



Global water monitoring for agriculture

Towards a biophysical atlas of our world.

Information memorandum



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1. Vision



Vision & Mission



||

"We enable smart farming globally by creating a biophysical atlas of our world."

To meet our ambition, we need scalable and actionable insights for farmers, which our biophysical atlas delivers



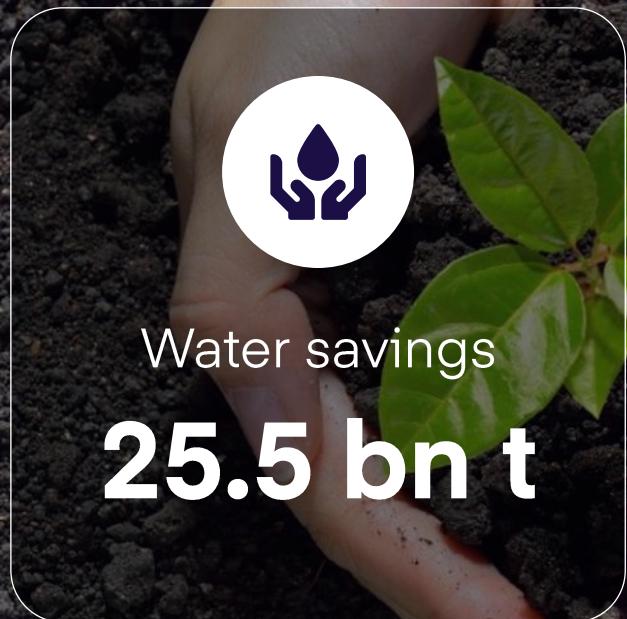
Actionable : early detection of stress



Scalable : Global reach and accessibility

We need more sustainable farming practices

By 2027, our solution will achieve key impact on water use and CO₂ emissions, while creating value



Based on area monitoring forecast in 2027. The potential value assumes 100% capacity use in 2027.

2. Key investment highlights

Key investment highlights

Large market

constellr is a leader in a multi bn EUR market



Sustainable agriculture solution

constellr reduces water consumption and CO₂ emissions, while increasing margin in crop production



Proven business model

Competitive pricing ; Industry familiar with constellr's pricing model



Most relevant dataset for agriculture

Only company globally with proprietary thermal and hyperspectral capability, the two relevant data-sets for agriculture.

World class team

Comprises some of the best people in the industry. Combined with strong backing by the European Space Agency.



Proven technology

Operational best-in-class thermal infrared sensor on-board the International Space Station



Commercial traction

Half a dozen pilots, including with large agri food companies such as Bayer & Syngenta. ~ €12m in advanced pipeline.



3. Product and business model

Our platform allows access to our analytics and proprietary infra-red data



Source: LisR (thermal) recording on 03/23/22 over Sacramento, 7 pm PDT



Globally scalable

Single, comparable dataset for the whole planet



Affordable

Few Euros per hectare per year



Reliable

Real physical measurement at field level



Symptoms instead of damage

Sees vegetation stress days to weeks before crop damage



We sell according an industry-proven SaaS business model

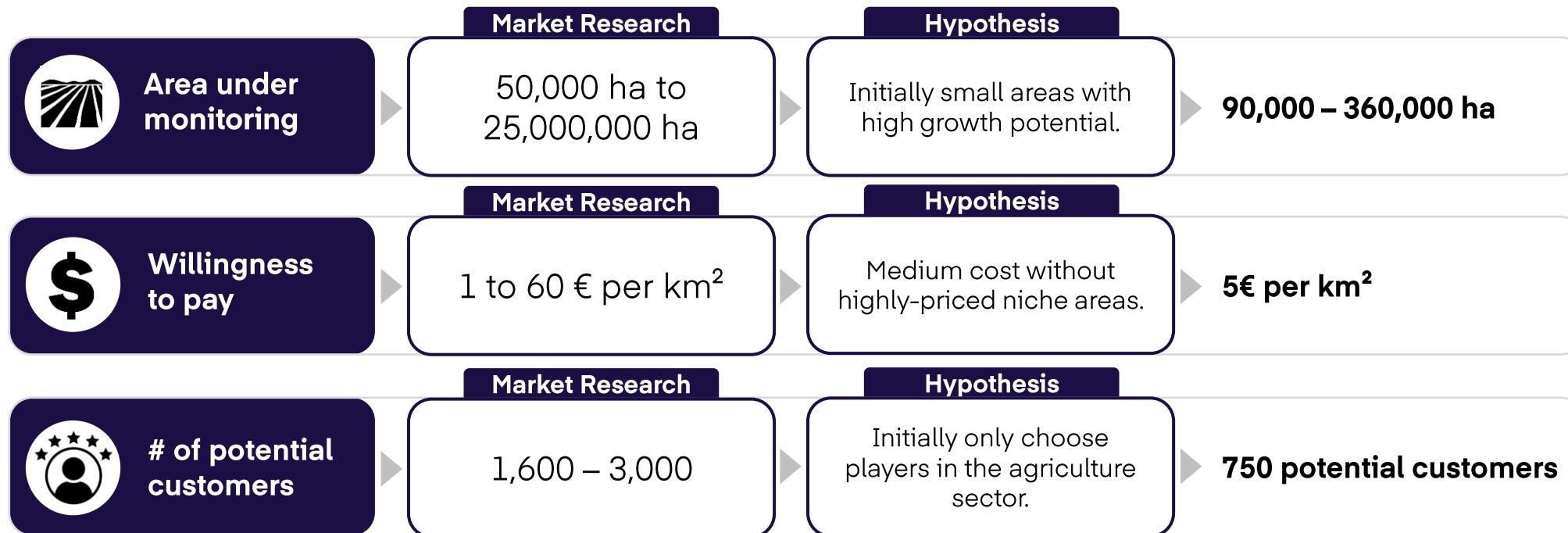


- One-to-Many**
Massively scalable space-based business model
- Daily, Global Data**
Continuous data stream, anywhere, every day
- Subscription Model**
Single data point has multiple & diverse subscribers
- Exponentially growing value**
Creating the most precise atlas of Earth's biosphere, starting with 1.5 billion ha of crop land

The pricing of our products is extremely competitive

	Basic	Professional	Enterprise	Customers
Area	< 10 k (ha/year)	> 100 k (ha/year)	> 10 m (ha/year)	 Hummingbird Technologies "... the commercial MRV [measurement, reporting, and verification] space has an opportunity for monitoring tens of millions of acres with price points ranging from USD \$1.25 [archive] – 25 [on-demand] / ha [per year] "
On-demand (near-real-time)	10 (€/ha/year)	8 (€/ha/year)	6 (€/ha/year)	 BayWa "From our perspective, the price-range for the monitoring service between 5 EUR and 10 EUR per hectare and year is realistic."
Archive (historical)	3 (€/ha/year)	2 (€/ha/year)	1 (€/ha/year)	 eleaf "With operational high resolution LST [Land Surface Temperature] [...], we could greatly improve the quality of our products , reach more clients, and increase the impact we want to have on a climate resilient future."

Example of for smart irrigation, use case ready by 2025



		Potential Customers	Penetration	Area monitored [ha]	Price point [EUR/km ² , 24 orders]	ARR – Revenue [EUR]				
EO analytics		264	✗	23%	✗	90.000	✗	5	=	6,500,000 €
Large AgTech distributer		500	✗	1%	✗	360.000	✗	5	=	2,500,000 €

We are laser-focused on capabilities we develop internally for our product

In house



Data & Analytics Platform



Mission Operations



Algorithms

Outsourced



Building Satellites



Launching Satellites



Ground Stations



4. Market

The market needs improved crop water management (1/3)

Ineffective water management #1 threat to global food system



Water cost in agriculture (2020)

EUR 334 bn

2030: Water subsidy cost EUR 184 bn



Cost of water wasted (2020)

EUR 134 bn

Lack of water management



Water cost development until 2030

6-12x

Demand exceeds supply by 40%



Sources: Water Use and Stress - Our World in Data (2014), GlobalAgriculture (2012), The global value of water in agriculture | PNAS (2020), High Tide Technologies (2020), UNEP (2016)

Image: Pixabay

The market needs improved crop water management (2/3)

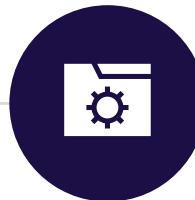
Water drives the global food system – it is the most precious resource of our time



Water drives global food production but 40% of global freshwater wasted by agriculture



Water (stress level) primary indicator for crop health



Current water stress data insufficient for water management at scale

This challenge will intensify dramatically



Climate change
Expecting dramatic yield losses without irrigation



Land degradation
Already 30% less usable growing area since 1975



Population growth
Production efficiency needs to increase by +60%

Effective water management requires the best possible water stress data.



Sources: Hoffmann, C. M. (2017), Perry, C. for FAO (2017), Garschagen (2020), Food and Agriculture Organization of the United Nations (2017), FAO Statistics (2020)

The market needs improved crop water management (3/3)

Current water data is insufficient for water assessment at scale

Crop production



Smart irrigation
Smart fertilization



Yield estimation



Crop trading
Crop insurance



Current solutions



Not
scalable

Not
actionable

Massive regulatory, environmental, and societal drivers demand a more sustainable agriculture



Green Deal & ESG

Only 10 years to change
a €214 Bn market



Climate Change

Up to 46% yield loss in key crops at 2°C increase



Food Security

+90% price increase for
corn, wheat & rice by 2030



Population Growth

Estimate +40% higher water
Use in agriculture by 2030



Sources: Global Center of Adaptation, Global Industry Analysts 2021, Infrastructure News 2021, Research and Markets 2019, Geospatial Analytics Market, Green Technology and Sustainability Market, Markets and Markets 2019, Transparency Market Research 2020, Bloomberg (ESG Assets, 2021)
Foto by Markus Spiske from Pexels

Investors seek sustainability

Challenges offers a massive market opportunity

II

"The evidence on **climate risk** [...] has become a defining factor in companies' long-term prospects. [...]. We will divest from investments that pose a significant sustainability risk."

