wet, bulky, and expensive to collect/centralize for conversion from rural, underserved communities. Each year, \$120 billion/year of biomass residues are burned in open-air, resulting in smog and air pollution.



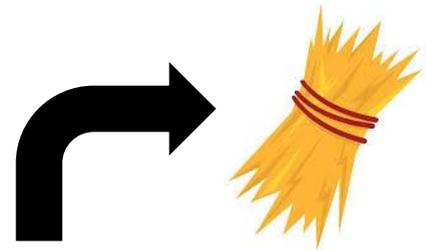


Our decentralized, portable, on-site deployment

Concept of our "Takavator" unit



Crop and forest residues (biomass)



Decentralized thermochemical conversion

- Requires no external heat/fuel to run
- >95% reduction in air pollution
- Builds self-sufficient rural bioeconomies

Actual operational unit in Haryana



Various output bioproducts

Fertilizer blends
(\$30B/year)

Activated carbon
(\$6B/year)

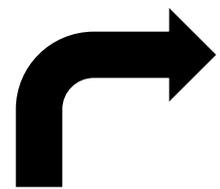
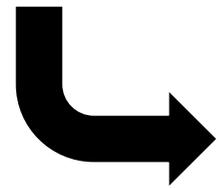
Biofuels
(\$68B/year)

Specialized chemicals
(\$7B/year)

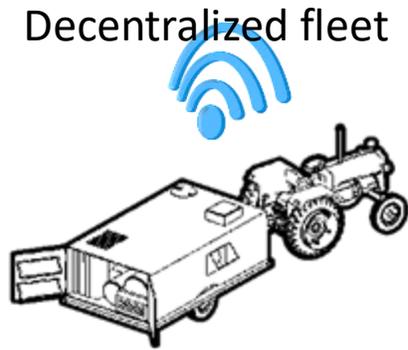
AI-enabled vision: Uber-like fleet for rural bioeconomy

Through real-time optimization and administration of carbon credits, we charge a per-ton usage fee for our software as a service.

