COupling DIgital Twins

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Niels van der Geest (Delphy)
Evelien van Tongerlo (WUR)

Introductie team

Evelien van Tongerlo
WUR

Paolo de Heer
TNO

Niels van der Geest
Delphy

Op welke manier bezig met digitalisering?

- Klimaat
- Bemesting
- Teeltplanning
- Gewasmanagement

Het ecosysteem van digitalisering

Bronnen van informatie

- **Sensoren** – Klimaat, plant, substraat
- **Modellen** – Plant, kassystemen, weer
- **AI** – Computer vision & voorspellingen

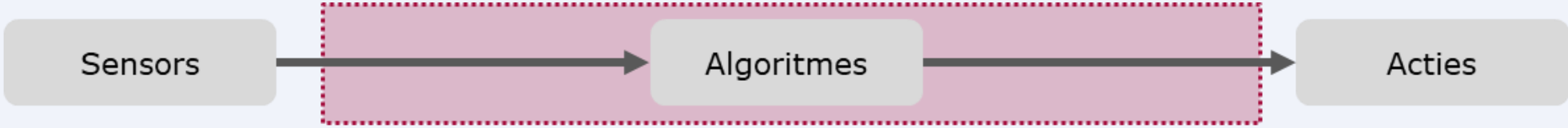
Kansen & uitdagingen

- Van data naar informatie
- Connectiviteit van platformen – hollistische aanpak
- Voorspelling vs real-time feedback

Digital Twin

- **Live** – model gevoed met real-time data
- Fysiek systeem wordt gemonitord, data gebruikt om te simuleren, adviseren en te optimaliseren.

Digitale landschap



Data partners

hoogendoorn growth management
KOPPERT BIOLOGICAL SYSTEMS
eurofins
CREATING A CLIMATE FOR GROWTH PRIVA
RIDDER
GEARBOX INNOVATION MAKERS
IUNU
De Ruiter
BASF We create chemistry
nunhems
ecoation
LETS GROW COM
gro
syngenta
Hazera Seeds of Growth
RIJK ZWAAN
axia vegetable seeds
ENZA ZADEN
Source

CODIT (digital twin)

Application partners

CREATING A CLIMATE FOR GROWTH PRIVA
hoogendoorn growth management
gro
RIDDER
Source
koidra
LETS GROW COM
blue radix

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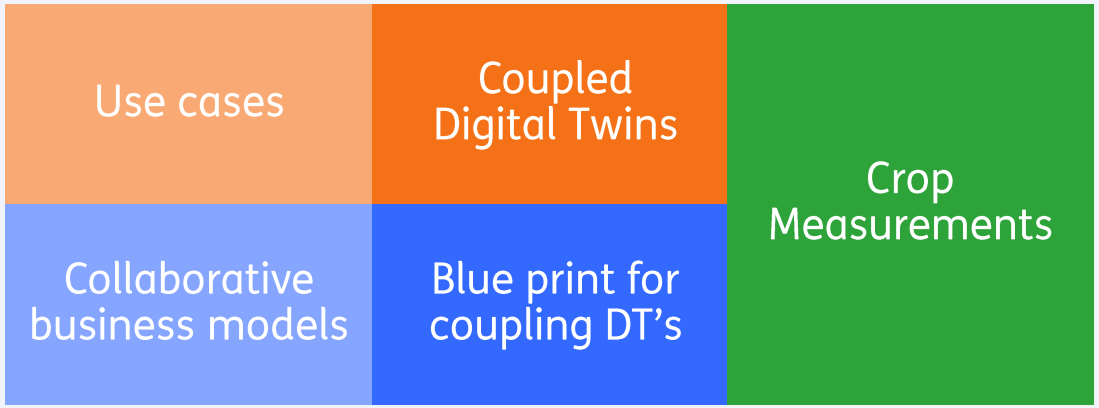
Setup & Doel