III

"We recognize the importance of sustainably sourcing our crops [...] to make agriculture more resilient, intelligent and inclusive. **Precision Agriculture will be critical** [...] to grow more, using less natural resources."



BlackRock

Larry Fink, CEO



PEPSICO

Ramon Laguarta, CEO



Increasingly **strong regulations** (CAP) drive agricultural markets

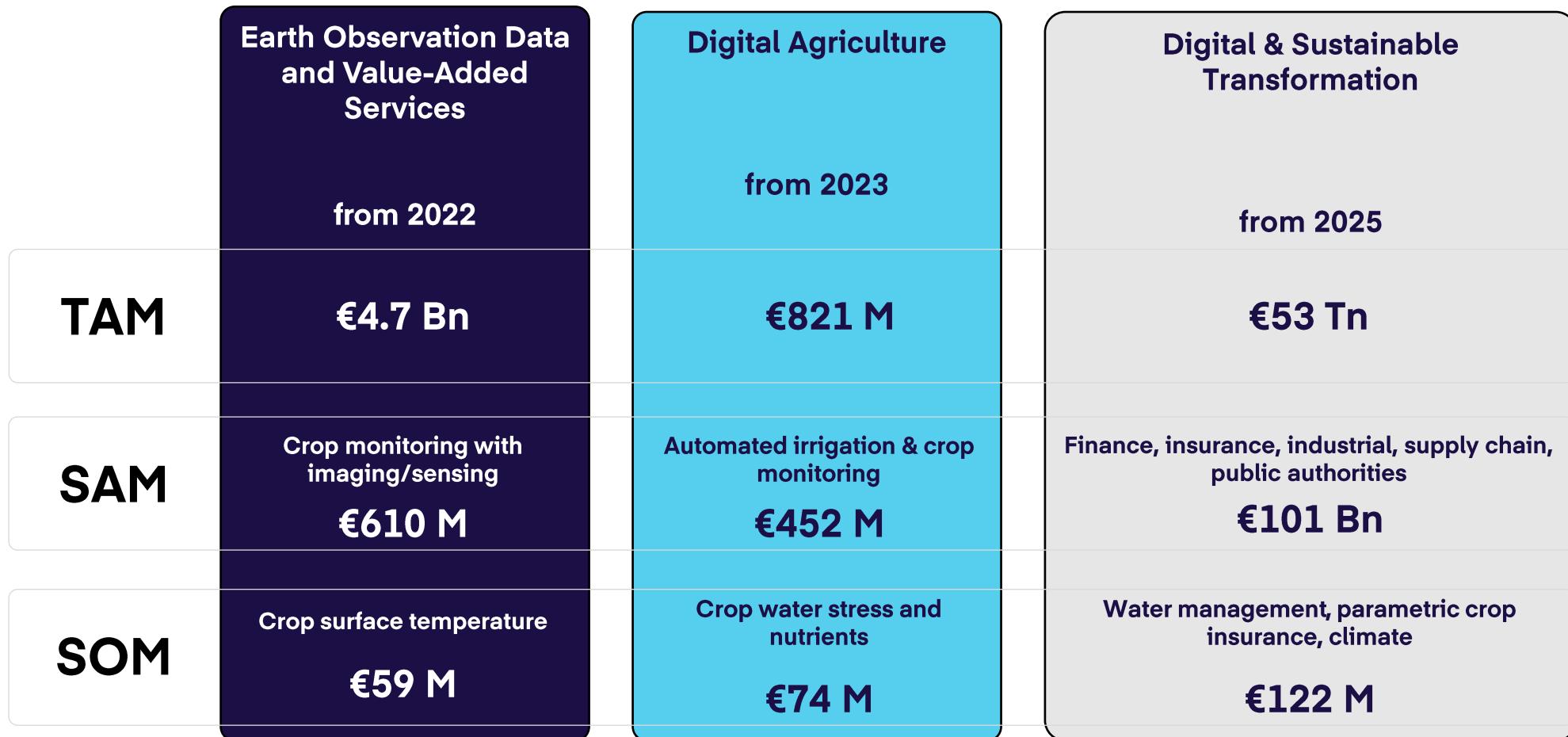


Accelerating **climate change** sets sustainability at the core of investments



Financial, insurance, and agricultural markets increasingly rely on **data-driven** approaches

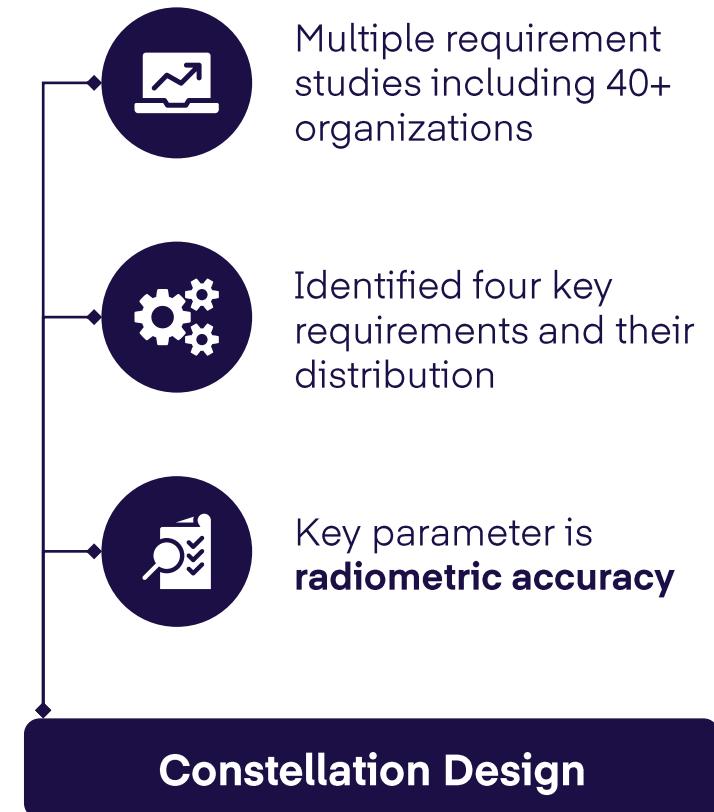
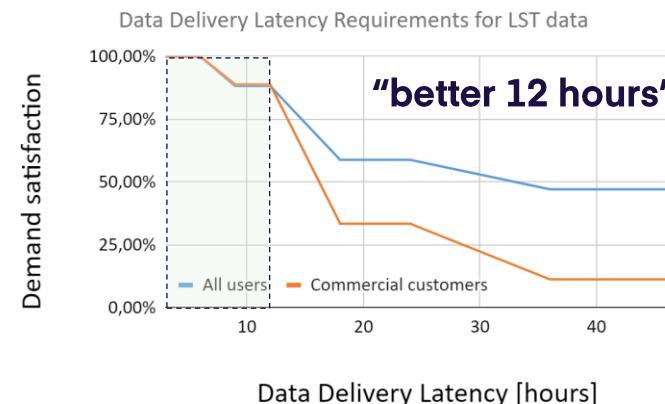
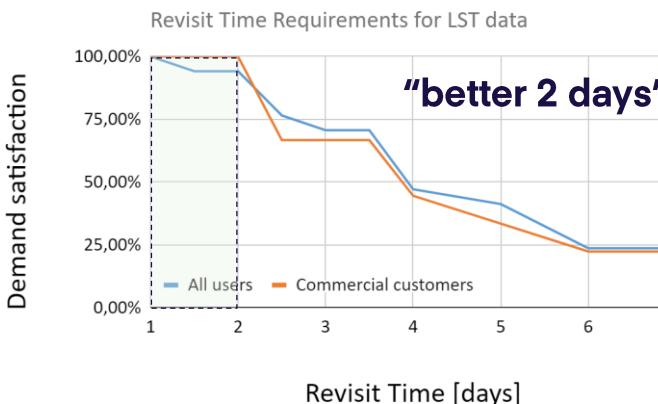
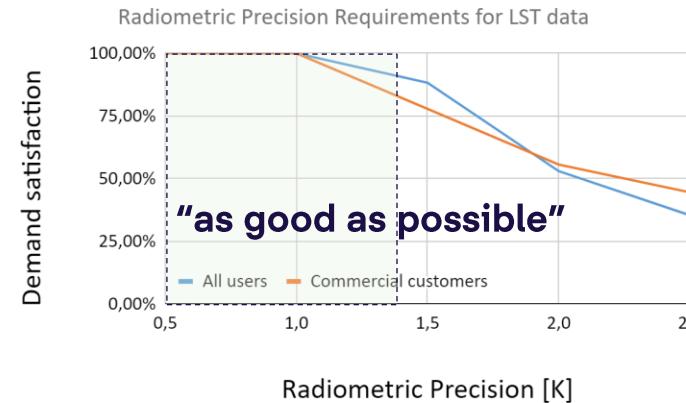
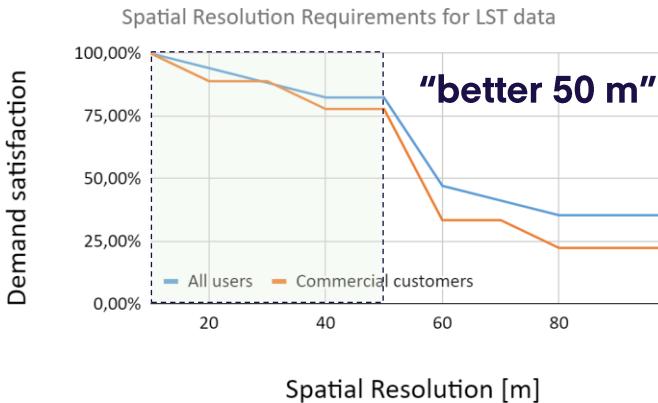
constellr operates in a multi-billion dollar market



