

# Algorithms for food

Ronald Hoek



# A short introduction



## **Ronald Hoek**

- Background in Marketing (MSc.)
- More than 15 years experience in IT, Data and Digital
- B2B, Energy, Horticulture
- Passion: Translate innovations to robust business models
- AgroEnergy, Director & Starting Blue Radix, CEO

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AUTONOMOUS GREENHOUSE MANAGEMENT

# Autonomous Energy Management

Smart steering algorithms to lower energy cost and optimize installations



De automatische piloot voor uw APX!

**Weersvoorspelling**  
BiedOptimaal leest dagelijks de weersvoorspellingen in.



## Voorspellen met big data

BiedOptimaal combineert gegevens van het energieverbruik, alle instellingen van uw energiestrategie, de weersvoorspellingen en de prijsontwikkeling op de energiemarkt. Wiskundige modellen berekenen dan vervolgens een 4-daags vooruitzicht.

1 2 3 4 dagen vooruit



**Tuinder**  
U beslist zelf of u het advies overneemt of op de automatische piloot draait.

**Lagere kosten**  
Een teler met een kas van 15 ha. en 2 WKK's bespaart 1500 euro per maand.



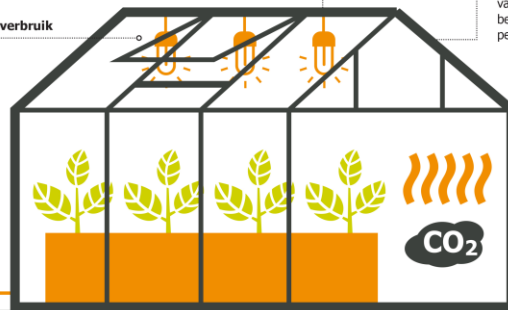
**Bespaar tijd**  
Ook bespaart hij 10 uur aan tijd per maand.

Bent u benieuwd naar ervaringen van tevreden gebruikers?  
[www.agro-energy.nl/biedoptimaal](http://www.agro-energy.nl/biedoptimaal)

**Begeleiding**  
De EnergieSpecialist van AgroEnergy ondersteunt u in uw energiestrategie en de inrichting van BiedOptimaal.

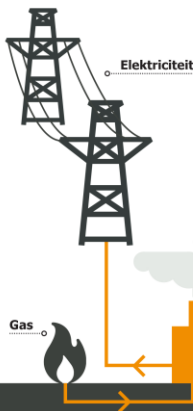


Energieverbruik



**WKK**  
De energiemarkt is dynamisch. Als u niet optimaal stuurt, laat u geld liggen.

Berekenen optimale inzet warmtebuffer



WINNAAR  
NEDERLANDSE  
DATA SCIENCE  
PRIJS 2017



**From  
autonomous *energy*  
management**



**to  
autonomous *greenhouse*  
management**



# **Will algorithms replace the green fingers of growers?**

Within the next 3 years?