Variable input feedstocks



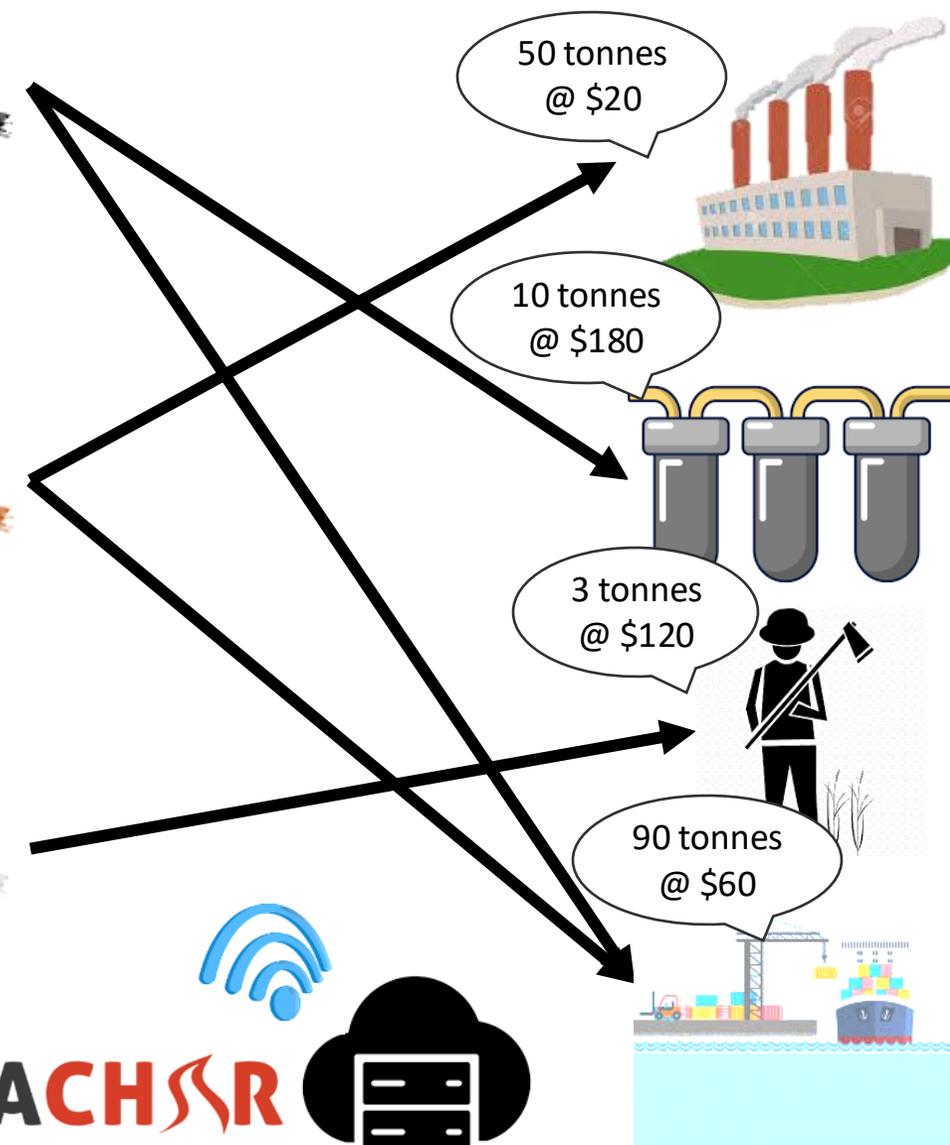
Decentralized fleet



Real-time, input-output flexible control



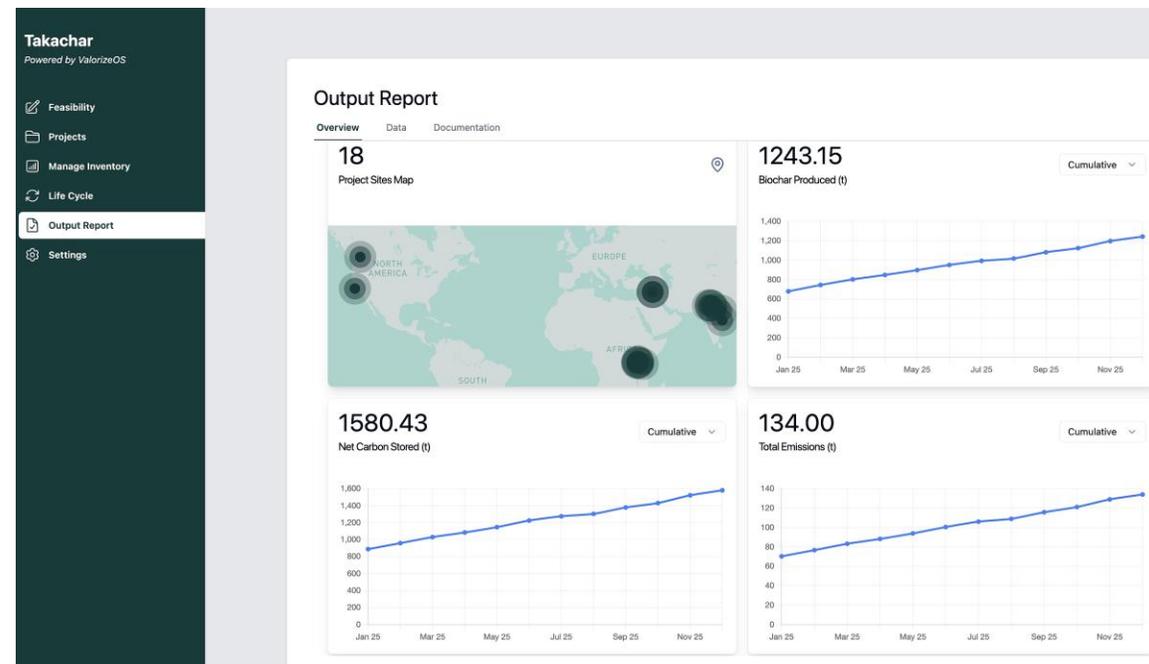
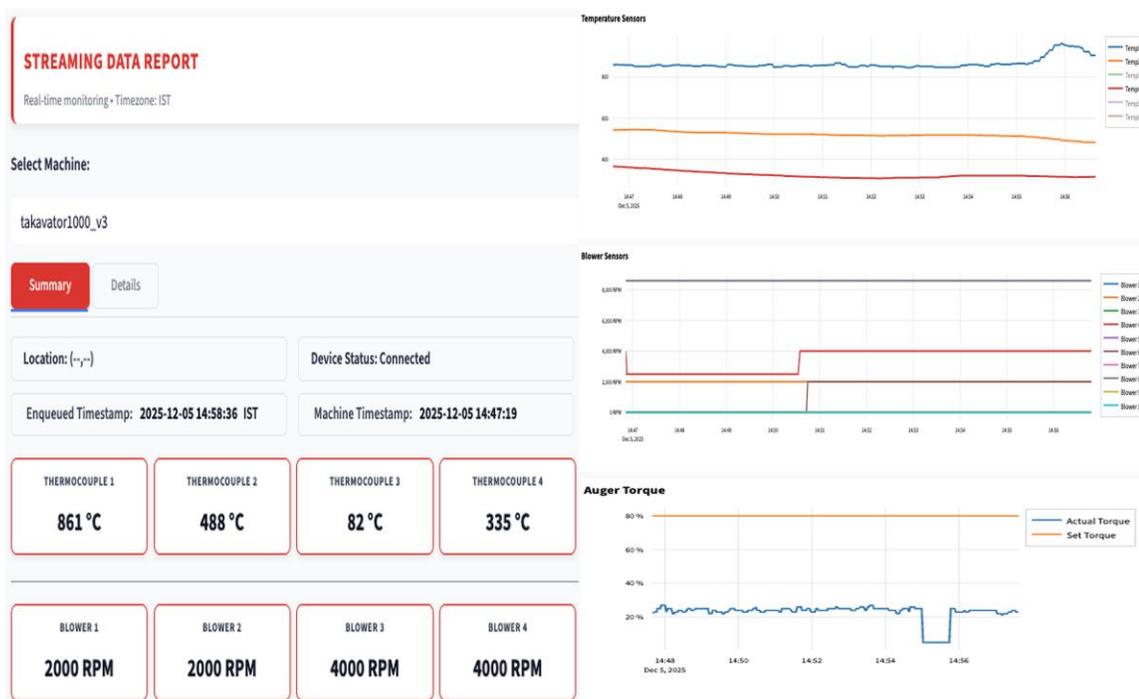
Customizable bioproducts



Unique advantage: A fleet of 17 reactors deployed worldwide, serving as first-of-a-kind sandbox for AI training data.



Real-time sensor and field data available for model training and validation

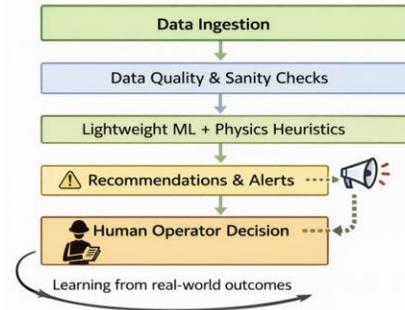


This hackathon: AI as a decision-supported layer for climate resilience



Real-time data from a fleet of 17 reactors

- Temperatures
- Input and output weights
- Reactor setpoints
- Local weather conditions
- Local market conditions



Early-stage AI decision layer

- Data architecture
- Data quality checks
- Lightweight ML and physics-guided heuristics
- Initially benchmarked against human operations



Community operator and outcomes

- Cleaner operation
- Fewer failed batches
- Increased revenues
- Increased carbon sequestration and soil health

Iterative community-centred co-design

Climate and rural impacts to date



15,000
farmers



USD 1.1 million
added rural
livelihood



4,240 tonnes
waste recycled



3,000 tonnes
CO₂e mitigated

- *“After switching, I never have to worry putting enough food on the table for my family. What’s more, I sell the excess rice and use the income to send my children to school.” – Mr. Kibhonge, farmer*

Scaling our impact

Without AI/software	With AI/software
Hardware sales only	Licensed hardware via OEMs
One-time sales revenue	Recurrent revenue
Manual scaling	Digital scaling
Capital-intensive growth	Capital-light growth
Limited geographical reach	Rapid global replication

Proof of Work: Electric Tripping Forecasting

A Transformer-based Framework for Forecasting Tripping Events in Biomass Auger Systems

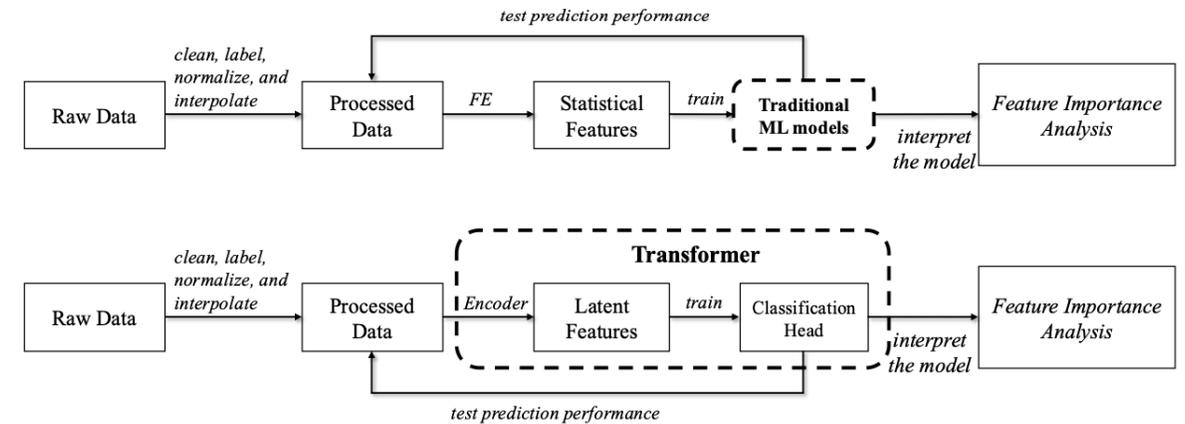
Chenxuanyin Zou,[†] Sagar Garg,[‡] Amit Sharma,[‡] Kevin Kung,^{†,‡} Sonal Thengane,[¶]
and Yankai Cao^{*,†}

[†]Department of Chemical and Biological Engineering, The University of British Columbia,
Vancouver, BC, Canada