Market size estimates for 2030 if not specified otherwise. Sources: Grand View Research 2020, Allied Market Research 2020, Global Center of Adaptation, Global Industry Analysts 2021, Infrastructure News 2021, Research and Markets 2019, Verified Market Research 2018, Geospatial Analytics Market, Green Technology and Sustainability Market, Markets and Markets 2019, Transparency Market Research 2020, Bloomberg (2021) ESG Assets May Hit \$53 Trillion by 2025



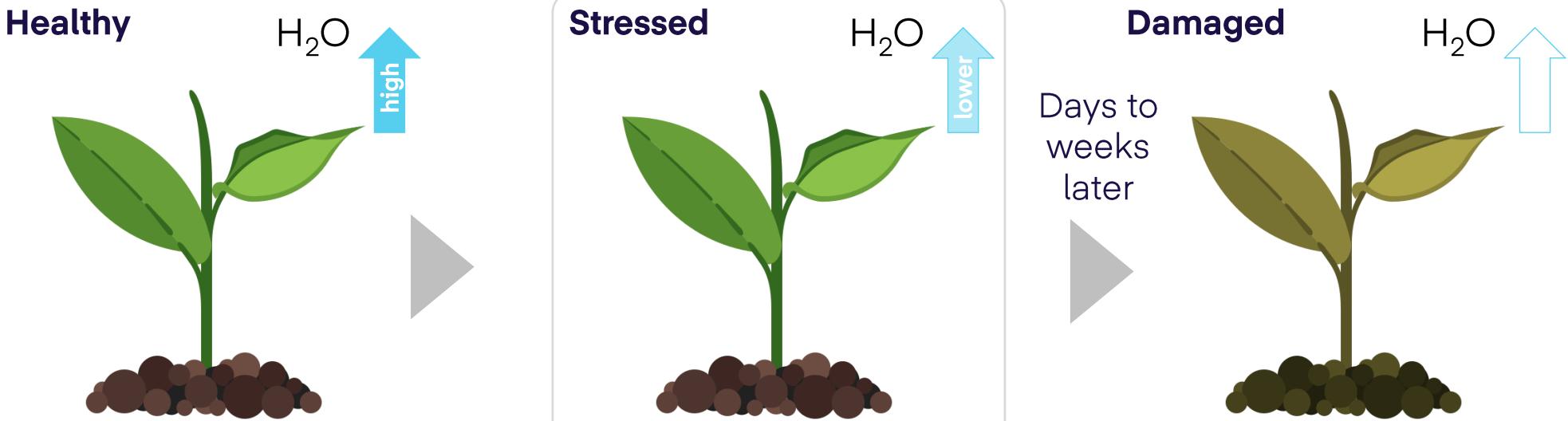
constellr's solution delivers highest customer satisfaction



constellr constellation's design parameters



constellr's is only scalable solution that allows to detect symptoms and repair crops before they get damaged



Symptom

None

None visible

Visible wilting & browning of leaves

Underlying cause

None

Reduced transpiration

Chlorophyll disappears

Effect

None

Leaf temperature rises

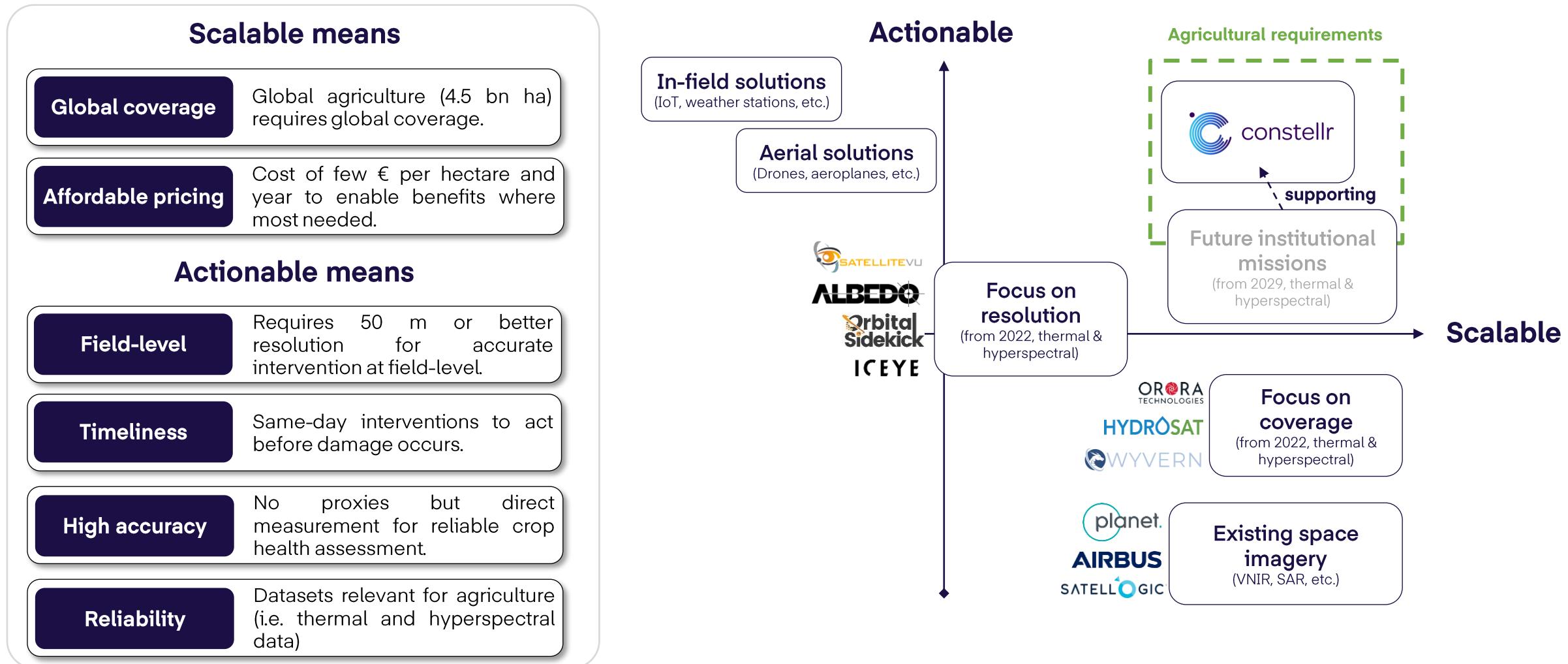
Yield loss



Existing space imagery
only notices when the plant is
already damaged

constellr is the only scalable and actionable solution (1/2)

Only constellation with proprietary thermal and hyperspectral data



constellr is unique in offering actionable (high-precision), and scalable (affordable) service (2/2)



Technology



Economics



Market

MiniSats



- **Low precision:** Single channel, cooled mid-wave infrared sensor, no absolute temperature reading possible

- **Expensive platform:** 150 kg mini satellite, 30 €/km²
- **Low capacity:** 16 km² per image

- First launch 2023
- Building temperature monitoring

CubeSats



- **Low precision:** Uncooled thermal infrared sensor
- **Low-resolution:** Small optics

- **Constrained:** CubeSat, low power, low agility, low stability, short live time

- First launch in 2022
- Agriculture, asset monitoring, wildfires

MicroSats



- **High precision:** (a) cooled thermal infrared sensor ; high-resolution, high-revisit; (b) **fusing with hyperspectral**

- **Cost-efficient:** 85 kg MicroSat, future-proof
- **High capacity:** > 250 km² per image
- **Low cost:** 1-10€/km²

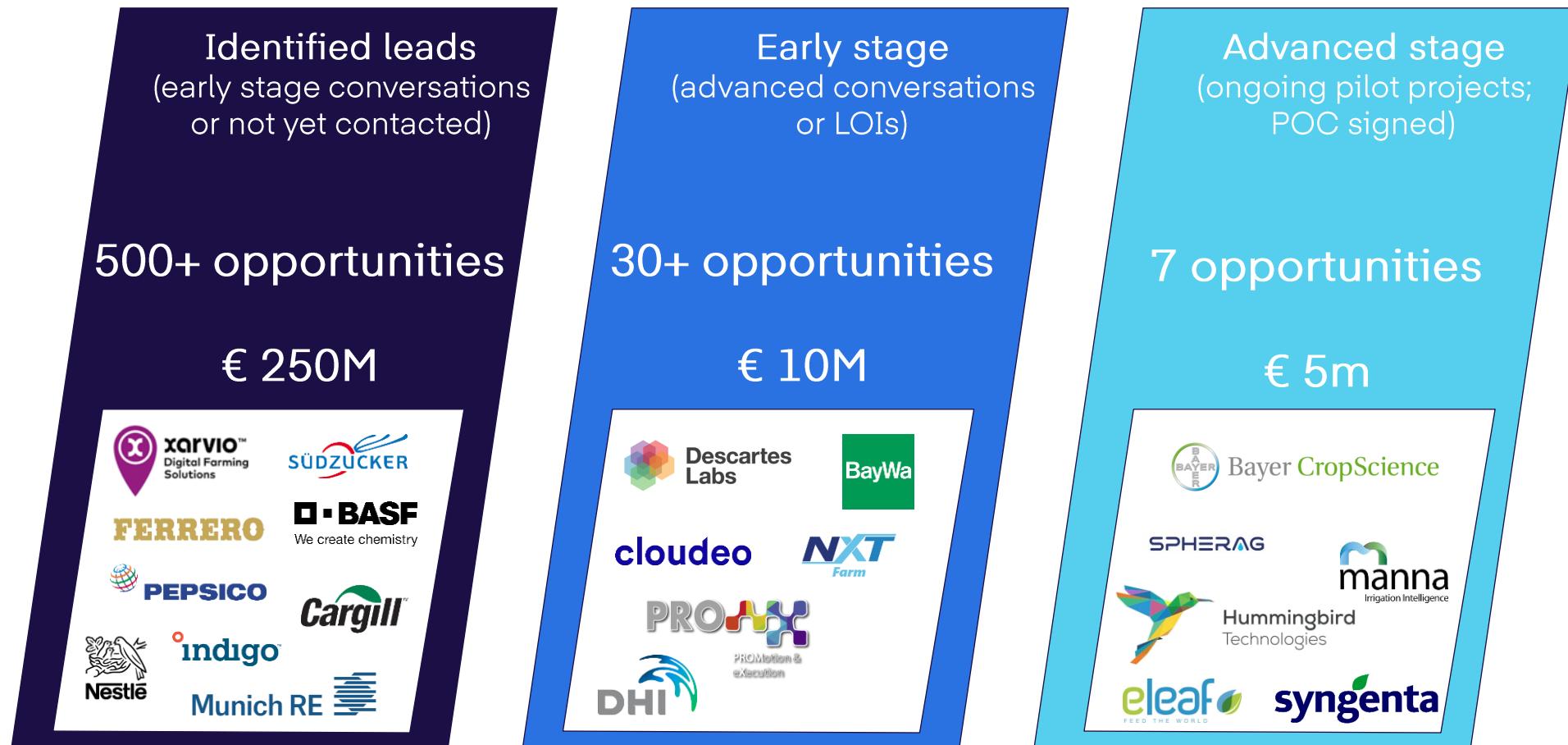
- **Orbital**
- Agriculture, insurance, carbon monitoring