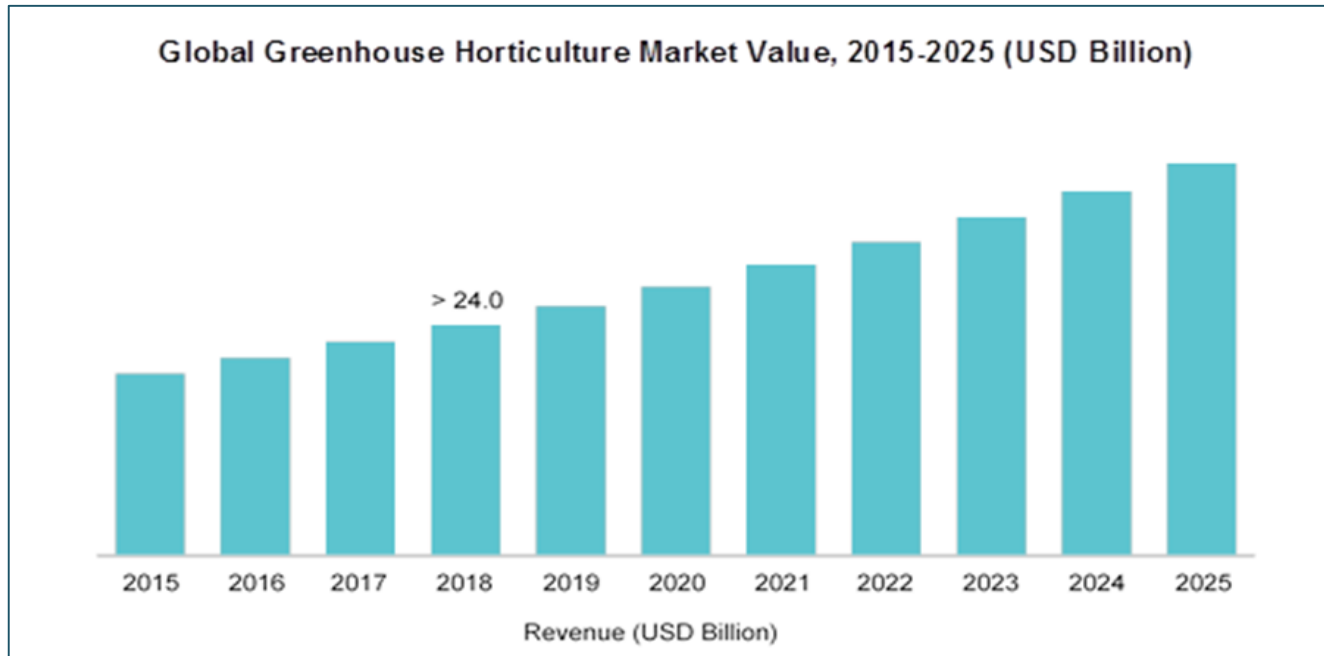


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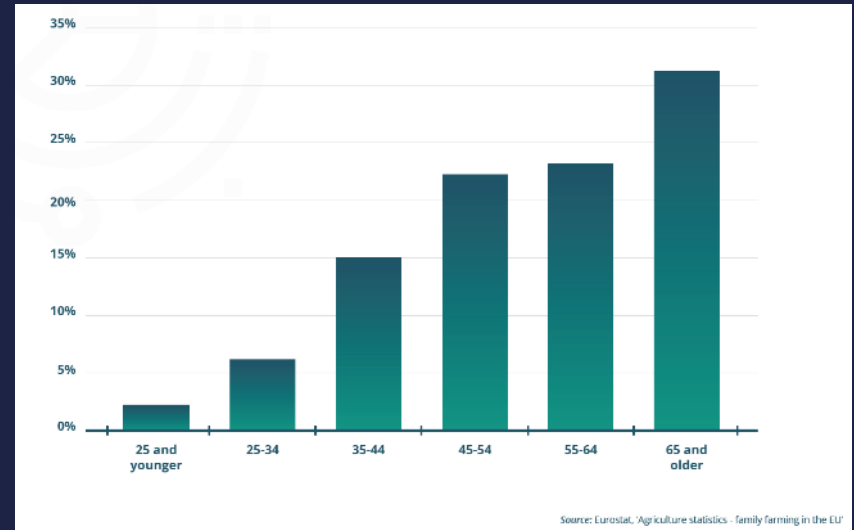
# Greenhouse horticulture grows with 8% per year

Greenhouse Horticulture Market will grow to hit \$41.84 billion by 2025.





## A huge challenge: the age distribution of growers

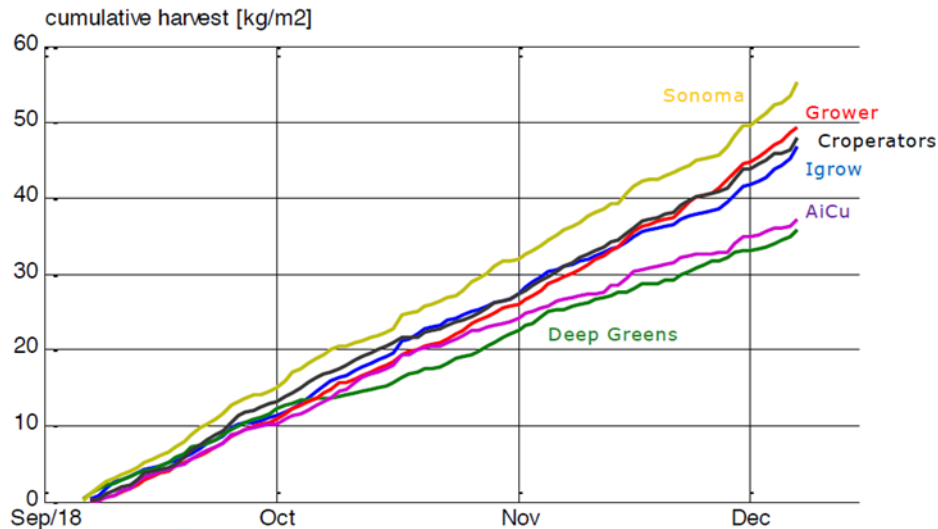


**Greenhouse sector is  
growing strongly, but...**

**...Who will operate the greenhouses?**



*Tencent* 腾讯



Strong competition by tech-giants



## Challenge results The Croperators

Challenge result: 3rd overall place of 14 international teams. **2nd place for AI approach**, beating the overall winner Microsoft (Sonoma).