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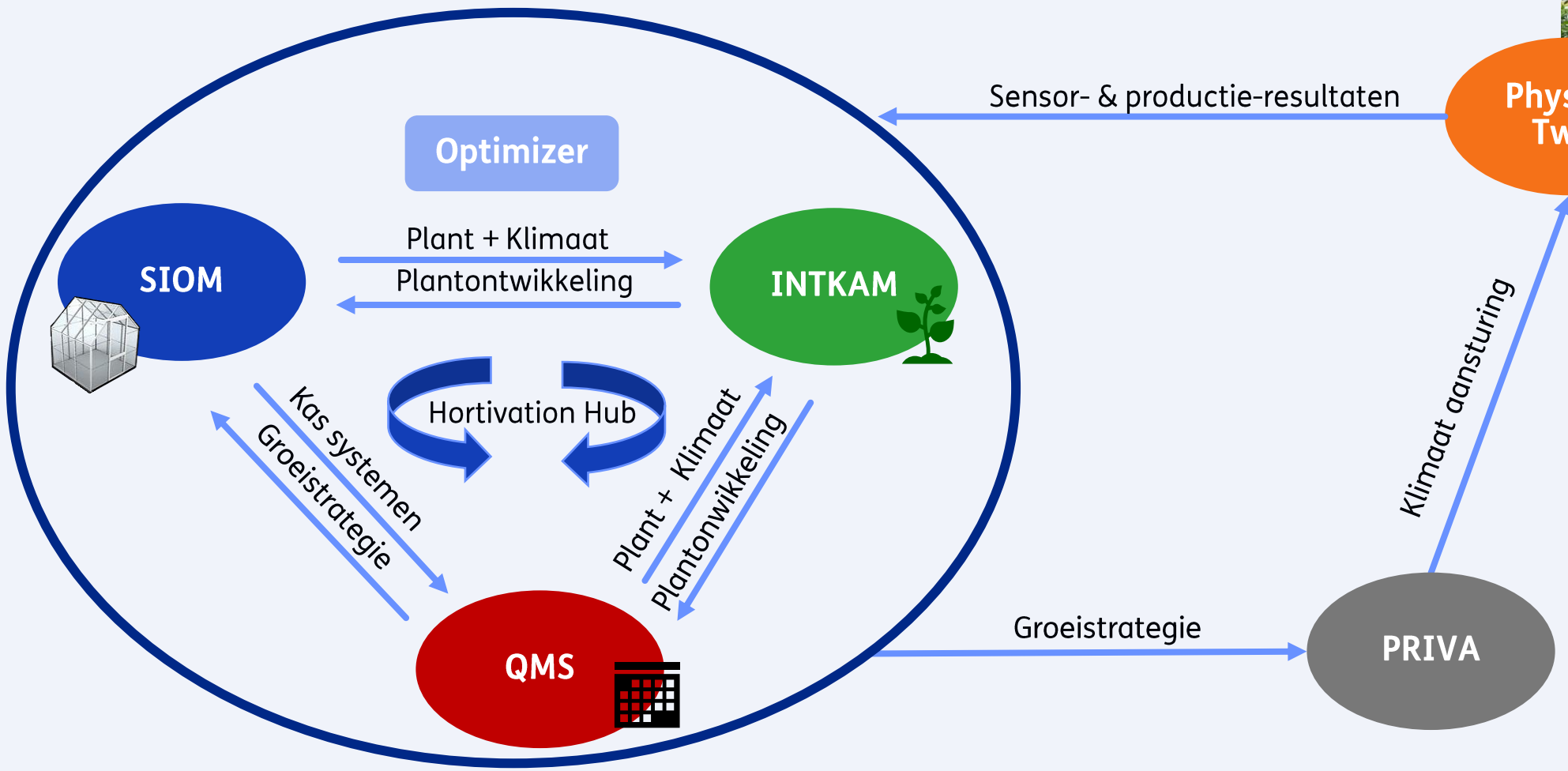
Delphy De Ruiter Vivent MechaTronix Hazera sendot Grodan wirelessvalue 2GROW

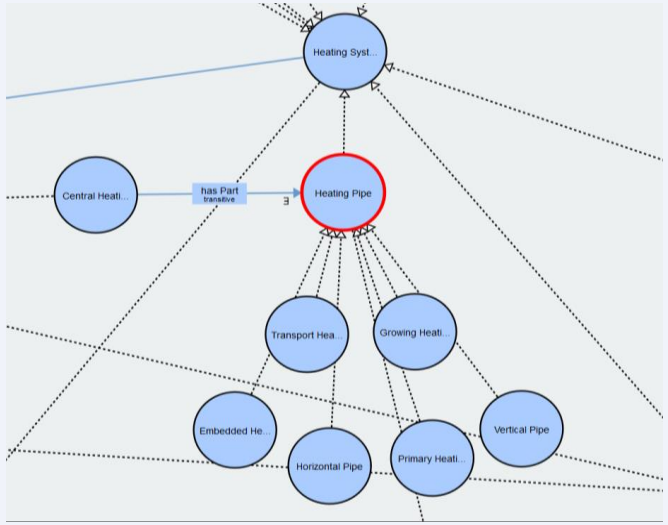
HORTIVATION
TECHNICAL GREEN INNOVATION HOLLAND