5. Commercial traction



Sales Pipeline

Players from beachhead market



Ass.: average revenue per agri-analytics customer EUR 200k p.a. (willingness to pay from 50+ customer interviews) and EUR 2,000k for large agribusinesses

Market validation

Large market pull in from agricultural players for crop monitoring

June 2022 – October 2022



Focus

Crop water balance monitoring

Outcome

Comprehensive crop health assessment

Partners



October 2022 – July 2023



Focus

Crop health monitoring

Outcome

Validation of evapotranspiration from thermal data

Partners



From October 2022



Focus

Soil health

Outcome

Soil organic carbon assessment via remote sensing from space

Partners



20+ LOIs



6. Team



Management Team

Energy, balance, competence

Management



Dr. Max Gulde
CEO, Managing Director & Co-founder
Physicist

10y+ scientific career (published in Nature Science etc.)
Several spacetech patents



Marius Bierdel
CTO & Co-founder
Aerospace Engineer

5y+ spacecraft technology development
Head of Geoanalytics Team at Fraunhofer EMI



Christian Mittermaier
Managing Director & Co-founder
Business Analyst

5y+ financial and entrepreneurial background from UTUM & Munich Re



Cassi Welling
COO
Environmental Governance

10y+ sector experience in finance, growth and climatetech



Dr. Lina Hollender
CCO
Business Developer

10y+ experience in business strategy, commercialization, and leadership



Dr. Gueric de Crombrugge
Public affairs

Former ScanWorld general manager
7y+ experience in innovation commercialization

Advisors



Dr. Jason Maroothynaden
Former ESA Business Broker, entrepreneur, UK Director HE Space



Dr. Chiara Manfletti
COO Neuraspace
Professor in Space Propulsion & Mobility



Fabrice Testa
Serial Space Entrepreneur & Angel investor



Company key stats

Founding date: April 2020

Team size: 30 and growing quickly

Funding to date: 5 M€ in convertibles

Execution: From incorporation to space in less than two years, successful acquisition

Space heritage: Key hires from Planet & OHB; team members contributed to more than 20 missions

Team

Top talent from Planet, OHB, Fraunhofer and Munich Re



Heritage: 20+ space missions

Satellites

Astrid-2
CHIME
CO2M
Envisat
Formosat
Gosat-1
IASI NG
ImmunoLAB
(ISS)

Constellations

Dove
Galileo
RapidEye
Skysat
HiVE (Q4 '23)
MetOP (EPS)
MetOP SG
NovaSAR
SciSat-1
Suomi-NPP
Terra
ERNST (2022)
LisR

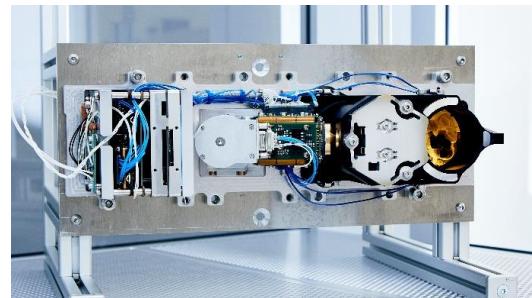
Experience with industry leaders



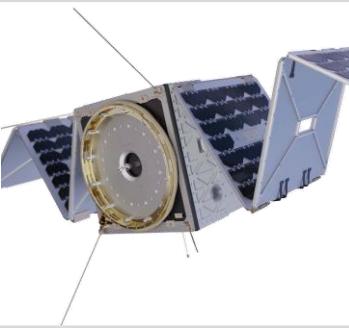
7. Technology

Towards daily, global infrared monitoring at field-level

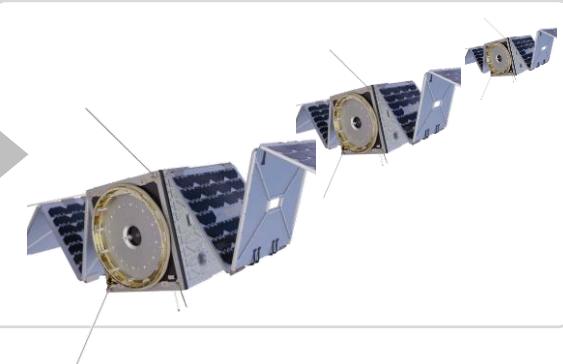
LisR



HiVE single



HiVE constellation



Status

Launched Feb'22

Orbit

ISS, 51.6°

Technology

Cryo-cooled, dual band LWIR

Revisit time

Weekly*

GSD (nadir)

80 m LWIR

Field of regard

30 km

NEDT LWIR

< 100 mK

L2 LST uncertainty

under evaluation**

Funding

Fully funded

Funded by Seed Round

18.5 M€ co-funding from ESA and EC

Platform rendering © NanoAvionics (2022)

*When homogenized with existing imagery.

**First results show that the accuracy of LisR L2 LST will be similar to Ecostress which provides an accuracy of 2.6 K.

Proven operational technology in orbit

Europe's highest resolution thermal sensor on board the ISS

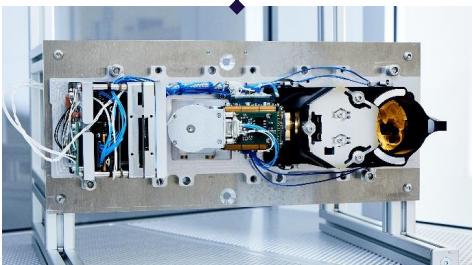
LisR-ISS



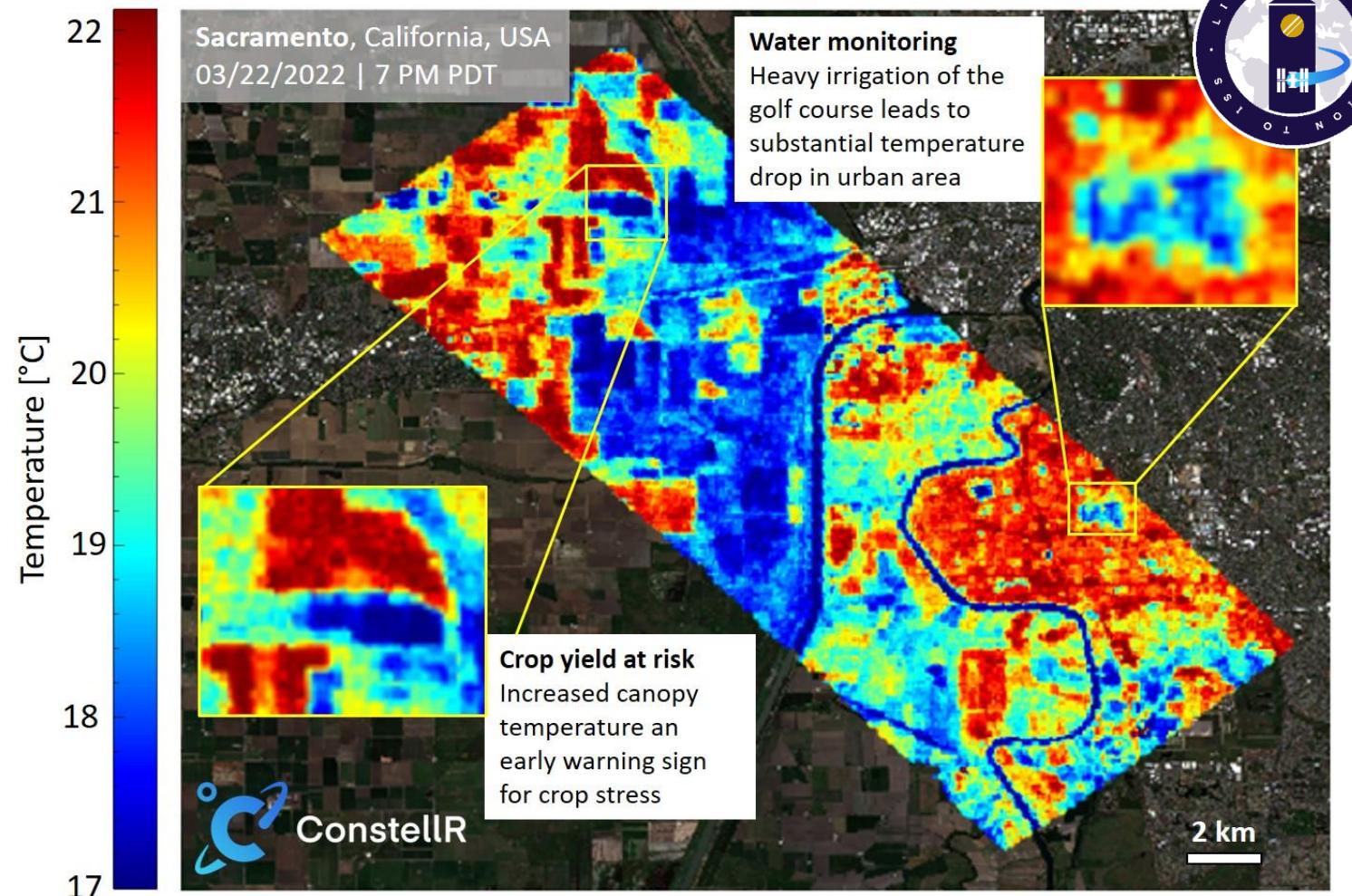
First light
on 16th
March.