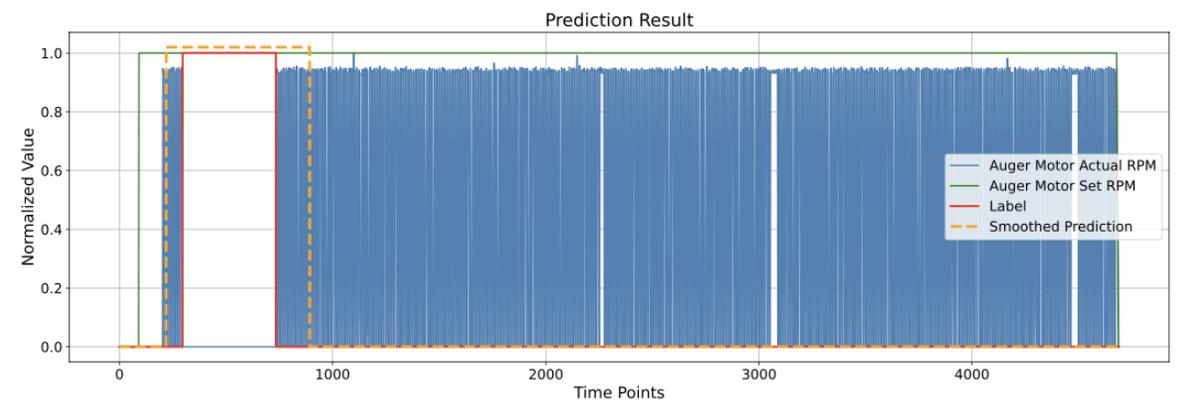
[‡]Takachar Limited, Richmond, CA, USA

[¶]Department of Hydro and Renewable Energy, Indian Institute of Technology, Roorkee,
Uttarakhand, India

Paper in Review



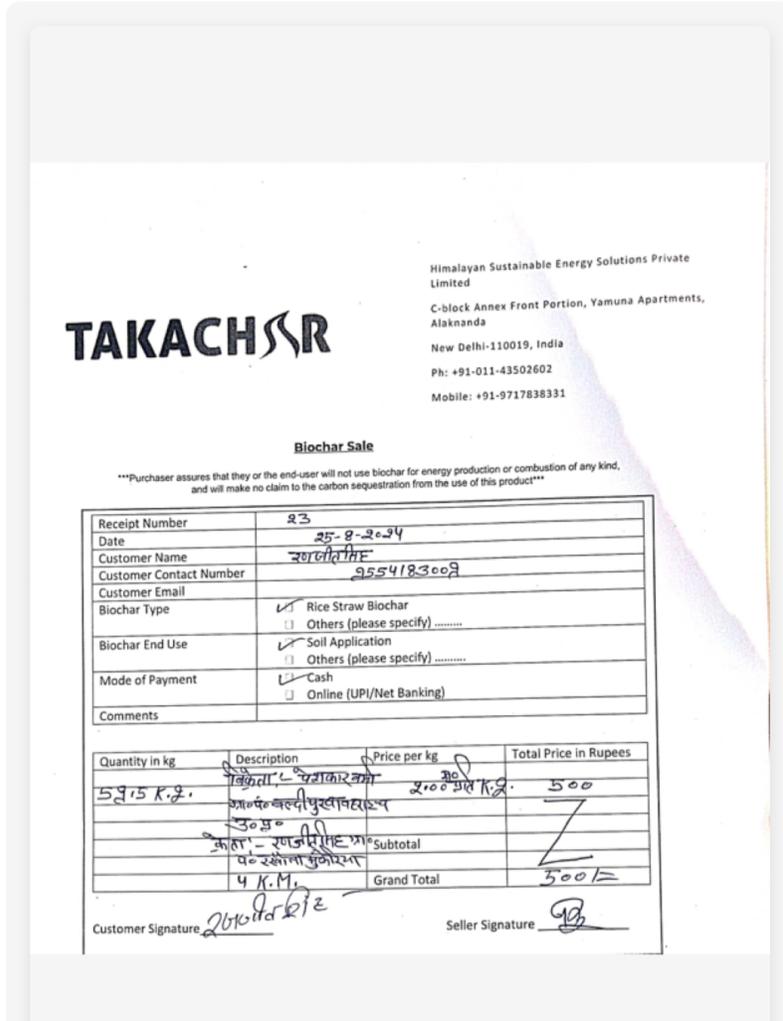
Conceptual Structure of Traditional ML Models (upper) and Transformer Model (lower)