Coupled Digital Twins – Model interacties

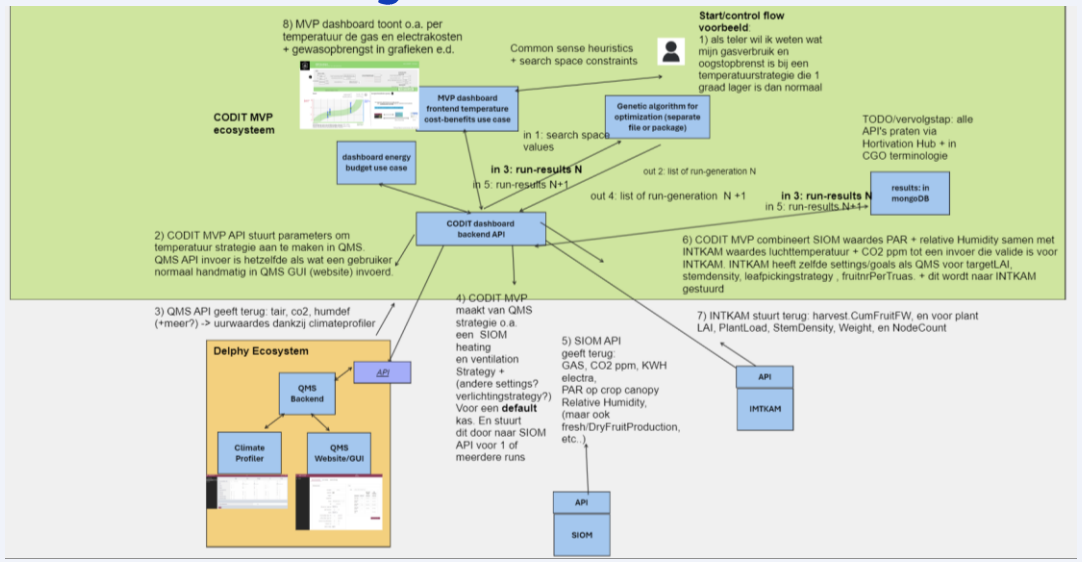


Technologische Componenten

Common Greenhouse Ontology



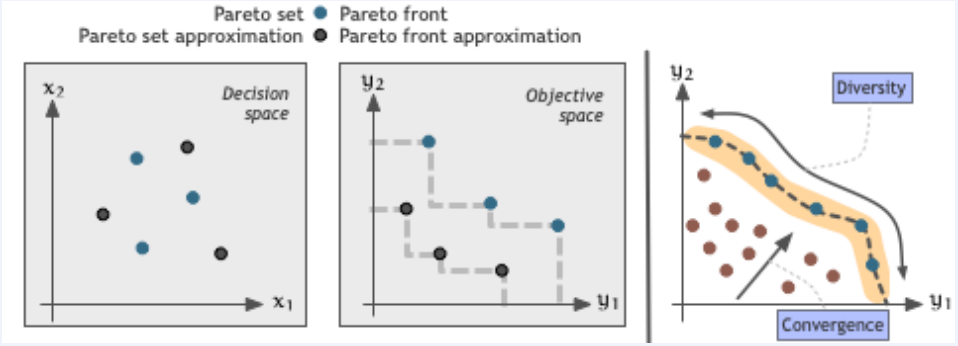
API verbindingen tussen DT's



Digital Twin Blauwdruk

- Kennis & regels
- Verbindingen