Jury report: "A very strong approach, solid use of AI, only team that is **ready to test in production greenhouses.**"

Media coverage in 15+ horticulture media, Dutch and international media





## The learnings of the challenge

- Autonomous management of climate, irrigation, energy and crop is viable!
- We can not deny any more that fully data driven growing is possible
- Autonomous greenhouse management makes greenhouse operations scalable

# The rise of autonomous growing

Smart data solutions for scalable  
greenhouse operations



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# Our mission: enable smart horticulture

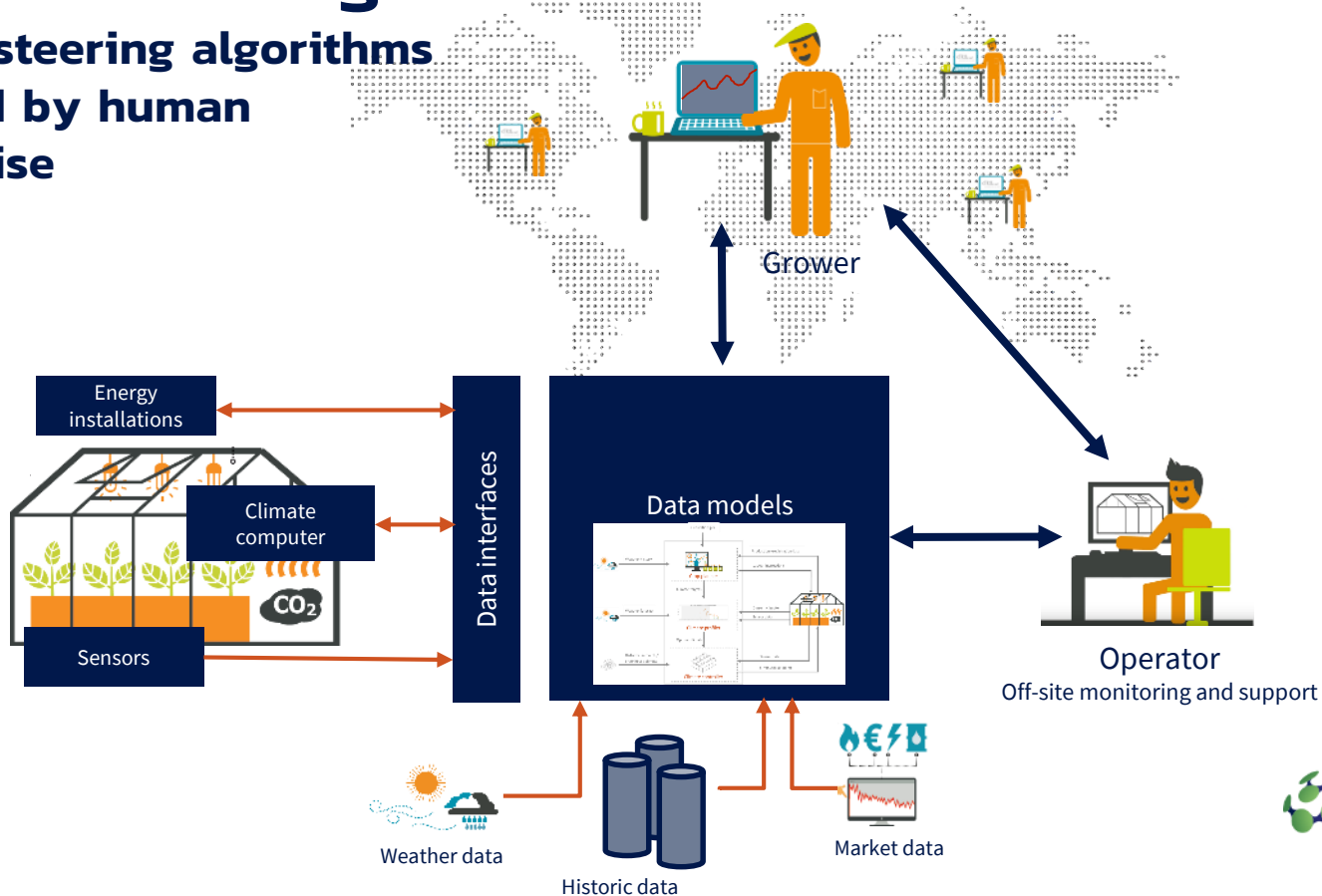
We add **automated intelligence** to the **daily decisions** in the greenhouse.  
To enable growers to meet their daily challenge: Produce more food and flowers with less resources.