Example of Smoothed Prediction Result

Proof of Work: AI-Based Receipt Extraction

Original Receipt



Extracted Data ✓ Extraction Complete

Invoice # LOW

Delivery Date

Buyer

Seller

Product

Quantity MEDIUM

Total Weight

Total Price

Currency

Receipt Score MEDIUM

Tags

Reason

Notes

(a) Complete Example of 'Pass' Case with Image on Left and Extraction on Right

Extracted Data ✓ Needs Review

Invoice # LOW

Delivery Date

Buyer

Seller

Product

Quantity MEDIUM

Total Weight

Total Price

Currency

Receipt Score MEDIUM

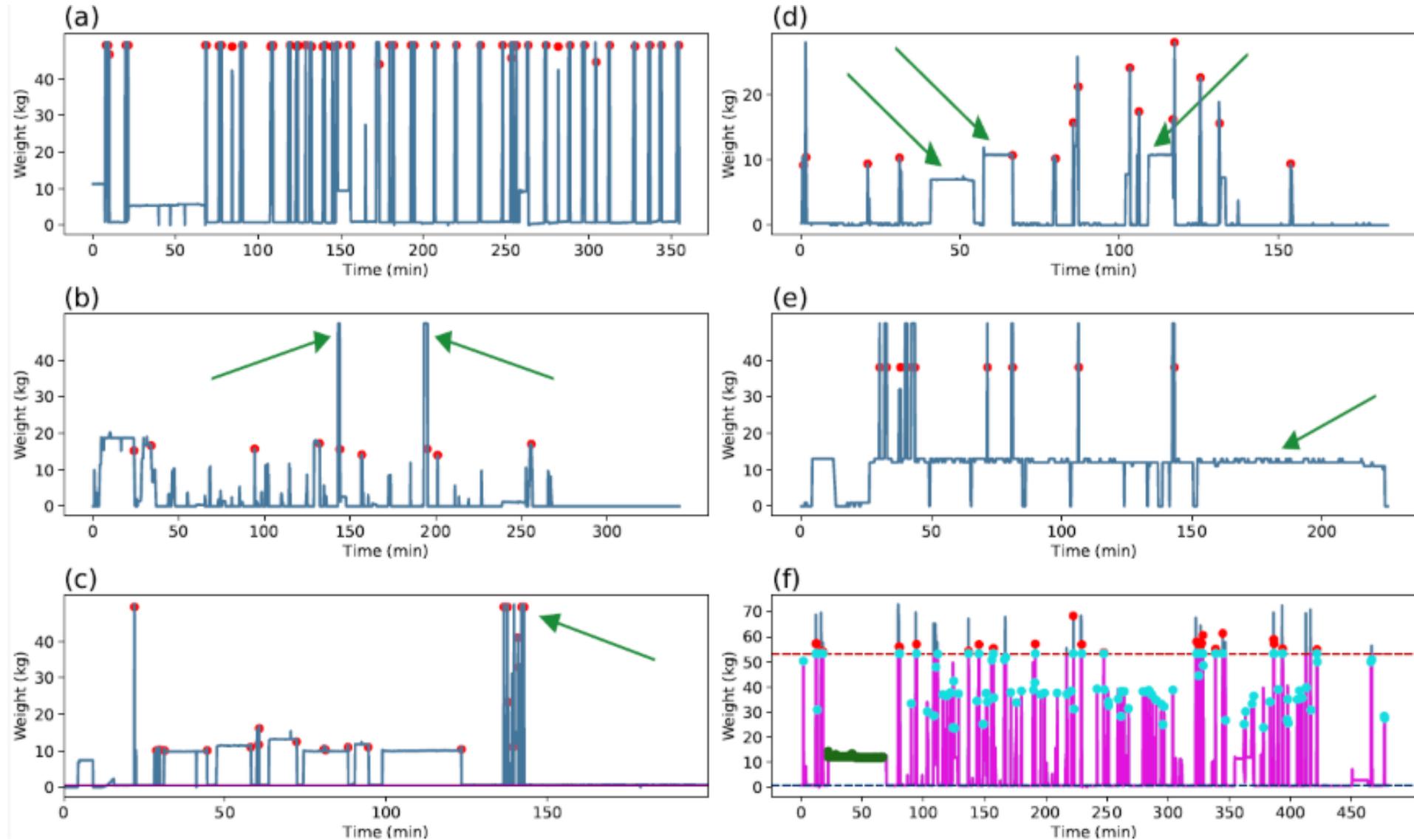
Tags

Reason

Notes

(b) Example of 'Needs Review', Right side only

Proof of Work: Sensor Error Correction



Common Errors in measuring input weight



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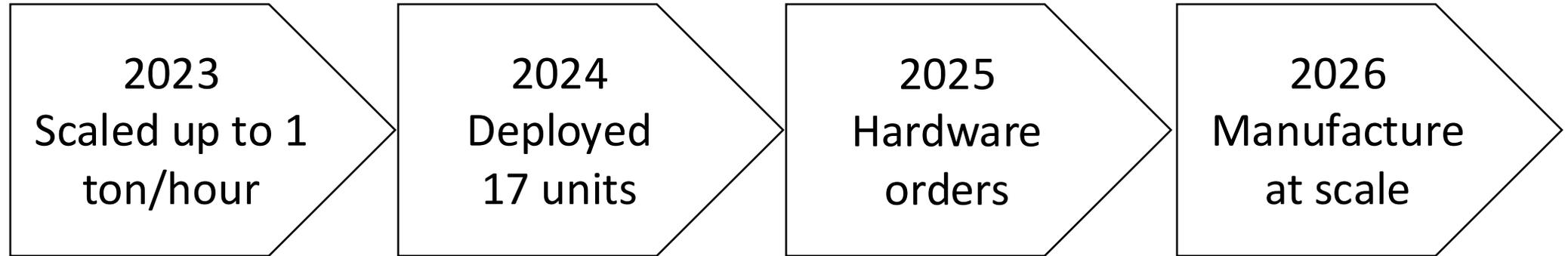
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Growth strategy

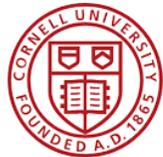
We have already deployed 17 Takavor units, achieving 6,000 tons of CO₂-e capacity. As we take hardware orders, we will eventually license with a hardware OEM to scale while charging an ongoing carbon credit verification fee based on cloud-based IoT platforms.



Breakthrough Energy
Fellows

Klarna.

Cargill



Cornell University

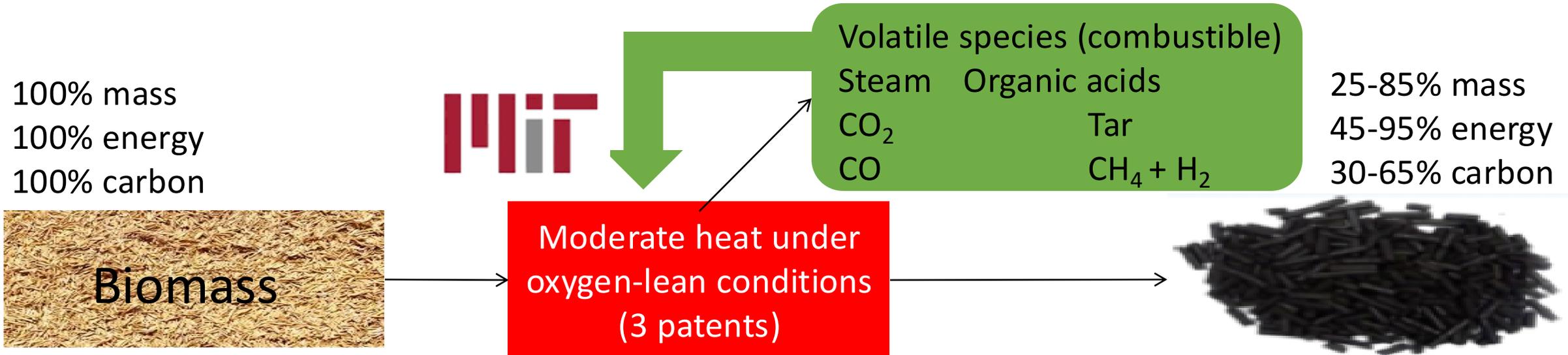


XPRIZE
CARBON
REMOVAL



World Food
Programme

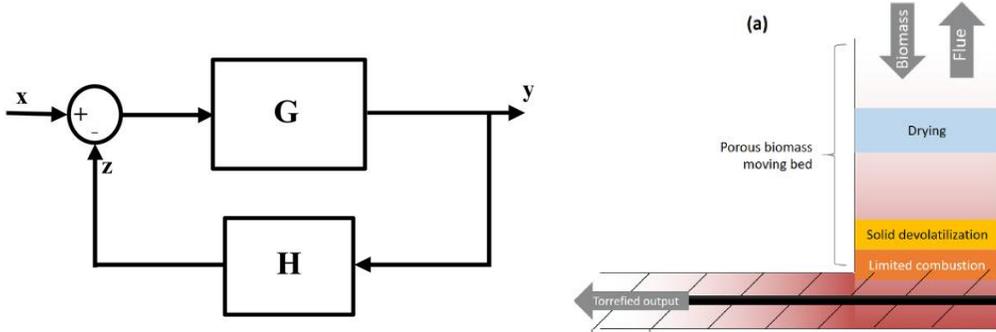
Product details: Cutting edge MIT technology at two scales



Current IP portfolio and regulations

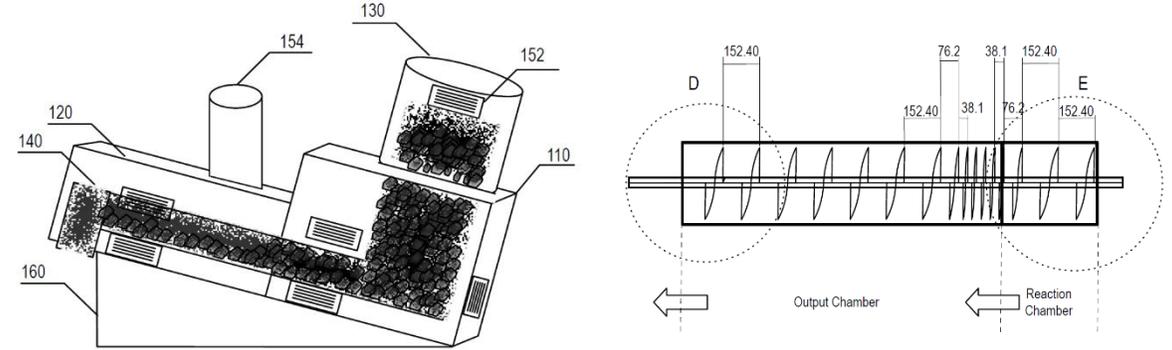
Control (+ hardware) patent

Granted (US11,339,342, US11,866,670)



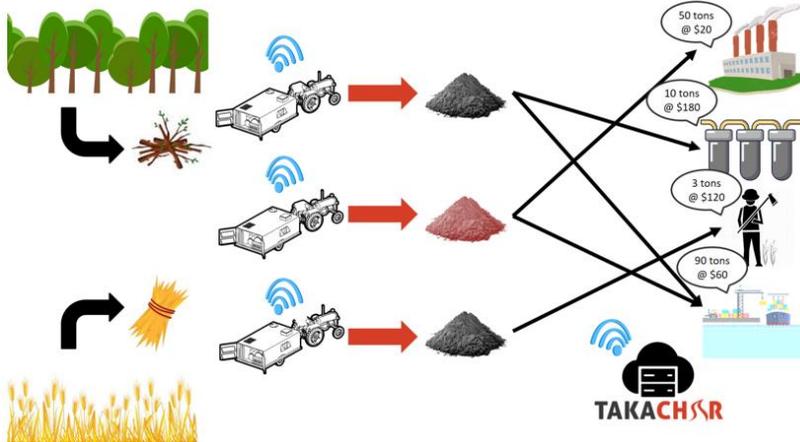
Additional hardware patent

Granted (CN115698234) & pending (PCT/US2021/034519)