- Best practices

Losgekoppelde optimalisatie



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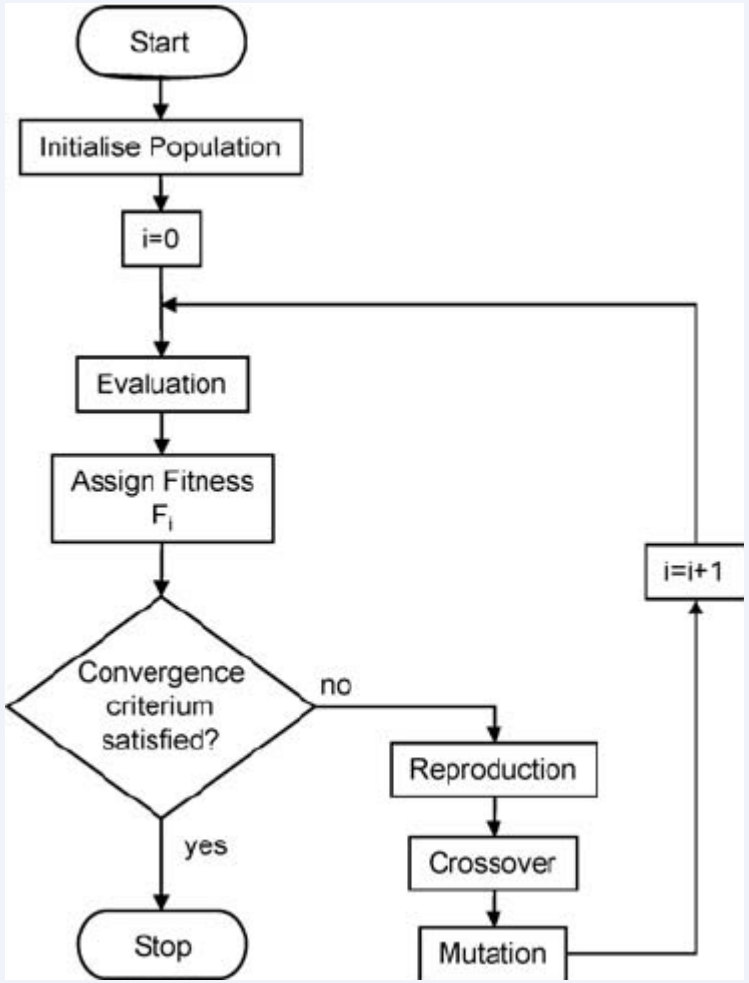
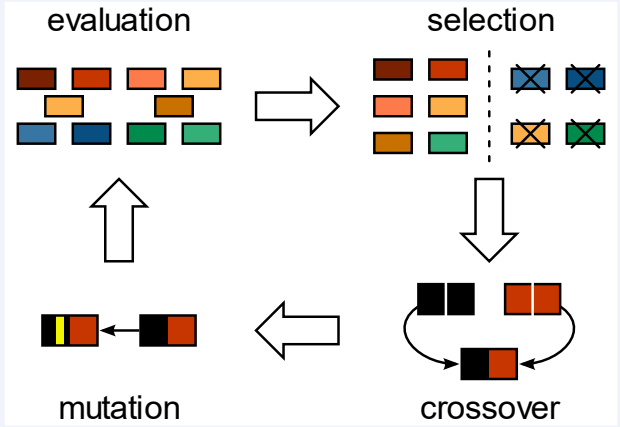
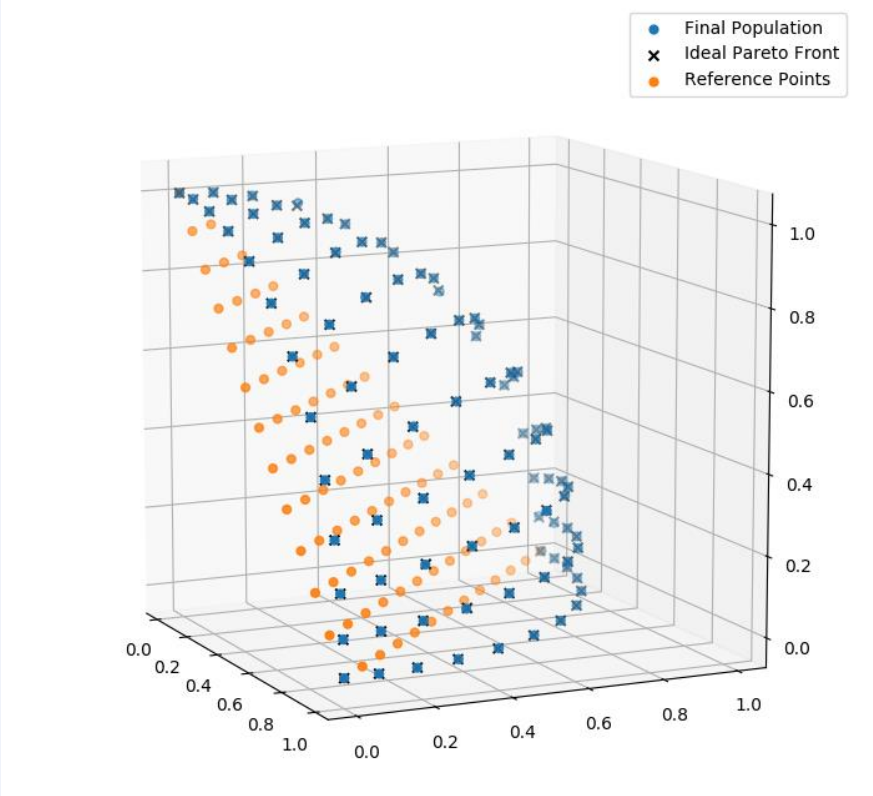
Optimaliseren met Evolutionaire Algoritmes