Our solutions **integrate deeply** in the ecosystem of greenhouses to cooperate seamless with humans and existing systems. **Supported by highly skilled operators**, trusted by growers world wide.



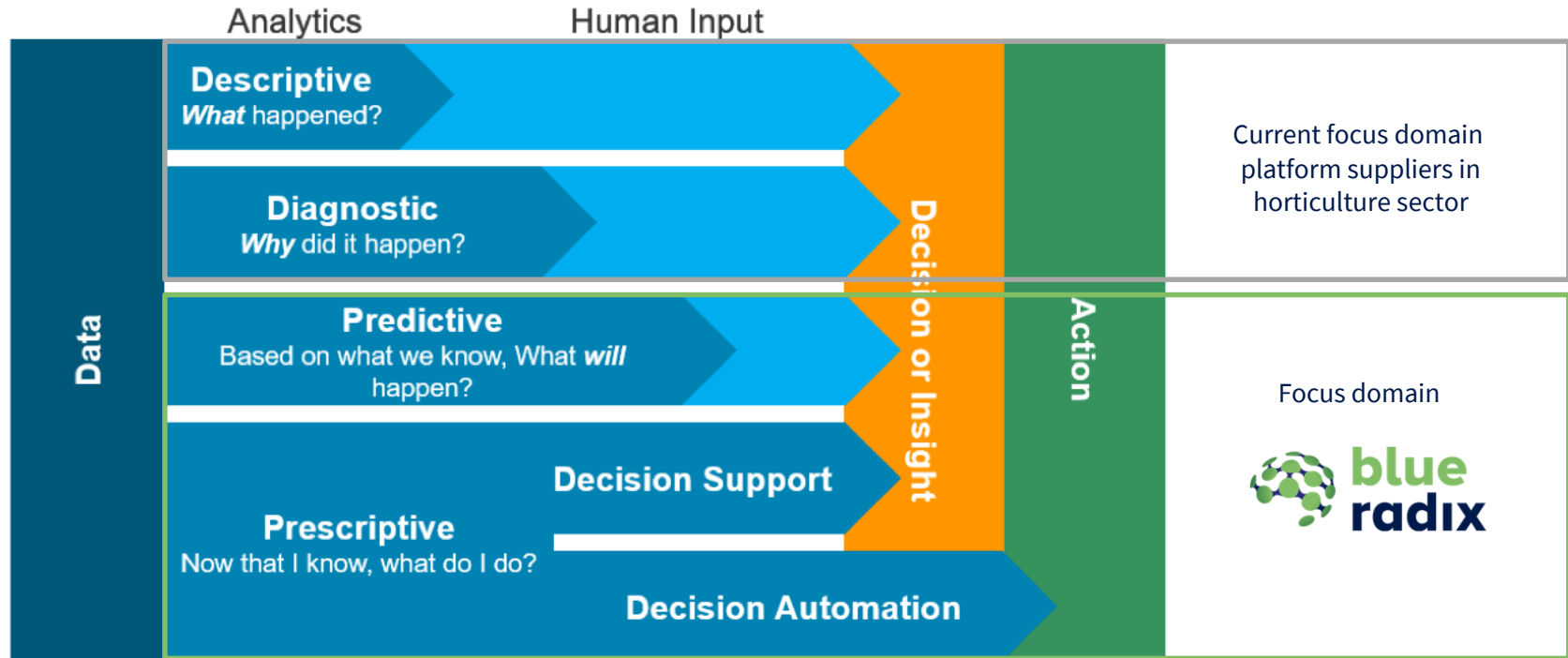
# Humans & Algorithms

Smart steering algorithms  
backed by human  
expertise



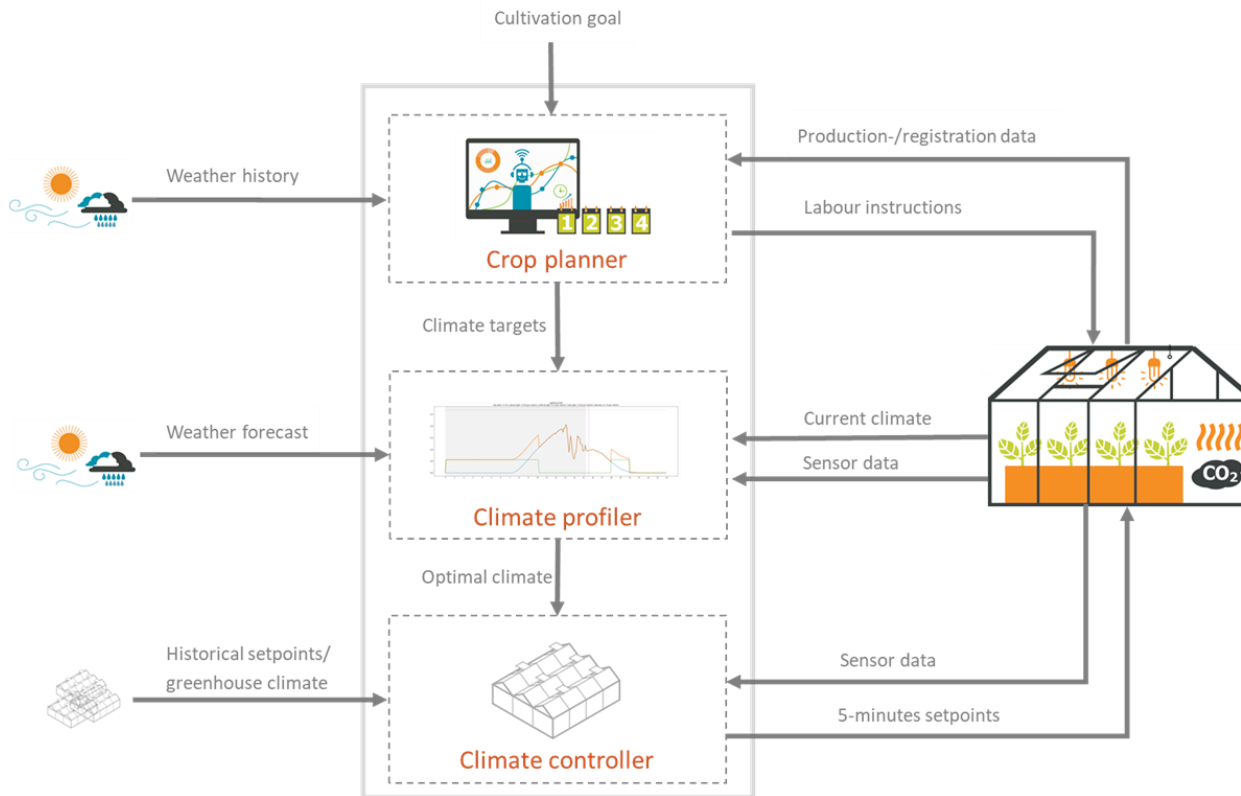
# Reporting, Analytics & Action

Blue Radix focusses on applied data science for action in greenhouse operations