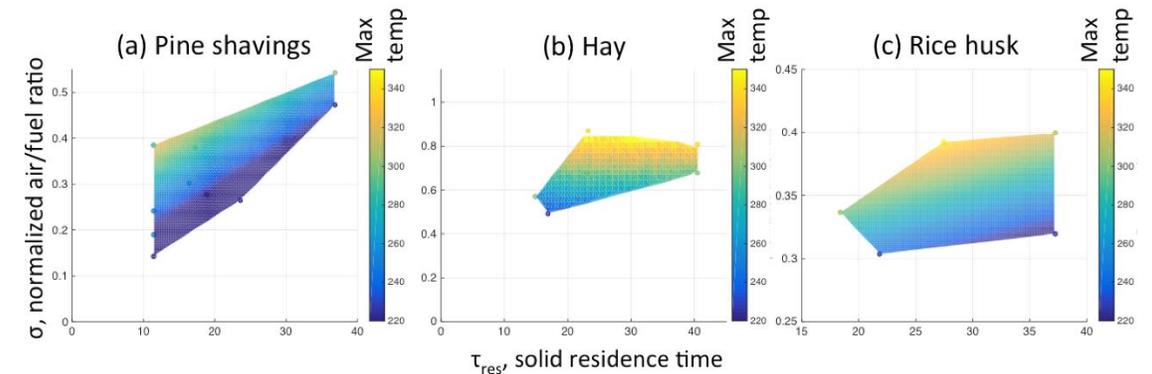


Networks patent

Granted (ZA202205452) & pending (PCT/US2020/060011)



Internal trade secrets



Certifications: Puro.earth carbon credit registry, local pollution and fire permits



Competition: Decentralized operations enabled by new tech

Role	Type	Competitive Characteristics		
		Low-cost	Soil regenerative	Application flexible
TAKACHSR		✓ 1/500 cost	✓ 27% yield increase	✓
Status Quo	Open-air residue burning	✓	✗	✓
	Centralized fertilizer production	✗	✗	✗
Small New Entrants	Community-scale composting	✗	✓	✓
Existing Conversion Pathways	Gasification	✗	✗	✗
	Incineration (biopower)	✗	✗	✓
	Chemicals	✗	✗	✗

Business model: medium and long Term - hardware and software

Hardware: We sell our units to biomass contractors working for farmers and forested landowners.

Medium term:

- Make reactor units with local contract manufacturers;
- Retail price: \$175,000 per unit, with the possibility of carbon credit financing through forward credit pre-purchases;
- We provide one-year equipment warranty and subscription to ongoing service plan.

Long term:

- License reactor as a complementary product to agriculture/forestry OEM to integrate within their dealership network;
- License fee: 7% of retail price;
- John Deere and Mahindra & Mahindra have separately reached out to us to inquire.

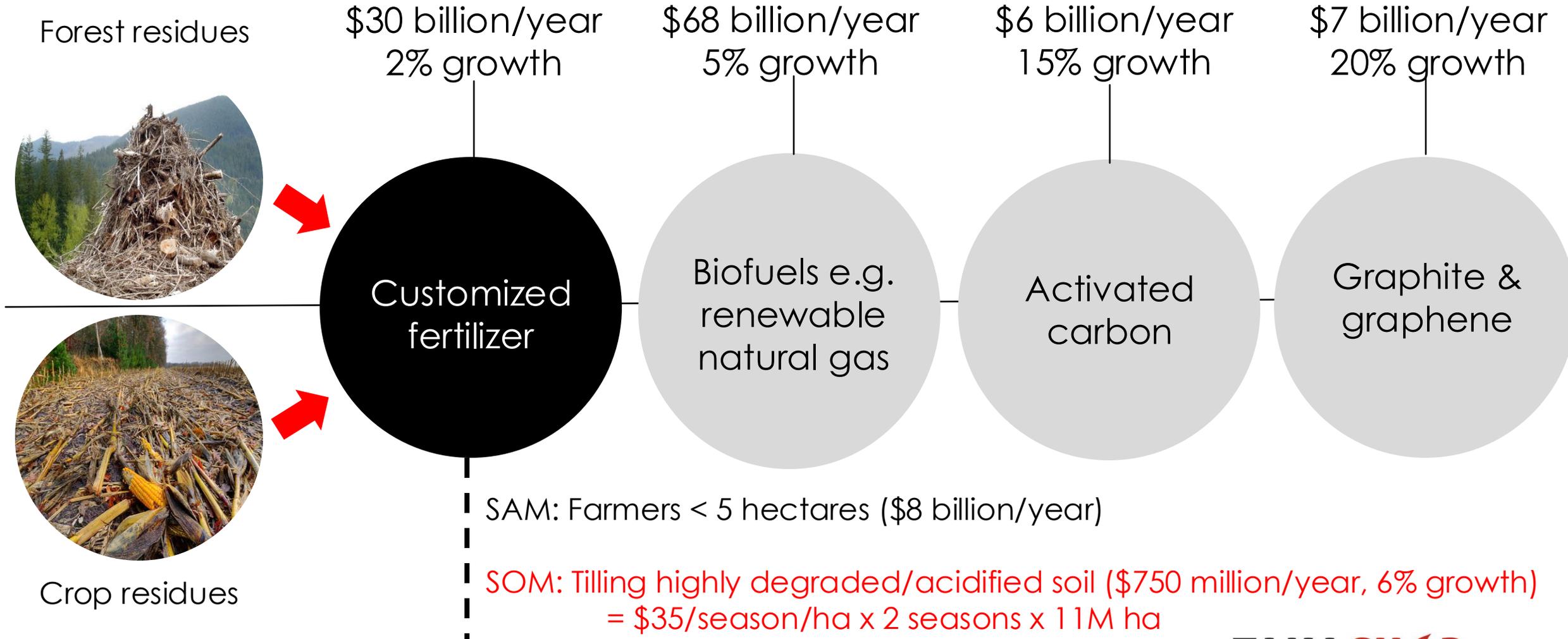
– AND –

Software: We charge end users a per-ton service fee for carbon credit monitoring, reporting, and verification (MRV) and real-time, cloud-based, Uber-like optimization of reactor fleet.

- Carbon credit certification in a standard registry (currently we are on Puro.earth) for rural communities who otherwise find the certification process to be too onerous/expensive.
- We charge a \$20/ton CO₂e fee against a typical \$100-200/ton CO₂e carbon credit price.

Market opportunity from \$120 billion/year of biomass residues

While we can make various carbon-based bioproducts/biofuels in rural contexts, our beachhead market is in water-saving fertilizer blends.





At the same price that farmers pay for their fertilizer inputs:

- We increase their yields on average by **27%**
- We increase their net income by up to **50%**

Current traction: Testimony from more than 14,000 farmers



One of the benefits of using Safi Sarvi fertilizer is that I always have enough food in the house for my family.