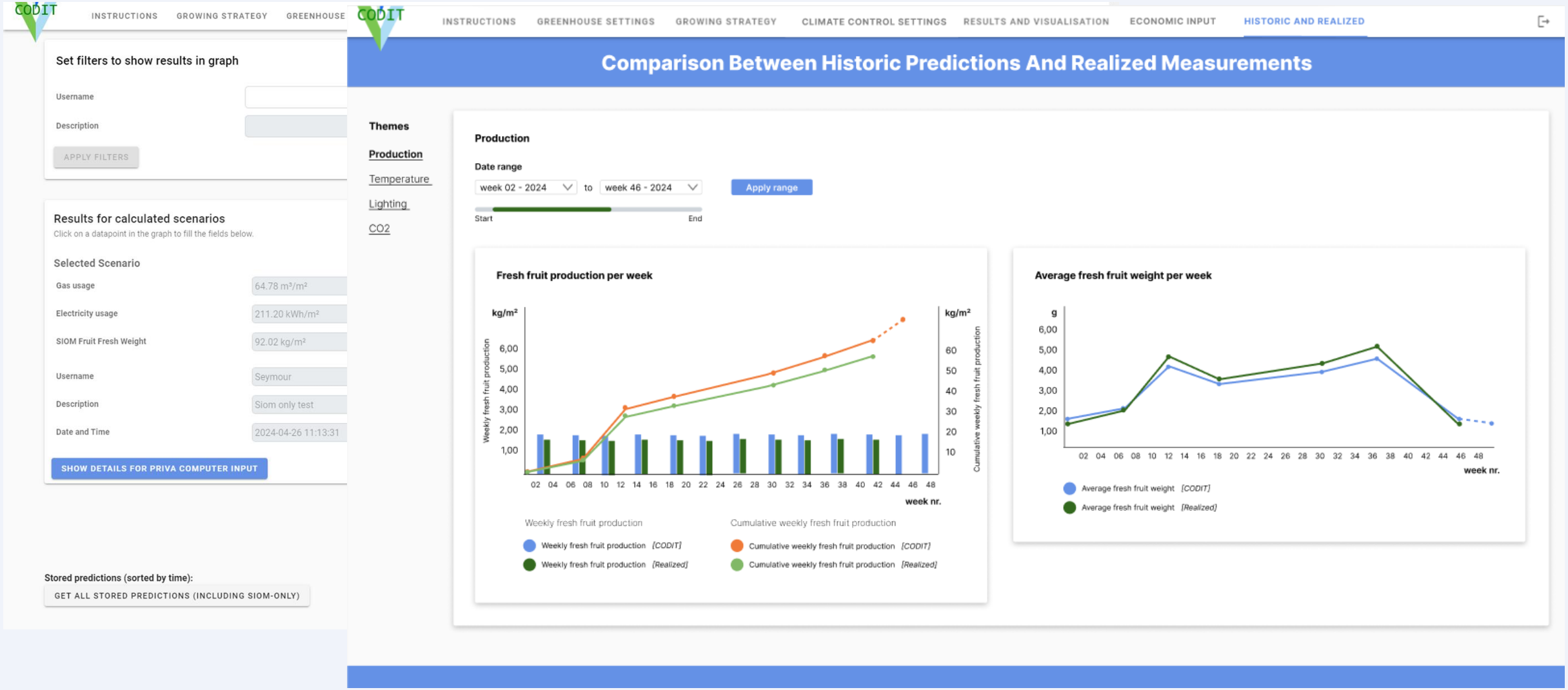


- NSGA-3: **Multi-objective** evolutionair algoritme
- **Output**: Meerdere ‘gelijkwaardige’ optimale oplossingen (het Pareto front)





CODIT Dashboard



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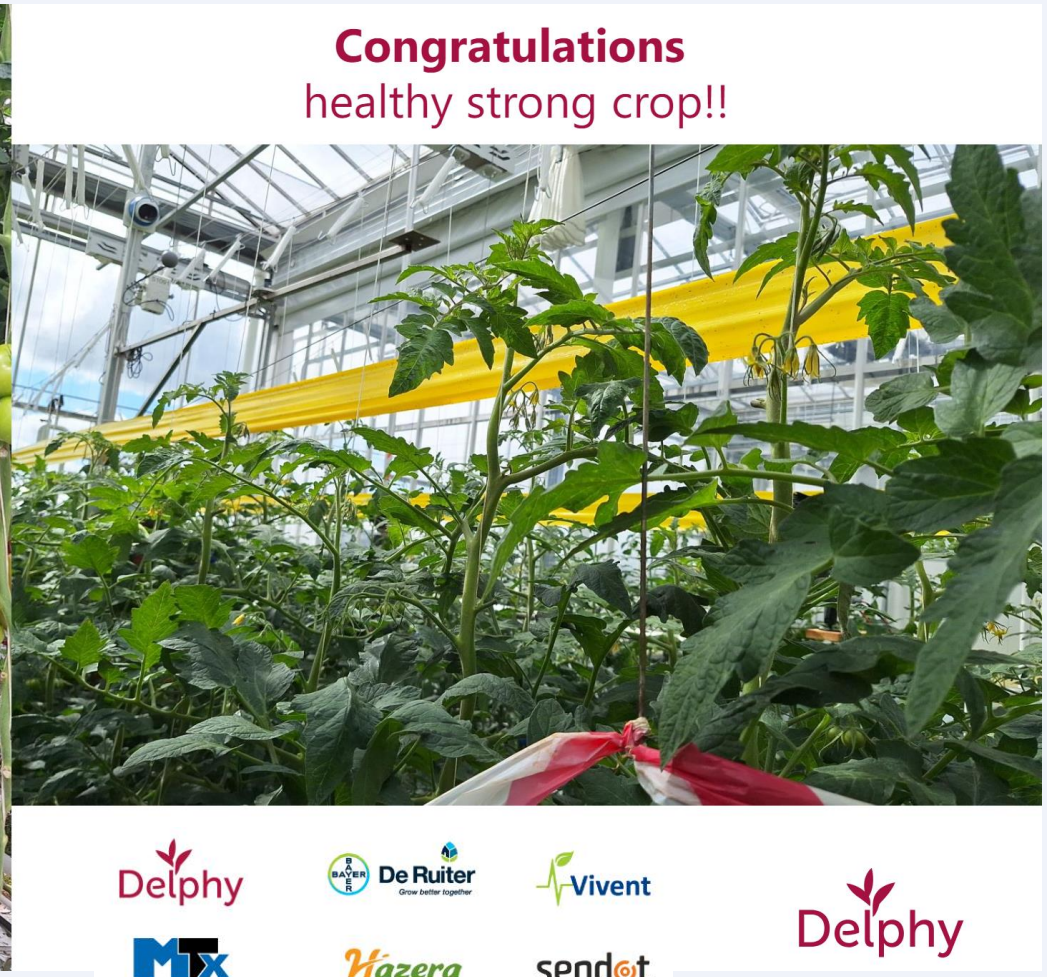
Growth Trial Experiments