# Model overview

Plant data is at the heart of our models to steer towards a climate for optimal yield





# Crop is leading

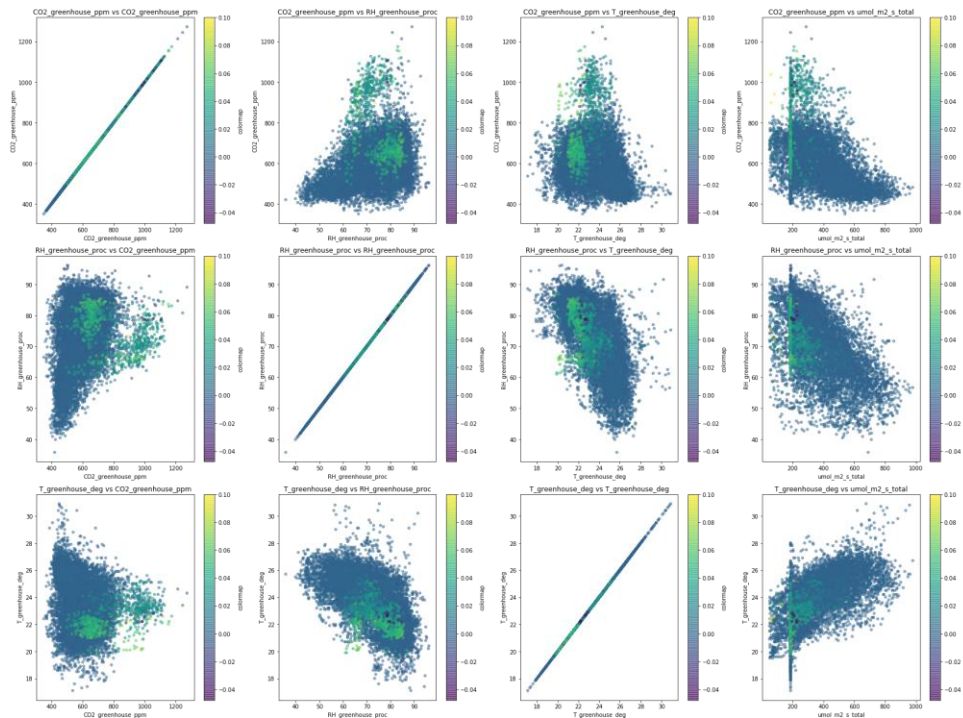
## Integrating direct plant feedback

- Focus on plant balances to steer the plant towards a productive and healthy state
- Direct plant feedback to get direct response from the plant
- Continuous monitoring to adapt on changes, day and night
- We currently conduct a subsidy funded research project (TKI) together with Delphy to find the best combination of sensors