Launched
19th Feb.
2022 to ISS



Developed
in less than
12 months



We are developing a precise thermal infrared imaging constellation

Codename for the constellation : HiVE

Innovation

Efficient mission architecture



Virtual calibration

Large system performance on microsatellites

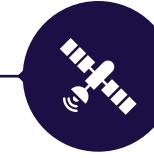


Several patents pending



Infrastructure

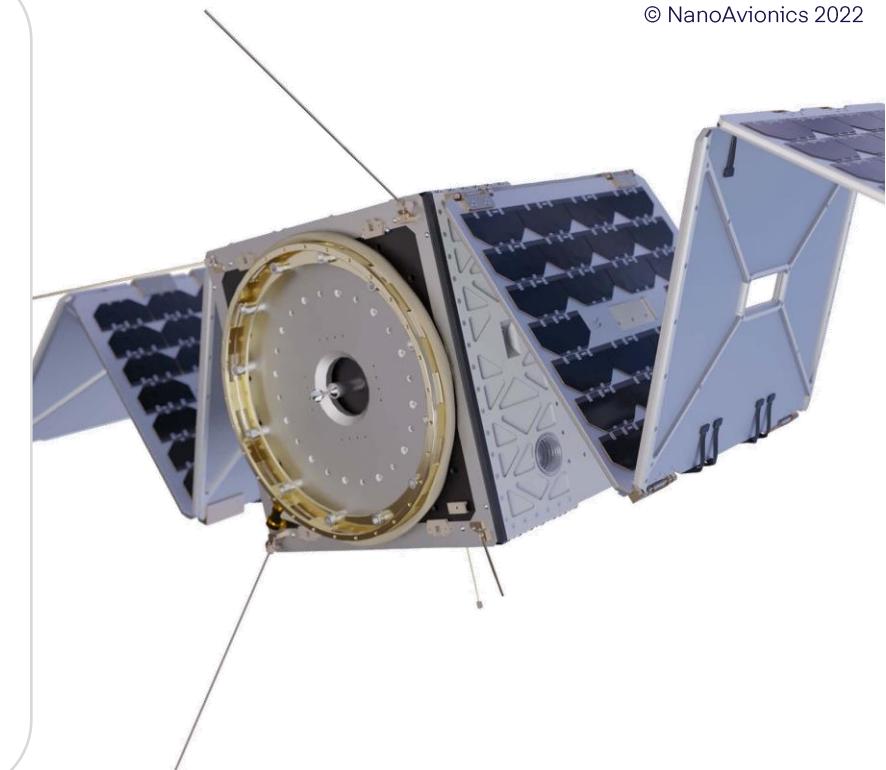
4 microsatellites
for daily access
globally



World-class
partners for
implementation



Data
harmonization
platform



© NanoAvionics 2022

Merging thermal with hyperspectral (1/2)

By acquiring ScanWorld, constellr now has a unique data-fusion capability using thermal infrared and hyperspectral sensors, specifically tailored for agriculture

Thermal *Legacy constellr*



Physical fingerprint
Temperature is the key environmental variable for the carbon, energy and water cycles.

Hyperspectral *Through ScanWorld acquisition*



Chemical fingerprint
Hyperspectral imagery delivers a comprehensive picture of key biomarkers



Together, we offer the most complete measurement on the biosphere currently achievable. It is a unique capability, globally.



Merging thermal with hyperspectral (2/2)

Deliver insights to the most pressing questions in agriculture: water & carbon

Current (TIR)



Product

Thermal data for crop water monitoring

Customer

EO agri-analytics providers, large agri businesses

Unique selling point
Highest radiometric accuracy & precision

From 2023 (TIR & free HYP)



Product

Analytics for crop health monitoring

Customer

Large agribusinesses and input providers

Unique selling point
Combining water stress (TIR) and biophysical (HYP) crop assessment

From 2025 (TIR & HYP)



Product

Carbon farming

Customer

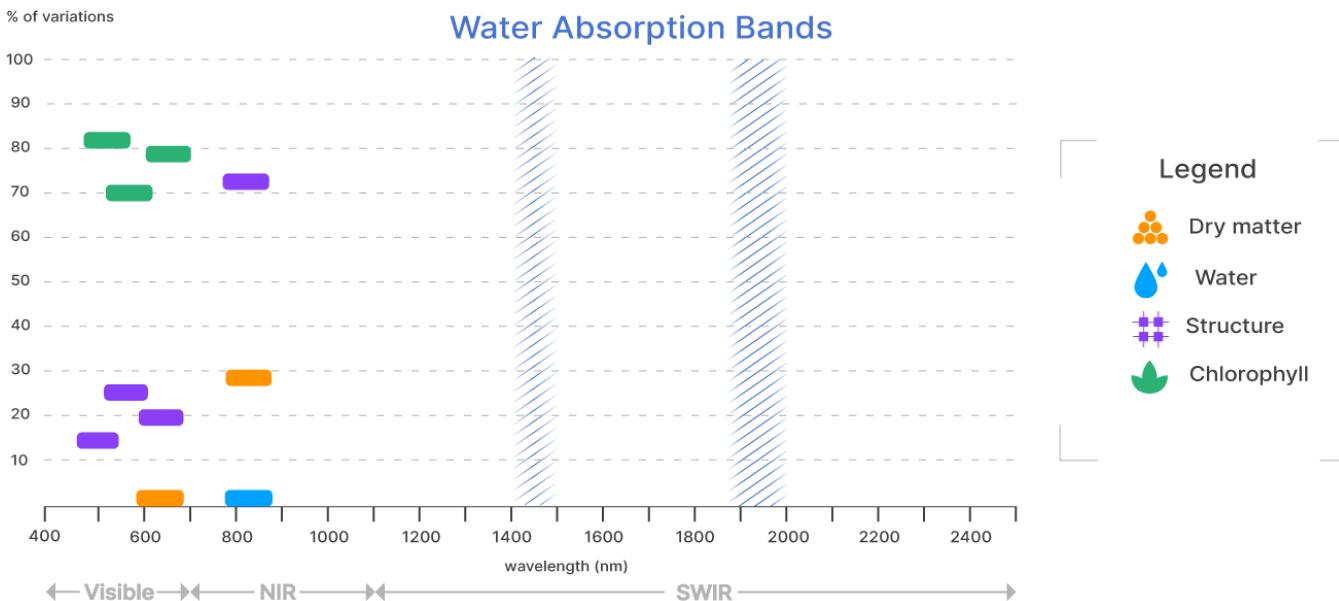
Carbon trading and offsetting markets

Unique selling point
Separation of moisture (TIR) and reflectance (HYP) changes from soil-organic carbon

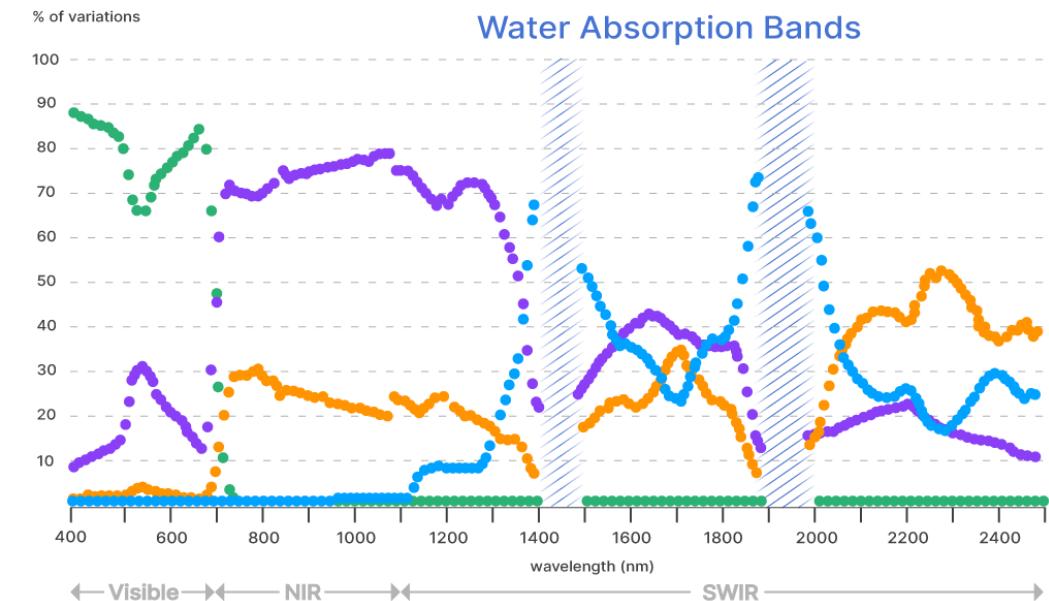
Hyperspectral: A complete picture of crop health

Replacing proxies by measurements

Multispectral system



Hyperspectral system



Current commercial systems
Unreliable proxies instead of
measurements



Sources: Ceccato 2001, Ceccato 2002

**Know-how through
ScanWorld acquisition**



SCANWORLD

Our technology is patent-pending and we have full freedom to operate

Overview

Data Processing

Virtual Calibration

PCT/EP2019/061790

USP

- Large-system radiometric performance in MicroSat form factor
- Allows low-complexity payload design

Inventor

- Max Gulde

License

- Exclusive license
- 2% revenue share in LST
- Capped at 3M€

Operations

Sensor Coverage

PCT/EP2020/065339

USP

- Real-time sensor coverage analysis
- Onboard processing potential

Inventor

- Max Gulde

License

- Non-exclusive license
- 4% revenue share of EO FindR platform
- Capped at 500 k€

Other

HeatR

MVP for sensor fusion between various thermal EO sensors

EO FindR

MVP for fast sensor access determination and EO data archive search

LisR

Orbital demonstrator onboard the ISS
(Launched Feb 19th 2022)

FTO¹



Initial FTO

- Conducted by Max Gulde and patent attorneys contracted by Fraunhofer
- No present documents impending FTO.