Traction and milestones: Evolution from prototype to product

MiniTorr v1

MiniTorr v2

Takavator



Various roadshows and live demonstrations

Boulder, Colorado

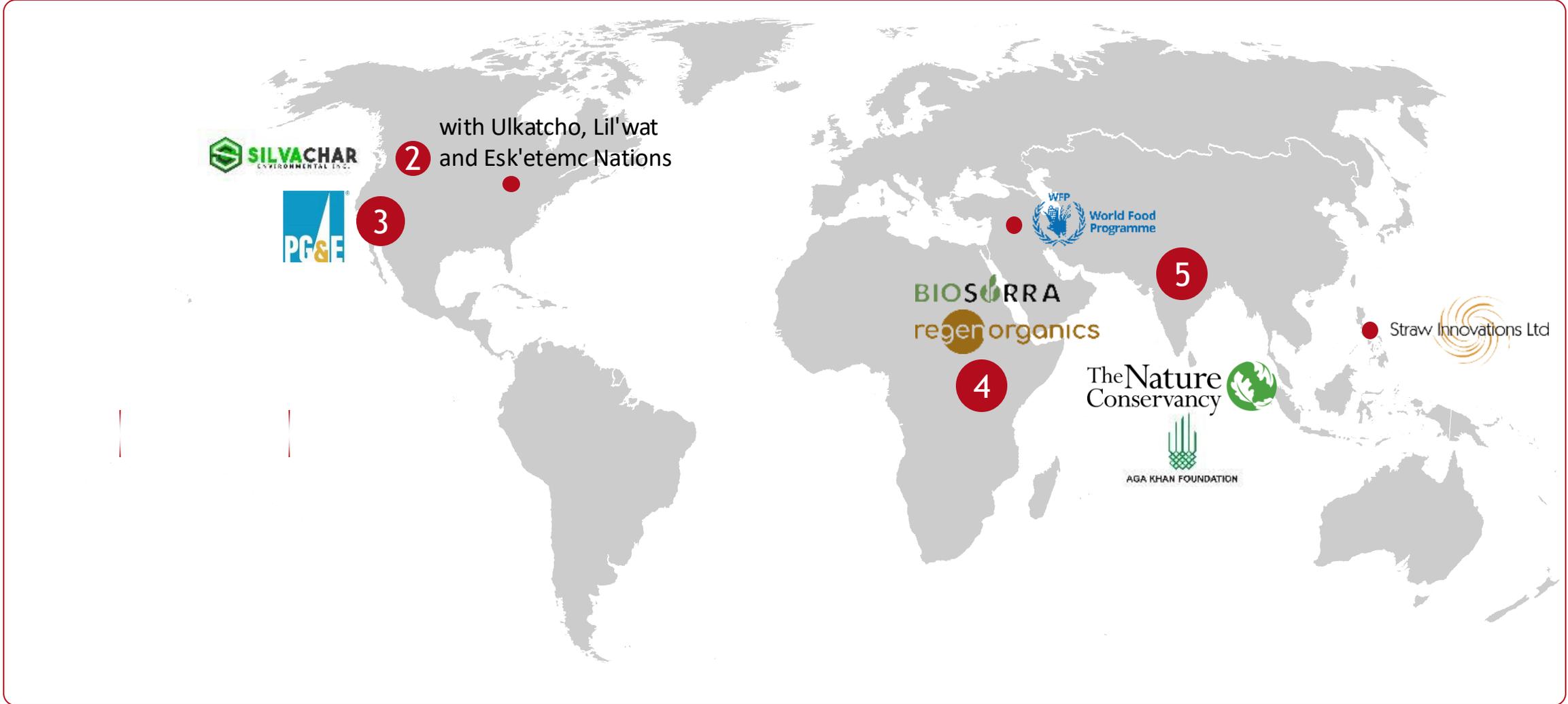


Lil'wat Tribal Land, British Columbia



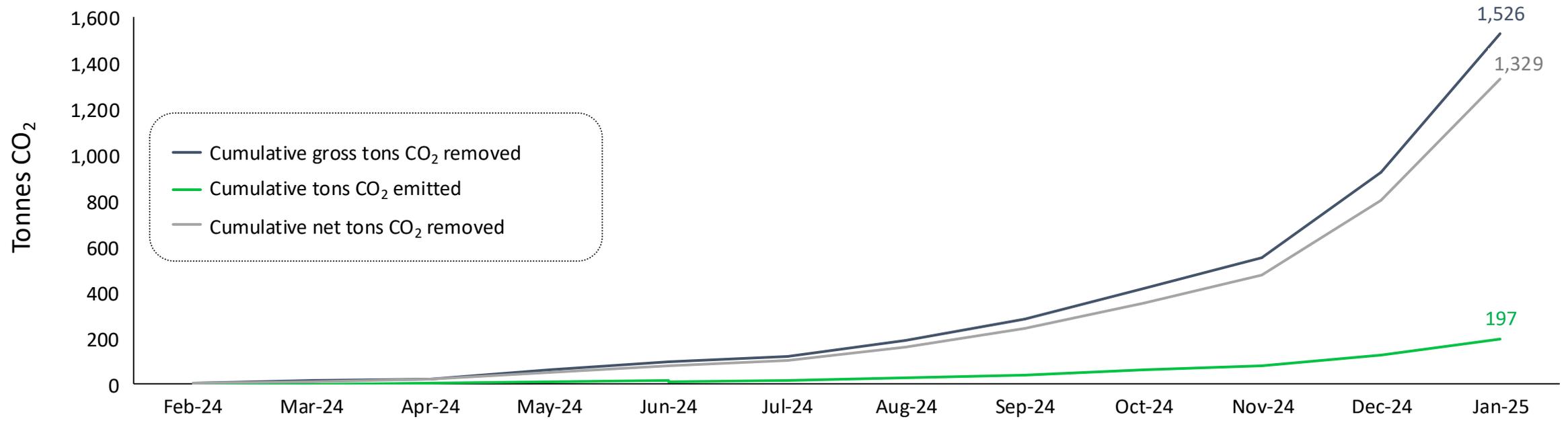
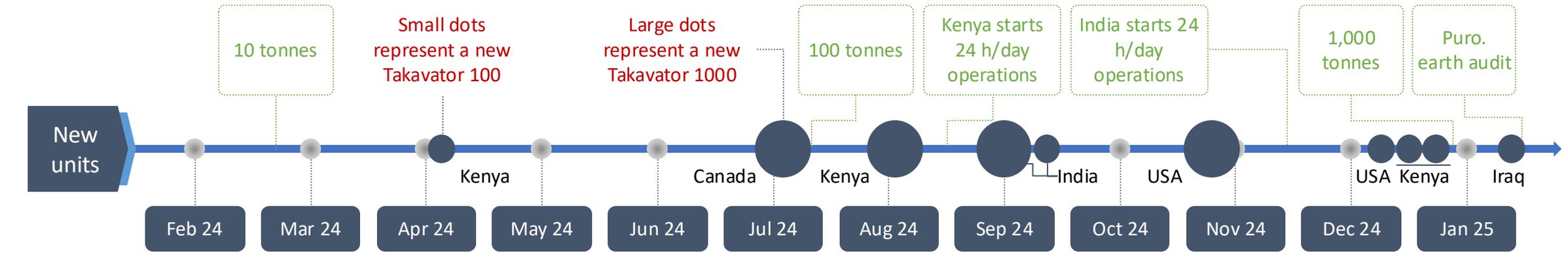
Ulkatcho Tribal Land, BC

Current traction: 17 Takavators deployed worldwide.



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Current traction: We removed 1,329 tonnes of CO₂e in 2024.