Experiment Setup

- Full-year crop trial
- Goal: **energy-efficient growing**
- Crop advisor uses CODIT weekly for new strategies
- Continuous monitoring
- Involved sensor manufacturers

Challenges

- Botrytis
- Low temperature growing
- Technical challenges

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QMS-Tomato – Crop Strategy Planner

Ras specifiek

Vlees tomaten

Tros tomaten

Cocktail tomaten

Cherry tomaten

Snoep tomaten

Ras profiel

Licht benuttings efficientie

Gemiddeld vruchtgewicht

Uitgroeiduur

Bloeisnelheid

Teelt doelstellingen vs Teelt plan

VRUCHT GEWICHT

VRUCHTEN PER TROS

PRODUCTIE

BRONNEN (ENERGIE, ARBEID)

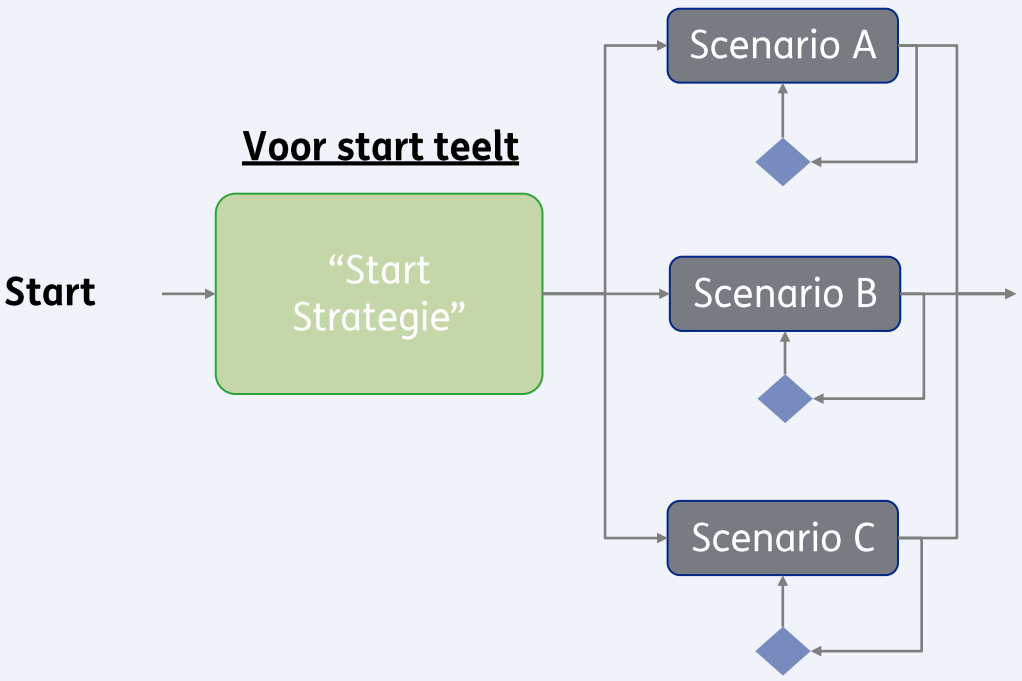
TEMPERATUUR?

RADIATIE?

RAS?

PLANT DICHTHEID?