Competitor FTO

- Conducted by independent 3rd party
- No present documents impending FTO.



General FTO

- Conducted by independent 3rd party
- No present documents impending FTO.

1. Freedom to operate

8. Roadmap and seed round

How to get there: Product & commercialization roadmap

Building the biosphere intelligence of tomorrow

Roadmap

Now →

Minimal viable constellation (2024)

Scale-up (from 2025)



Temperature monitoring

- HeatR platform with proprietary (LisR) and public datasets
- Smart agriculture market



Water monitoring

- Minimal viable constellation for daily, global service
- Moving from imagery to actionable insights



Biophysical atlas

- Every field, every day
- Embed biophysical parameters
- Adjacent market penetration

Investment

Seed: 15 M€

First commercial traction

Series A: 50 M€

Vertical downstream integration

Series B: 100 M€

Horizontal expansion

The Seed round enables



4-day global coverage

- Build, launch and operate the first full-performance satellite in Q3 2023 and get satellite 2 ready for launch in Q1 2024



commercial transition

- From data seller to analytics provider selling actionable insights on crop water stress



early monetization

- Data fusion approach with free & public data to enter commercial pilots



Growth Opportunities

Multiple levers and vectors

Geography



1.5 billion ha of agricultural area globally

New verticals



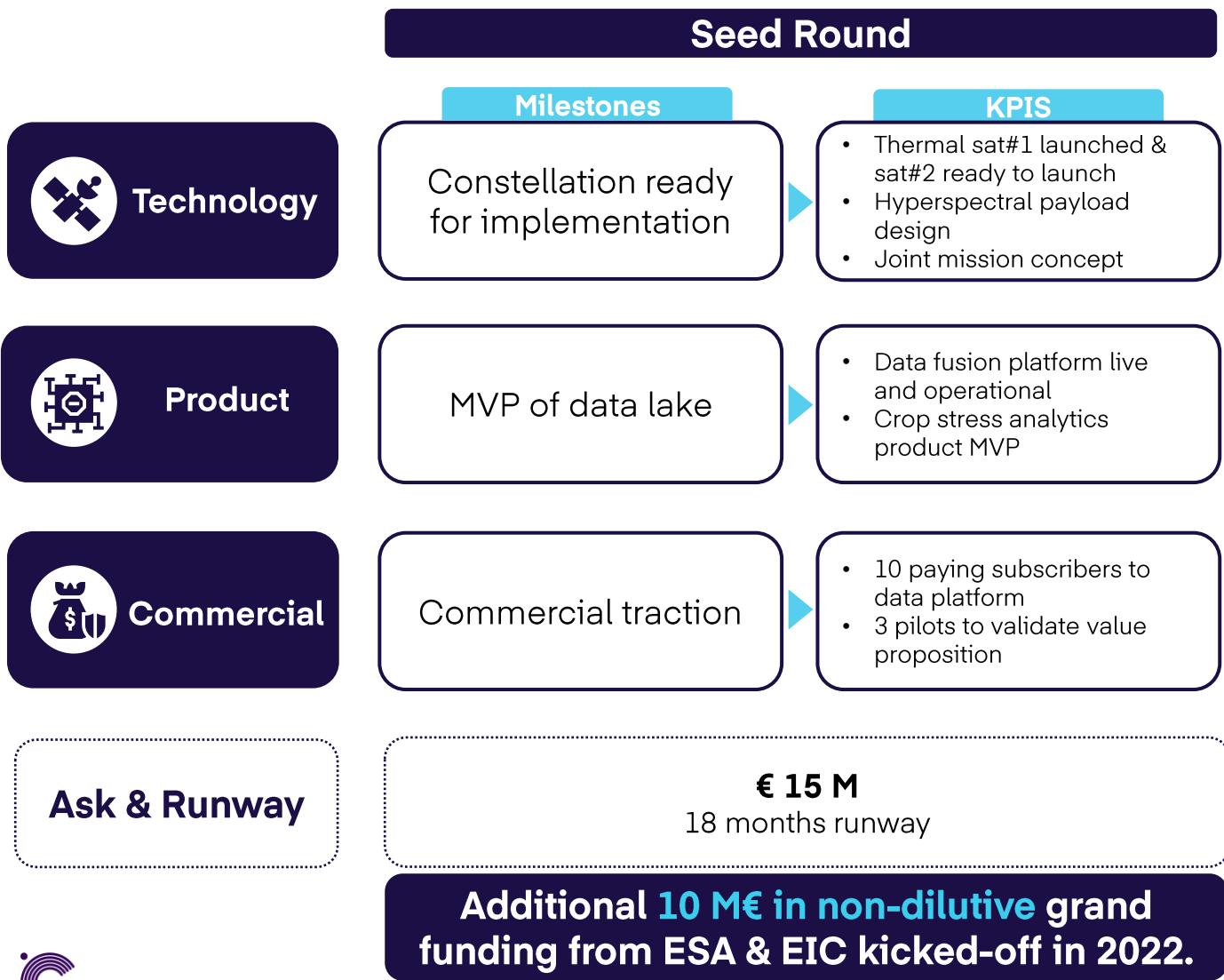
More than 30 use cases identified across industries

Value-added services

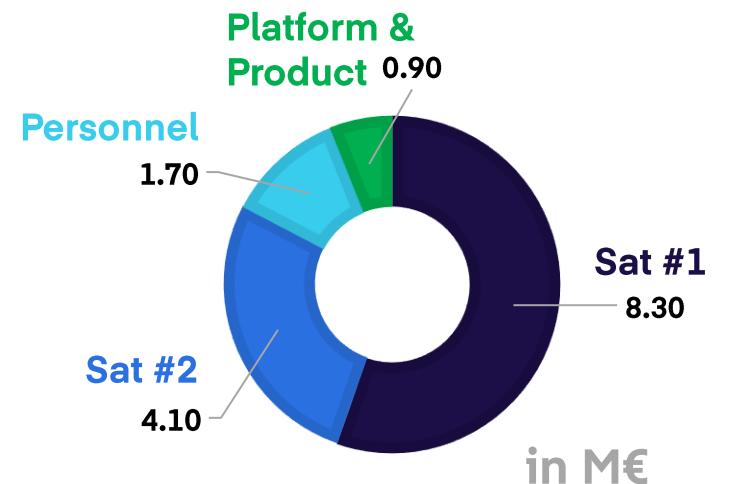


Fusing novel datasets to forecast future outcomes

Milestones, KPIs, and use of funds



Cost breakdown of funding need



Current investors
(5 M€ raised so far, further 4 M€ committed for Seed)



Financial

Space



Impact



AgriTech

Top-level product roadmap

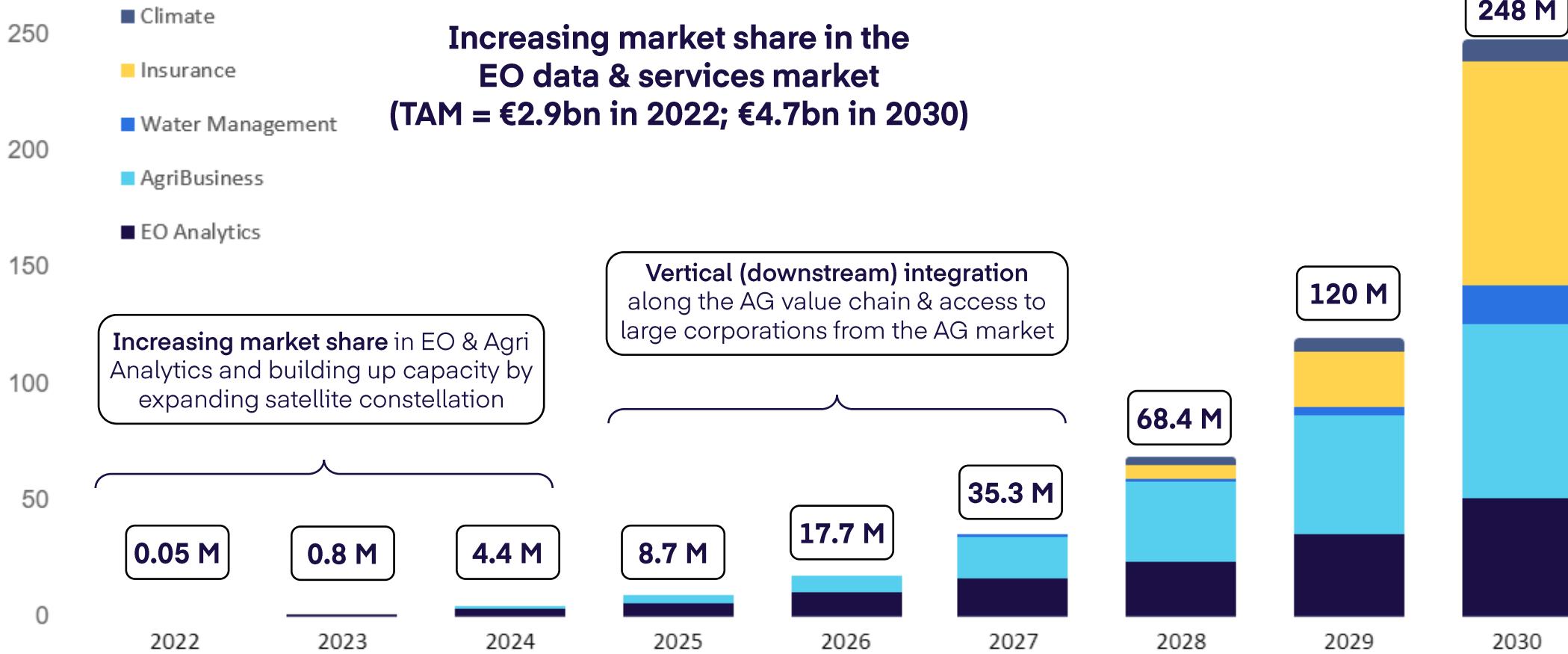
Deliver insights to the most pressing questions in agriculture: water & carbon

Use case	Data for smart irrigation	Insights for crop health monitoring	Carbon farming and certification
Customer	EO agri analytics companies	Farms management information system and input providers	Carbon trading platforms, private offsetting market, governments
Product	ARD L-2 Land Surface Temperature	Crop water stress index and nutrient information	<ol style="list-style-type: none">1/ Stratification of sampling2/ Extrapolation to follow up3/ Spaceborne SOC estimate
Value proposition	See symptoms at parcel-level before damage occurs	Direct measurement of water stress & capability for fertilizer uptake	Robust, standardized and highly scalable SOC quantification
USP	Accuracy	Combining water stress and biophysical crop assessment	Separation of moisture and reflectance changes from SOC



Revenue forecast per market

Estimated turnover 2022-2030



Appendix



ScanWorld acquisition



One team, one company

ScanWorld acquisition



Single Management to cater for the needs of the company, reducing management overhead.