Traction and milestones

Puro.earth certified in March 2025



PRODUCTION FACILITY & OUTPUT AUDIT STATEMENT

350Solutions, Inc. has verified the CO₂ removal capability and eligibility for CO₂ Removal Credits (CORCs) under the Puro.Earth Puro Standard General Rules v3.1 and the associated Biochar Methodology Edition 2022 v3 for the following company:

Technology & Company Information		
CO ₂ Removal Supplier & Facility Operator	Production Facility Location	CO ₂ Removal Method
Himalayan Sustainable Energy Solutions Pvt. Ltd. (dba Takachar)	Novato, 3900 Sears Point Road 94945, United States	Biochar

350Solutions affirms that the organization has the appropriate equipment, procedures, and protocols in place and documented to quantify CO₂ removal through the production of biochar, via measurement of biochar output and quality, and appropriate lifecycle analysis in accordance with the requirements of the Puro.Earth General Rules and Biochar Methodology. Eligibility criteria are verified as follows:

Eligibility Criteria		
Criteria	Verified Eligibility Status	Rationale
Sustainable Feedstock	Eligible	Forest waste biomass feedstock
Biochar Use	Eligible	Soil application, livestock feed additive. Not used for energy.
Net Negative LCA	Eligible	Documented according to Puro Biochar Methodology
No Fossil Fuels for Process Heat	Eligible	Used only for onsite vehicles and generator.
Negligible Methane Emissions	Eligible	Methane emissions minimal
Molar H:C Ratio	Eligible	H:C ratio = 0.55
Safe Environment and Biochar Handling	Eligible	Biochar properly and safely handled
Environmental & Social Safeguards	Eligible	Facility properly permitted
Additionality	Eligible	Project not required by any regulation and requires carbon finance
Biochar Quantification	Eligible	Biochar quantified during operations
Production Facility Data	Eligible	Production facility data matches Puro.Earth Registry

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Support letter from PG&E



John Fiske
Director
Vegetation Management

8111 Bollinger Canyon Rd
Room 43000
San Ramon, CA 94583

Phone: 925.244.3070
Cell: 415.517.0946
Fax: 925.244.3149

April 14th, 2025

Chief John McCarthy
Wood Products Program Manager
California Department of Forestry and Fire Protection

Subject: Letter of Support for Takachar Limited, Re CAL FIRE Business Development Grant (Q1-2025) "Trash is cash: Developing a decentralized monitoring, reporting, and verification platform to process for stranded biomass in underserved regions"

Pacific Gas and Electric Company ("PG&E") is pleased to offer this letter of support for the proposed "Trash is cash: Developing a decentralized monitoring, reporting, and verification platform to process for stranded biomass in underserved regions" submitted by Takachar Limited in response to CAL FIRE Business Development Grant (Q1-2025). This project relates to PG&E's current work with Takachar under EPIC 3.47, as well as an in-development future project under EPIC 4.19.

PG&E, a subsidiary of PG&E Corporation, is an investor-owned electric and gas utility operating in the state of California, covering over 70,000 square miles and serving approximately 11 million people. PG&E has a strong interest in successfully enabling promising technologies within the PG&E service area that advance safety, reliability, affordability, and clean energy adoption.

As such, PG&E supports the proposed project's overall goals to:

- Reduce the cost to treat woody biomass residues and manage vegetation throughout California as a wildfire prevention measure.
- Improve the affordability and consistency of carbon-based bioproducts, thereby reducing wood disposal operation's carbon footprint.

We support the advancement of this project and wish you a successful outcome from the proposal selection process.

Sincerely,

John Fiske

John Fiske
Director
Wood Management
Pacific Gas and Electric Company

Farmer testimonials

"If they have not started using it, they should start now." – Mr. Kibuchi

"My yields have doubled after switching." – Dan

"I express strong support for its continued use on my farm." – Gloria Ferrar

"With better soil conditions, my crop has become more vigorous and productive." – William Henpann

Current traction: We produce government-certified fertilizer blend.



Our biochar-based fertilizer blend displaced 199 tonnes of chemical fertilizer during the demonstration

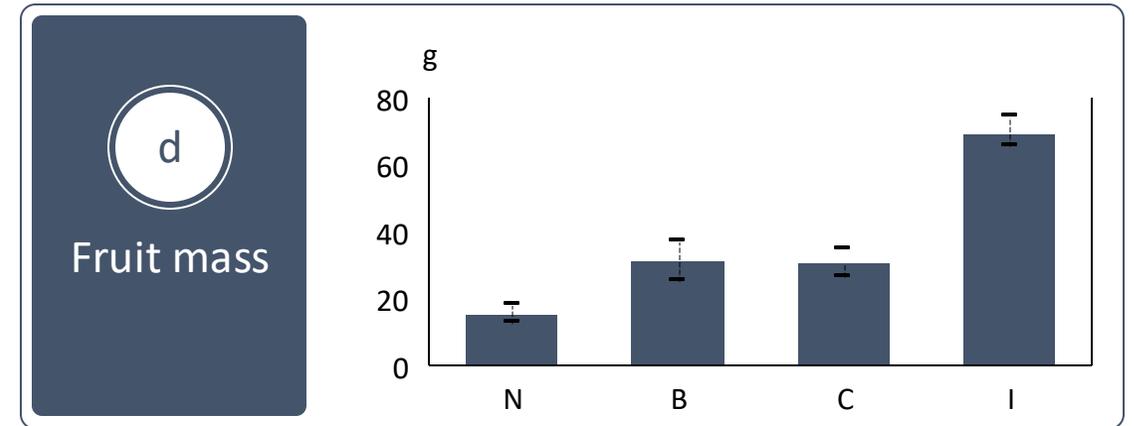
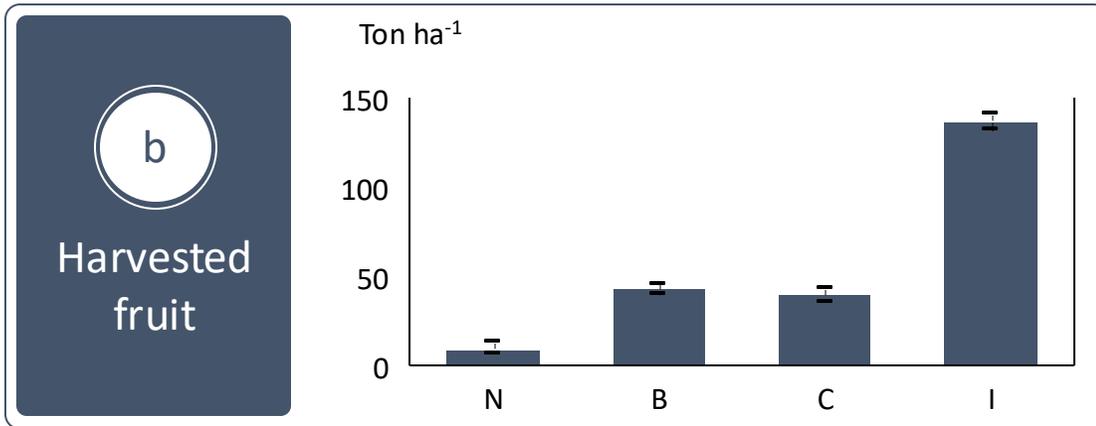
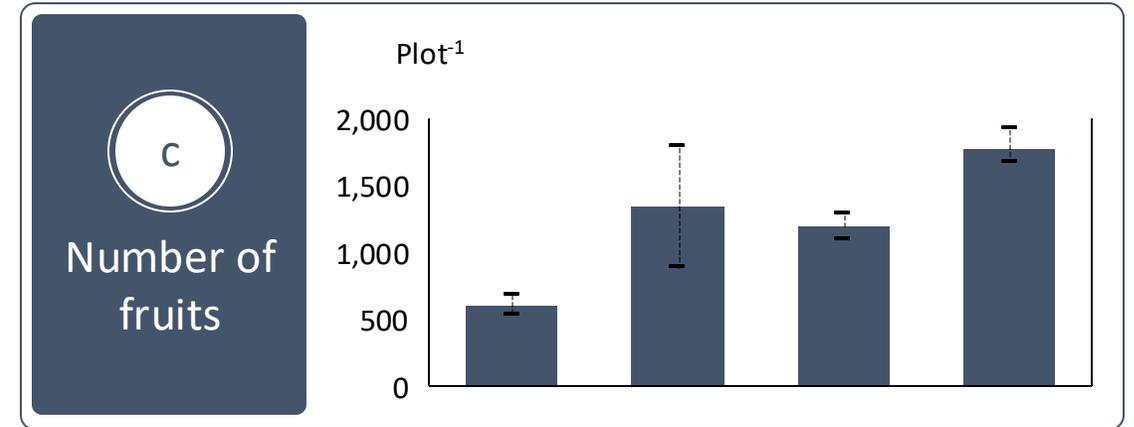
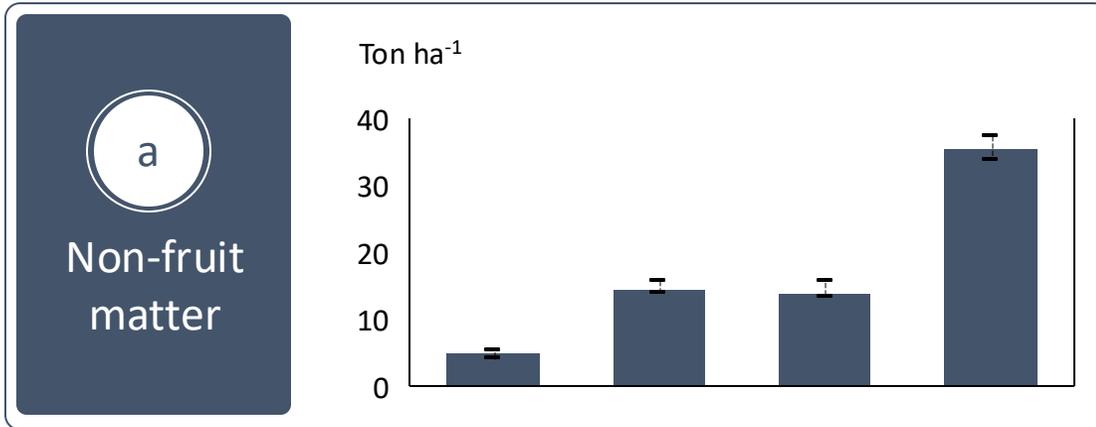