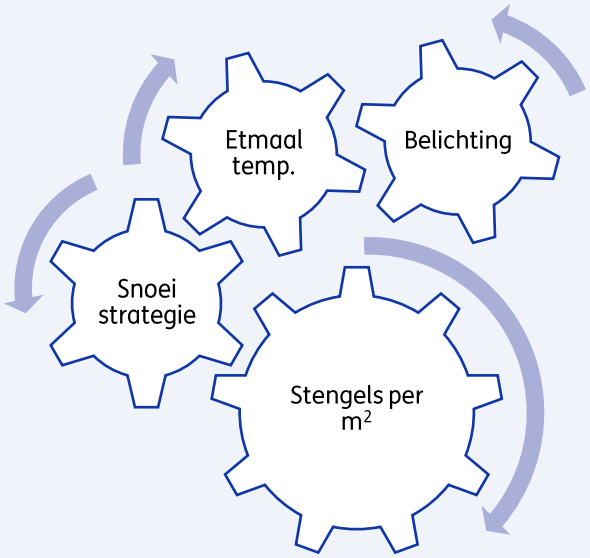
Planning



Scenario A
- Snoei strategie
- > Vruchten per tros

Scenario B
- Hoge plantdichtheid

Scenario C
- Meerder dieven aanhouden



Optimaliseer Wekelijks Eenmalig

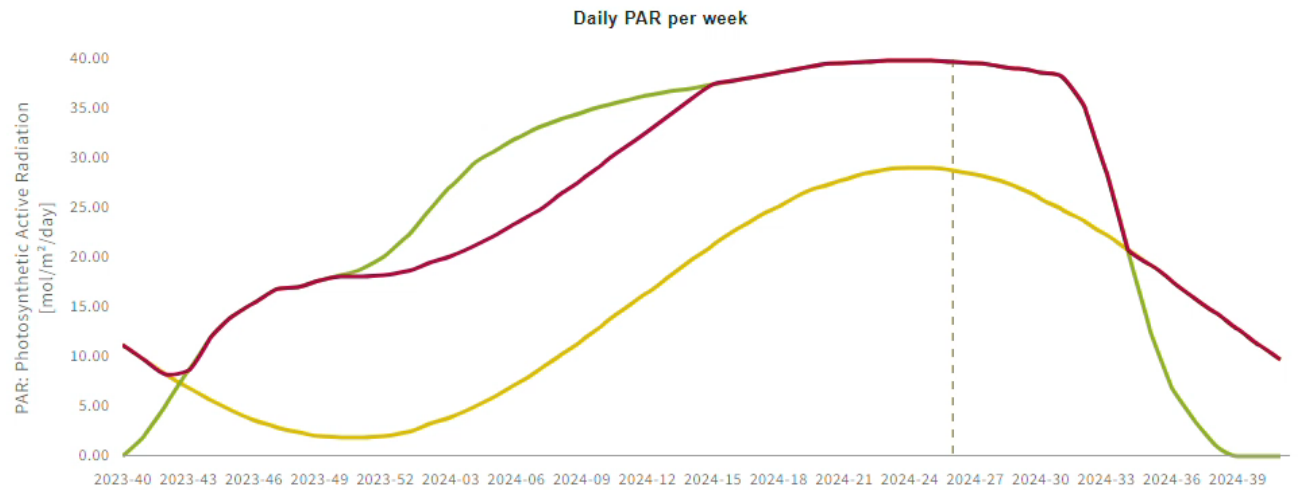
7627 - Afdeling 3.3 2023-2024

Merlice (LED)

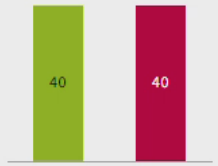
General Calculation | **Start Strategy** | Adaptive Strategy

Export

Enlarge



Daily PAR per week



2024-26

Inside PAR [mol/m²]	28.8
Total PAR [mol/m²]	39.7
PAR demand [mol/m²]	39.7

Production

2024-26

Calc. production cum. [kg/m²] 106.43

Predefined charts

- Stem density and fruit load
- Development speed
- Fruit weight and fruits per truss
- Ratio Temperature Radiation (RTR)

Cancel | Edit | Calculate

Climate averages per day									Weekly crop data: Merlice (LED)							
Year	Wk	Outside Radiation [J/cm²]	Inside PAR [mol/m²]	Adviced Lighting 1 LED [hrs]	Artificial lighting PAR [mol/m²]	Total PAR [mol/m²]	PAR demand [mol/m²]	24H Temperature [°C]	Flowering speed [trusses / stem/ week]	Fruit per truss [#]	Fruitload [tom./m²]	Fruit weight [gram]	Truss weight [gram]	Ripening time [days]	Calculated net production [kg/m²]	Calculated net production cum. [kg/m²]
2023	40	744	11.2	0.0	0.0	11.2		20.2								
2023	41	643	9.7	0.0	0.0	9.7	2.0	19.9	0.83	5	10.3	160.0	800	61		
2023	42	547	8.2	0.0	0.0	8.2	5.2	19.6	0.80	5	20.3	160.0	800	60		
2023	43	458	6.9	2.0	1.8	8.7	8.7	19.4	0.78	5	30.1	160.0	800	60		
2023	44	378	5.7	6.9	6.2	11.9	11.9	19.1	0.76	5	39.6	160.0	800	59		