# Beyond human insights

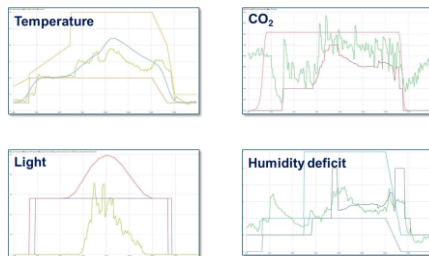
Optimizing greenhouse climate on all relevant aspects in one optimization solution



Algorithms are capable to find correlations beyond the capabilities of human insight.

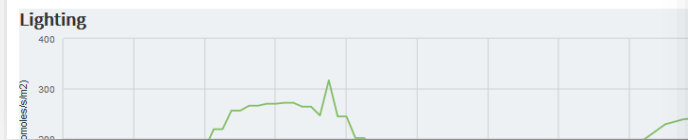
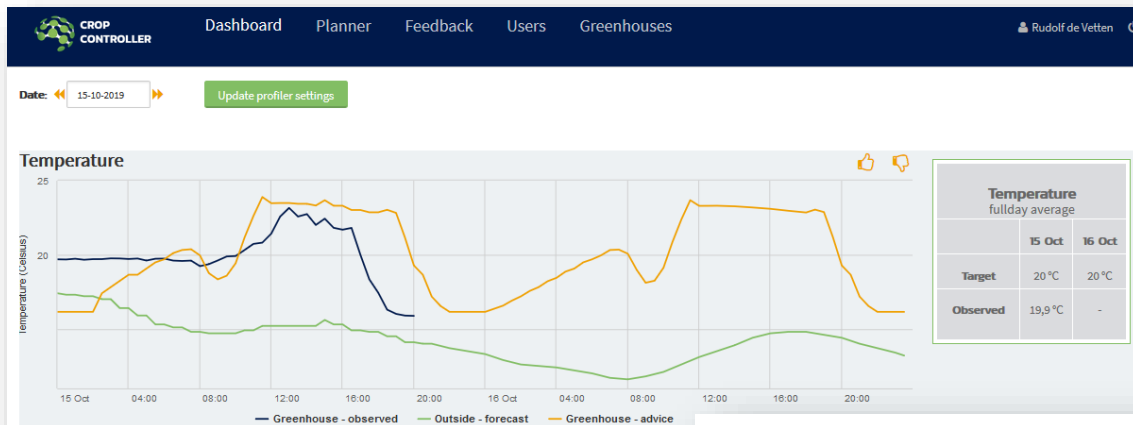
By using well defined datasets we train models to learn the dynamics of plant growth and greenhouse climate.

Greenhouse climate can be steered directly based on historic data and grower defined targets.



# Crop Controller interface

## Algorithms made adjustable and visible



### Manage profiler settings

	Morning 1 hour for sunrise	Morning dip At sunrise	Day After morning dip	Pre-night At sun down	Night After pre-night
	min - max	min - max	min - max	min - max	min - max
Temperature in °C	19 - 20	16 - 18	19 - 27	15 - 17	17 - 19
CO2 in ppm	600 - 700	600 - 700	550 - 1100	400 - 550	500 - 500
Humidity deficit in g/m3	2 - 3	2 - 3	2 - 8	1 - 2	2 - 3

[Close](#) [Save and re-run profiler](#)

# The similarity between growing and driving your car

Would you step into a fully autonomously driving car? Today?

## AUTOMATION LEVELS OF AUTONOMOUS CARS

### LEVEL 0



There are no autonomous features.

### LEVEL 1



These cars can handle one task at a time, like automatic braking.

### LEVEL 2



These cars would have at least two automated functions.

### LEVEL 3



These cars handle "dynamic driving tasks" but might still need intervention.

### LEVEL 4



These cars are officially driverless in certain environments.

### LEVEL 5



These cars can operate entirely on their own without any driver presence.

SOURCE: SAE International

BUSINESS INSIDER



## Tesla: 'Volledig zelfrijdende auto is volgend jaar al een feit'































Topman Elon Musk van Tesla belooft dat zijn auto's uiterlijk eind volgend jaar volledig autonoom vanaf een parkeerplaats naar een bestemming kunnen rijden. Hij spreekt over volledige autonomie, wat betekent dat de bestuurder intussen een dutje zou kunnen doen.