In the last 12 months, sold 664 tonnes of biochar-equivalent to 14,000 farmers, earning \$330,331 in sales



The biochar selling price excluding the blended nutrients worked out to be \$270/tonne, which equals what farmers would otherwise pay per hectare per season for chemical fertilizers

Current traction: Randomized controlled field trials with Cornell



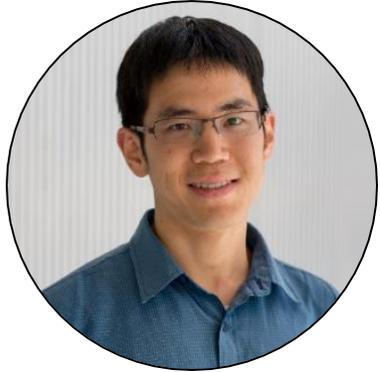
N = No intervention

C = Chemical fertilizer

B = Carbon base only

I = Takachar intervention

Founding team We marry lived experience in rural communities with cutting-edge MIT technology.



Kevin Kung, Ph.D. (CTO)

MIT PhD in Biofuels and Renewable Energy; co-founded SafiCoils which sold more than one million low-toxin mosquito coils



Vidyut Mohan (CEO)

Co-founded Pirool Energy which turned wildfire-prone pine needles into biofuels; human-centered design with Simpa, a distributed solar company

Advisory Board



Lisa Tomlinson

Human resources executive at Activate; expertise in building diverse, equitable, and inclusive teams and cultures



Johannes Lehmann, Ph.D.

Professor, Cornell University School of Integrative Plant Science; expertise in soil science, nutrient cycling, and biochar



Jennifer Wagner

Former President of CarbonCure; expertise in carbon markets and impact measurement

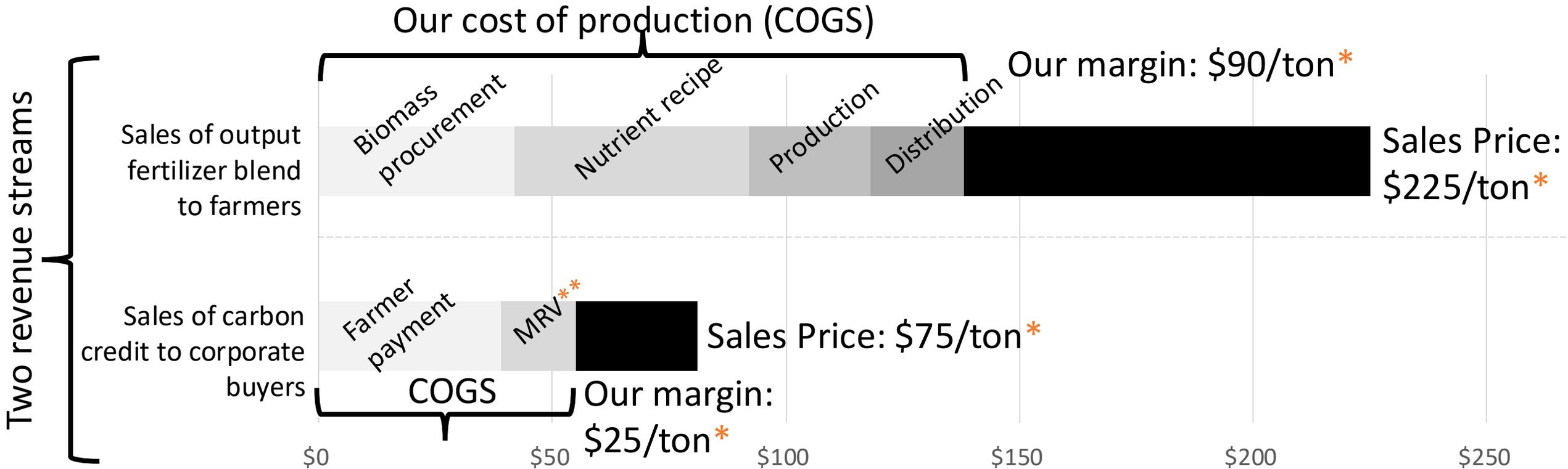


Magali Anderson

Board Member on Anglo American; seasoned CSO with corporate investment experience

Unit economics of a Takavator

Based on the Takavators we own and operate as a pilot:



*Normalized per ton of output product

**Monitoring, reporting, and verification

Media coverage

- [Klarna: Klarna announces multi-million contribution from internal carbon tax for game-changing climate impact solutions, 2023.](#)
- [Breakthrough Energy: Takachar is on a mission to transform agriculture globally, 2023.](#)
- [Mitacs: Eighth annual Entrepreneur Awards recognizes top Canadian talent and breakthrough innovations, 2023.](#)
- [World Food Programme: Climate innovation takes to the stage at COP27, 2022.](#)
- [MIT News: Spinoff Takachar processes waste biomass to reduce airborne pollutions, 2022.](#)
- [The New York Times: Prince William's Earthshot Prize, 2021.](#)
- [XPRIZE: XPRIZE and Musk Foundation award \\$15M to milestone winners, 2021.](#)
- [CNN: Turning crop waste to fertilizer could fight air pollution, 2021.](#)
- [UN News: Young Champions of the Earth, 2020.](#)
- [Lawrence Berkeley Laboratory: Cyclotron Road introduces its fourth cohort of entrepreneurial technology fellows, 2018.](#)