Single team, which can flexibly work across locations in different projects.



Shared IP, to be used by both entities (stored inside constellr).



Single commercial face, based on joint infrastructure (space, ground and cloud).



Single constellation and respective infrastructure (mission concept to be developed).



Technology



Our sensor delivers the highest quality thermal infrared images



LisR offers **excellent image performance** at close to field-level resolution



LisR has **< 2% of the mass and volume** of NASA's ECOSTRESS



From 2023, HiVE will **substantially improve** image quality and resolution



Sentinel-2



visual imagery



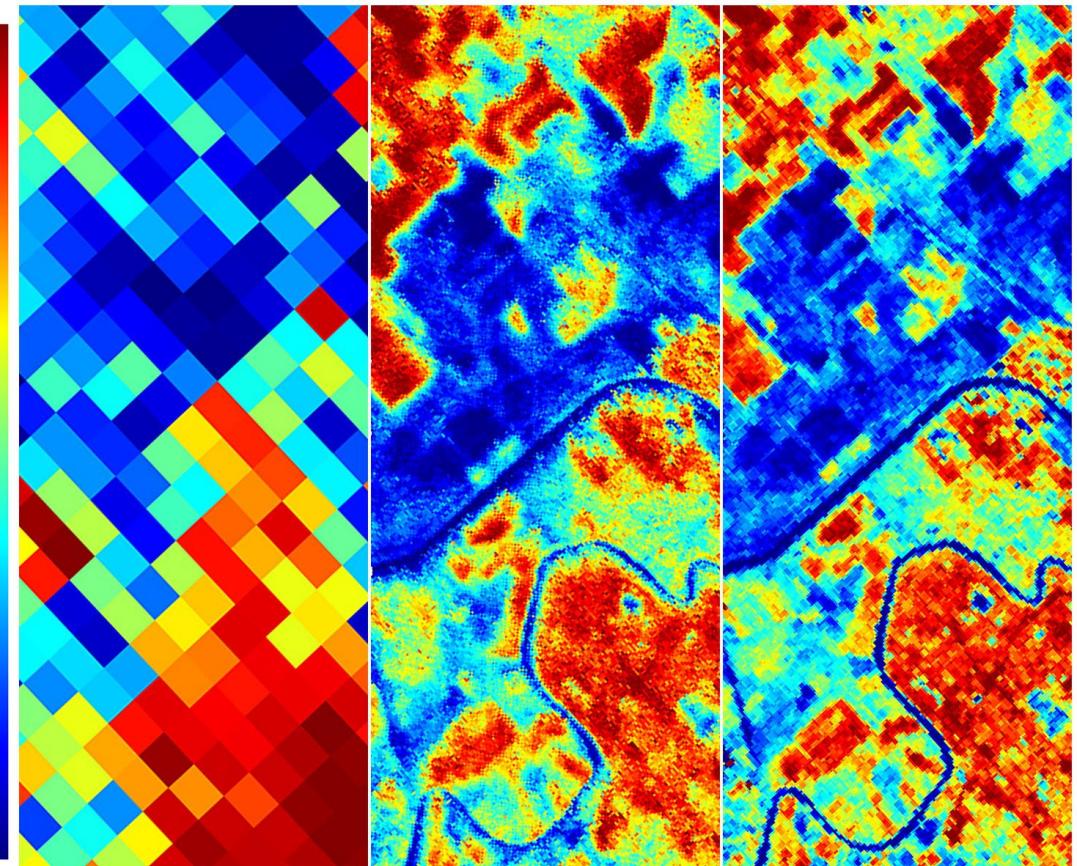
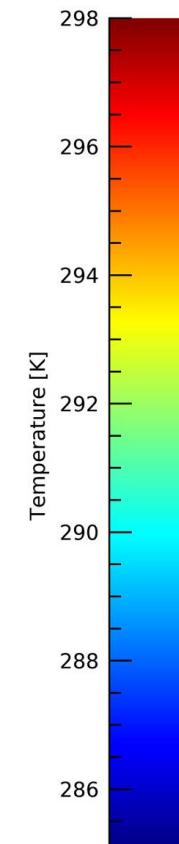
Sentinel-3



ECOSTRESS



constellr
LisR



Commercial



Examples of companies constellr is interacting with

Customers
with LOI or
Pilot Project



Focus:
Smart agriculture

Customers with
early
engagement



Focus:
**Yield estimation &
insurance**

Total target
customers



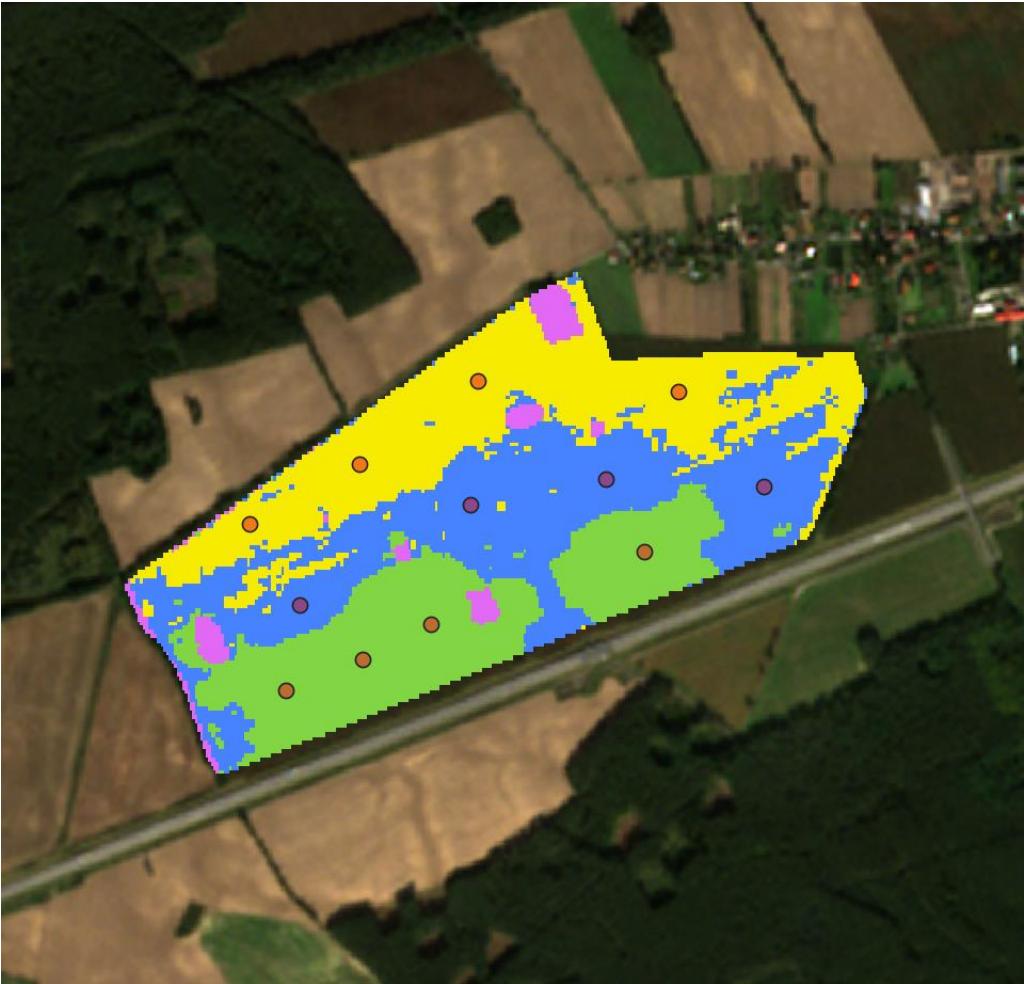
Focus:
**Cross-ecosystem
predictive analytics
solutions**

Analytics product MVPs



Remote sensing soil organic carbon

A space-based stratification map to help choosing the sampling locations



What we are delivering



Stratification

Helping operators choose where to pick up soil samples

- Map-based stratification of any parcel (3-5 clusters per parcel)
- An estimate of the SOC content ranges per cluster in t/ha

Operational solution



Follow-up

Providing a recurring update of the SOC content calibrated with past sampling campaigns

- Maps of Soil Organic Carbon content in the top 30cm
- Delivered on a frequent basis (we recommend every 2 months)