Niek Schenk / Tweakers 21-02-19, 12:07 Laatste update: 12:47



# Autonomy levels in greenhouse management

Phased approach to increase span of control in hectares and yield for growers

Level	Autonomous greenhouse management	Daily setpoint adjustments	Weekly setpoint adjustments	Proactive monitoring	Reactive response to alerts	Define crop strategy
0	The grower is settings the right setpoints manually in the climate computer based and monitors the effect.					
1	The grower controls most settings manually, but some specific functions are automated like a screen control system.					
2	Autonomous crop management can control a selected set of setpoints in the climate computer during normal circumstances. Other more complex settings are controlled by the grower. Also during extreme circumstances the grower must take over control.					
3	The greenhouse climate is fully controlled autonomously as long as no complex changes are required or extreme events occur. The grower has to check regularly for incidents and keeps an eye on the settings.					
4	The greenhouse climate is fully controlled autonomously in normal circumstances based on a defined crop target. Only in extreme cases the grower takes over control.					
5	The role of the grower is to set the crop targets. The greenhouse climate is controlled fully autonomously even during extreme situations.					

Trust & value

# Ecosystem

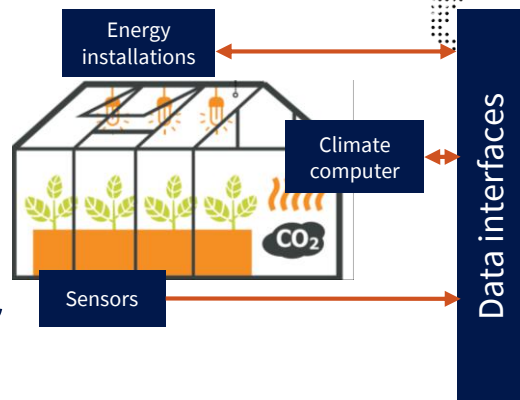
## Fully integrated solutions



Climate computers



Greenhouse suppliers



Data and sensor suppliers



Our solutions will be **fully integrated** with climate computers of the major brands and interact directly with sensors and energy installations in the greenhouse. **Independent and open for new data sources.**

We integrated the domain specific solutions of component suppliers to provide the grower with a single optimized answer on the question: How to control my greenhouse for optimal yield at reduced costs?