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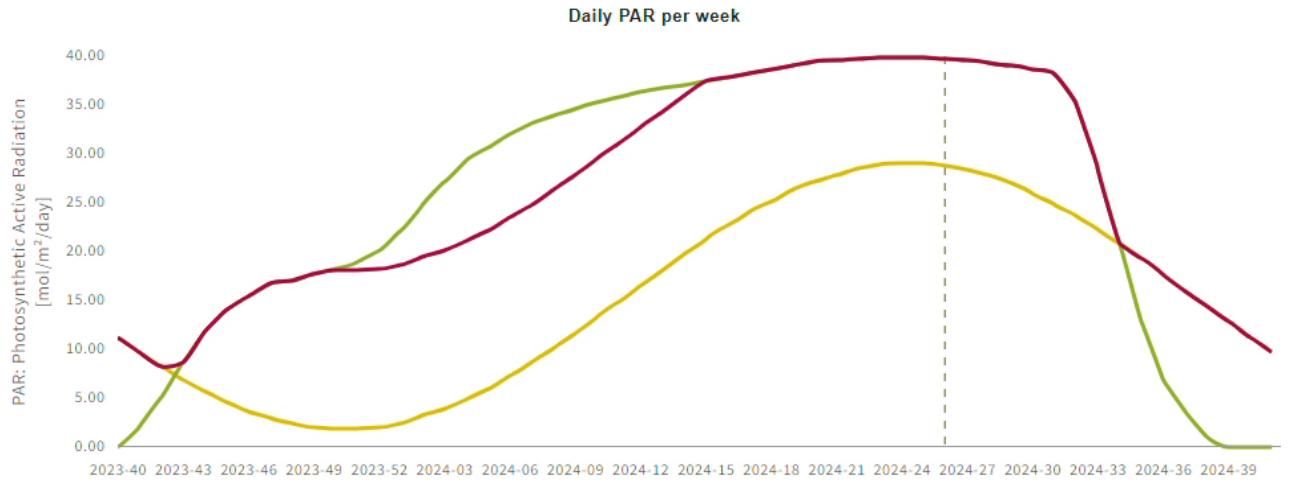
7627 - Afdeling 3.3 2023-2024

Merlice (LED)

General Calculation — **Start Strategy** — Adaptive Strategy

Export

Enlarge



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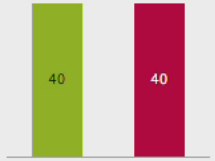

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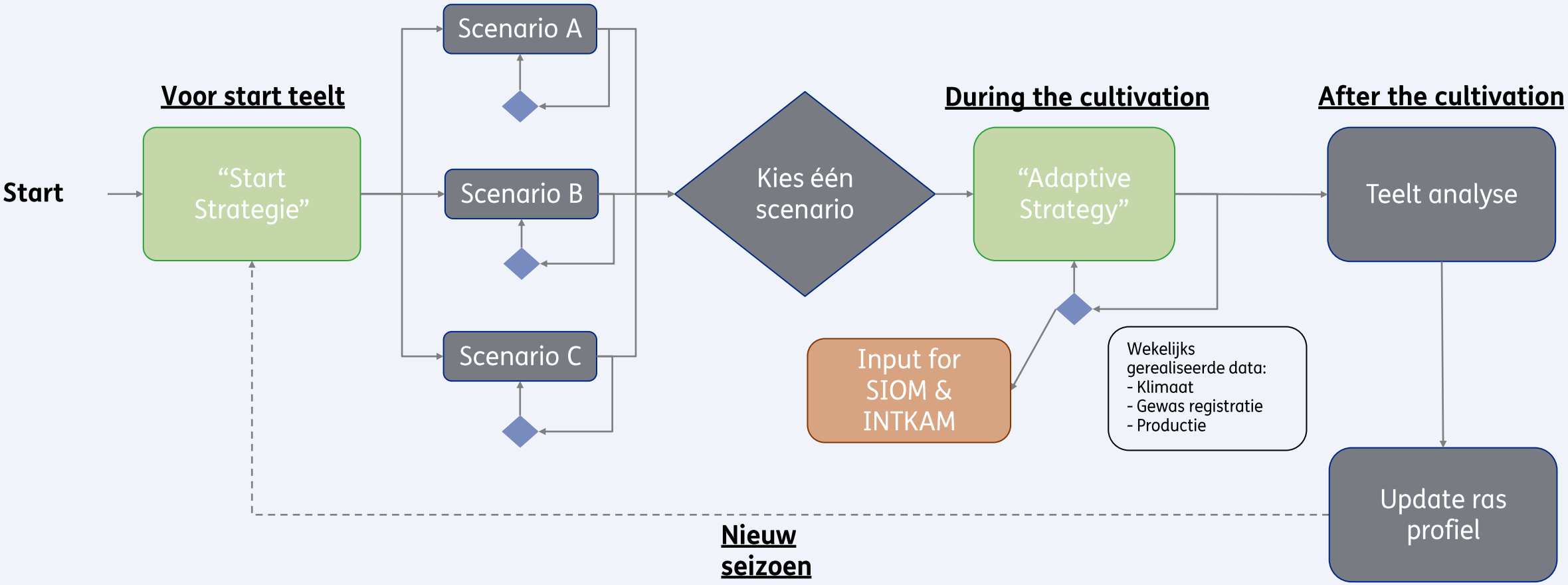
Planning + management



Optimize Weekly One-time

Data-gedreven telen

Creeërt teelt inzichten

Teelt beslissingen op basis van data

Volg een plan

Pas doelstellingen aan indien nodig

Bedankt voor uw aandacht

We horen graag van u!

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