R&D phase

A methodology based on thermal and multispectral data

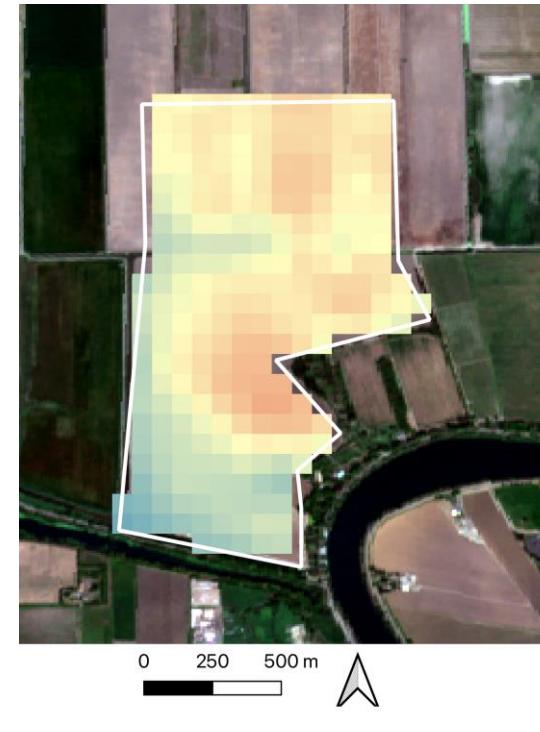
Area definition



Vegetation growth pattern analysis



Proprietary TIR data



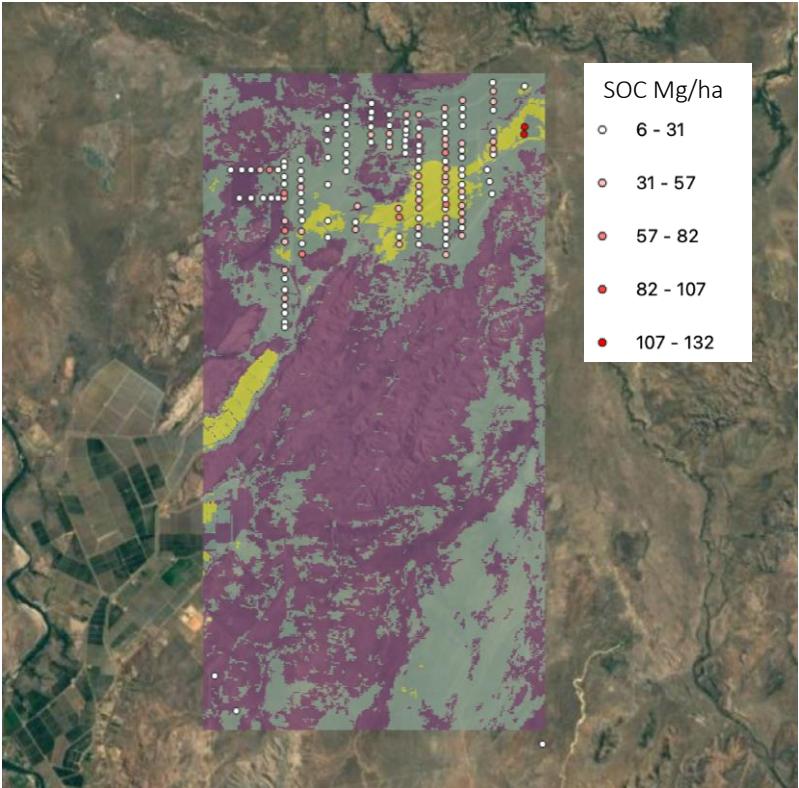
Clustering and range definition



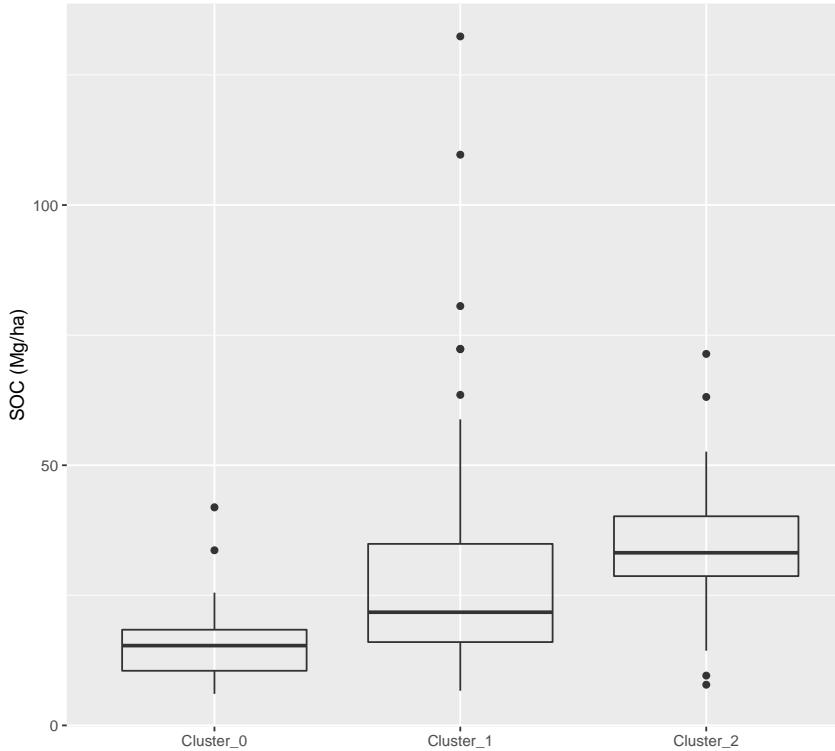
LISR_LST_22March2022, 7:00 pm
■ <20 C
■ >25 C

We validated our technology in field trials

Area definition



Correlating the clusters with field data



Validating the methodology

- Our validation focused on areas in Australia where large-scale public measurements campaigns were performed
- The field data used as a reference included:
 - 150 field samples
 - SOC layer top 0-30cm
- Field samples confirm the validity and usefulness of the clusters in providing a first understanding of a new site.

Our investors



Current Investors: FTTF GmbH

We provide venture capital for start-ups using Fraunhofer technology



- Investments from pre-seed to early stage 250 KEUR- 1 MEUR
- Additional funding of up to 5 MEURO in follow-on rounds
- Private fund backed by EIF and Fraunhofer

Current Portfolio # 24

A circular arrangement of 24 company logos, each with its name and a brief description below it:

- DGG Making 3D Accessible.
- MONITORFISH
- HIGHLINE TECHNOLOGY
- operaize
- Multiphoton Optics®
- SENODIS Industry. Information. Insights.
- pso|ido
- vibOTec virtual board technology
- mecorad
- adiutaByte Augmented Realtime Optimization
- volytica diagnostics
- mondas® DATEN. BEWERTEN. HANDELN.
- constellr
- XPOLI
- SMART CLOUD FARMING
- credium
- MOTIONMINERS
- NODE
- mySHOEFITTER
- VARIO LYTICS Making the invisible visible.
- ROBUST AO
- FUSION BIONIC
- ECOPALS

Team



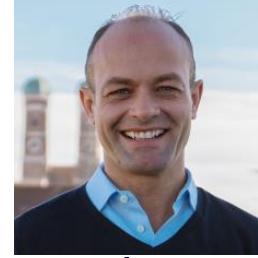
Matthias



Tobias



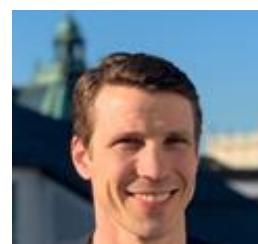
Liane



Johann



Thong



Jörg

www.fttf.eu

Current Investors: OHB Venture Capital

Corporate venture arm of the OHB group



OHB

- ❑ OHB is a German mid-cap spacecraft prime which is majority family-owned and has a background for starting as a start-up in the 90s

Strategic focus

- ❑ Tackling humanity's challenges using space solutions

Benefit

- ❑ Using technical know-how and contact within the space industry



OHB space capability overview

Team



Egbert Jan van der Veen



Marco Fuchs

Portfolio



Current Investors: Amathaon Capital

Growing a new breed of game-changers in sustainable agriculture



Our focus:

AgTech & AgBioTech companies working on solutions for the upstream food value chain facing the consequences of climate change, decreasing biodiversity, political & societal trends and supporting global food security.

Value proposition:

Deep know-how in agricultural industry, its looming disruptions, global industry cash-flows and transformational roadmaps of corporate landscape (potential exit partners) incl. a wide international network to key decision makers, potential co-investors, customers and partners.

Our backing:

Amathaon Capital backs the most promising solutions to the greatest challenges of our generation with capital, industry know-how and a strong relevant network.

Management Team



Borris Förster

Managing Partner
Leading expert in AgriFood innovation and commercialization. Investment Committee Member, German Agriculture Bank



Dr. Tobias Schönhaar, LL.M.

Managing Partner
Leading expert in VC/PE transaction execution & negotiation.

Portfolio / Heritage



Next Humanity Ventures invests in founders with a radical mission to leverage technology to actualize world net positives at scale

- First check, pre-seed & seed
- Backing Deeptech & Breakthrough science ventures that solve humanity's grand challenges (Sustainable Systems & Infrastructure & Planetary Health)



Founding Partner
Sal Matteis



Founding Partner
Tamara Minick-Scokalo



Founding Partner
Philippe Fornier

19

investments
in portfolio



Solving world hunger and powering food systems infrastructure with ocean and brackish water soil agriculture.
agrisea.co.uk



Creating world shaping satellite technology to radically influence the future of food.
constellr.space



Avoiding 7 billion chicks being grinded with CRISPR gene edited chickens laying sex-detectable eggs.
eggxyt.com



In a wild where drones become ubiquitous EVA is building the Cleantech infrastructure to sustain this..
eva.xyz



The fastest and greenest way to fly between cities
talyn.com



Addressing water scarcity with an intelligence platform.
droople.io



Nutritional, antibiotic-free and sustainable cultured fat for plant and cultured meat.
peace-of-meat.com



Powering the upgrade of the trucking industry with AI, connecting empty trucks with businesses.
quicargo.com

2000 companies under active review

Hearts Radiant

Increasing healthspan for the future of elderly care.

heartsradiant.com