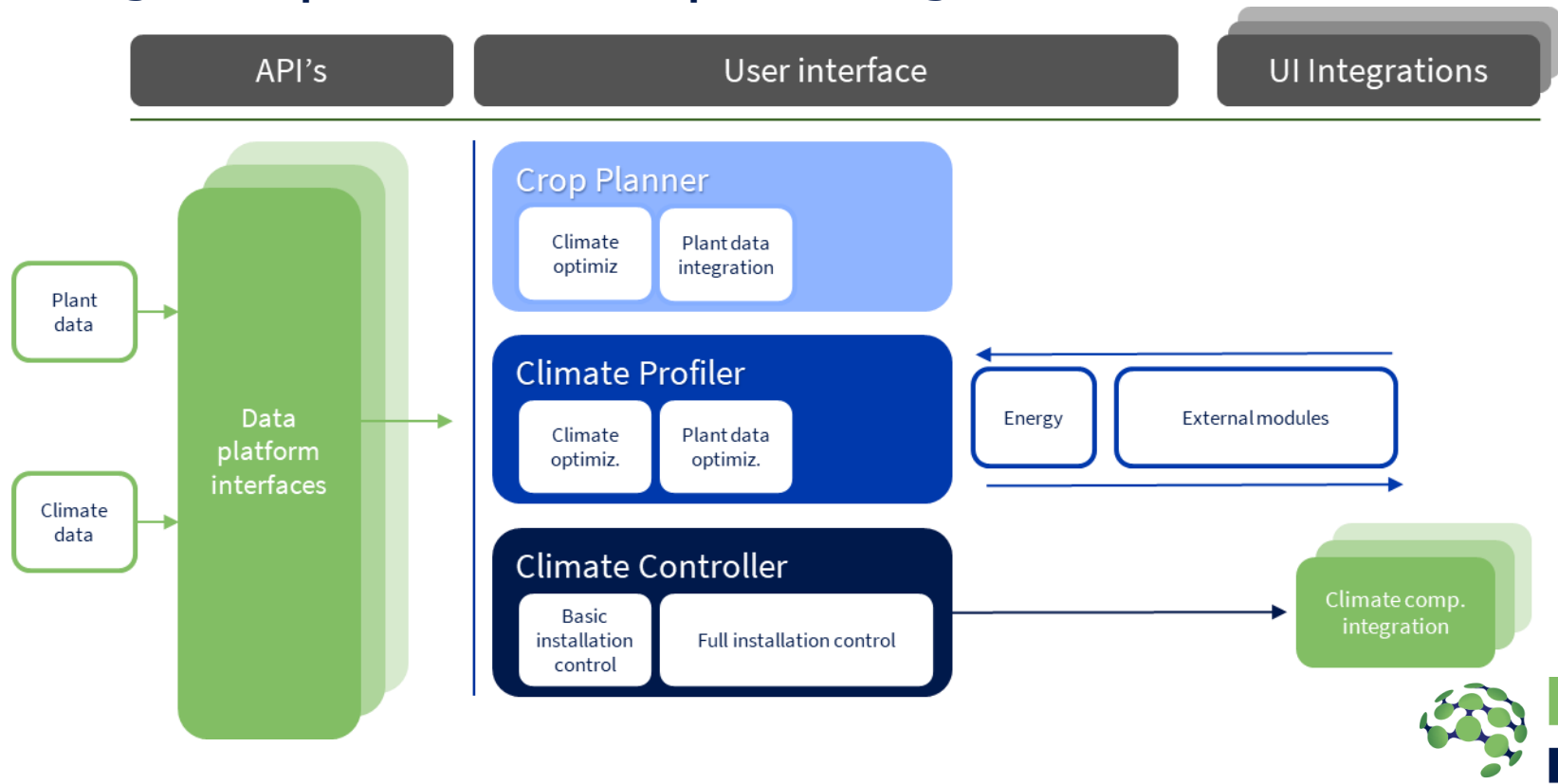


Operator  
Off-site monitoring and support



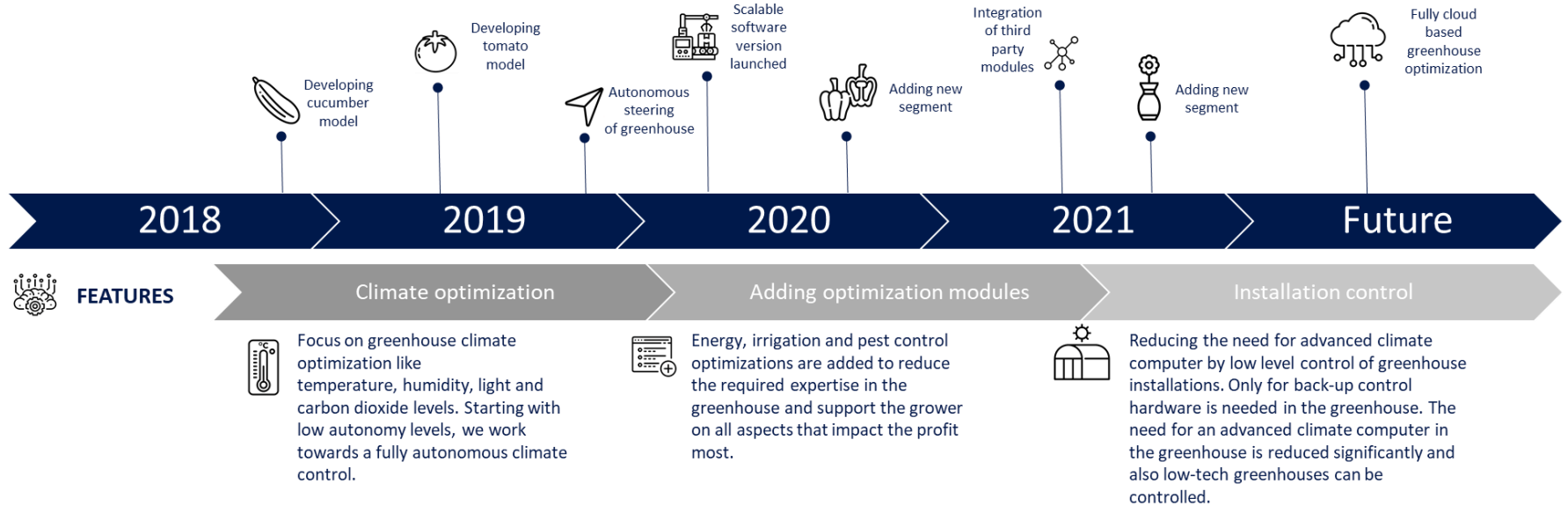
# Feature and connection overview Crop Controller

A logical setup of modules, UI and platform integrations



# Product roadmap

Algorithms and services are developed at a relatively high pace





# Statement

Algorithms will start replacing the 'green fingers' in greenhouses within the next 2 years!

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