Water use in horticulture

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Wageningen UR Greenhouse Horticulture

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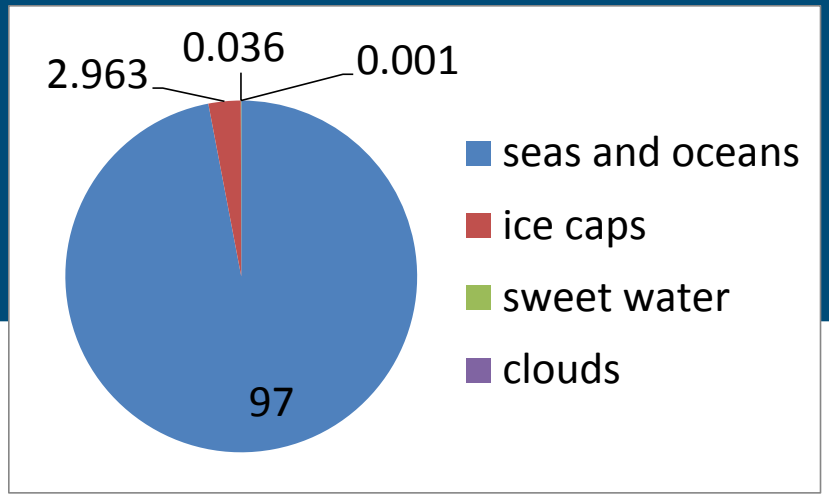
The global water situation

- World population tripled over the last 100 years (by now 6.8 billions)
- 2.4 to 3.3 billion people will suffer from lack of water by 2025
- Very limited water resources in arid areas
- Low water quality (salt, dirt, pathogens)
- Competitive demands (e.g. food, biofuel and industry)
- 70% of the world water usage is for agriculture



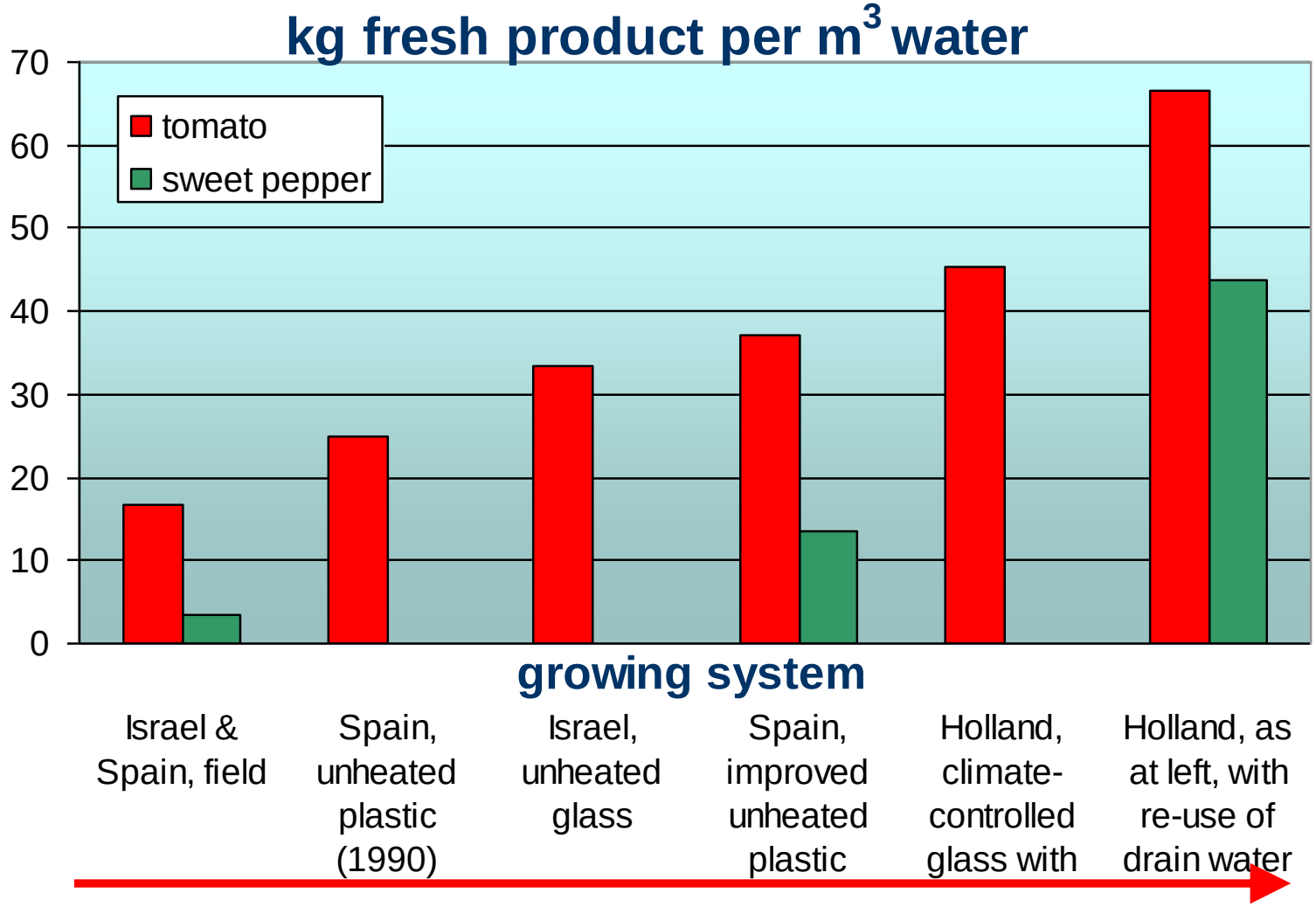
Water trends

- Climate is changing: increasing dynamics (droughts and flooding)
- Sea level is rising (increasing salinity close to the coast)
- Falling water table (high costs)
- Poor water management at the farm level
- Increasing costs for water
- Low water use efficiency

Local implications: water quantity & quality

- Too much water
  - excessive use of water and nutrients (costs!)
  - yield loss
  - emission to ground and surface water
- Lack of water & high salinity
  - Yield loss
  - Reduced product quality
  - Lower profitability

Water use efficiency goes up with…



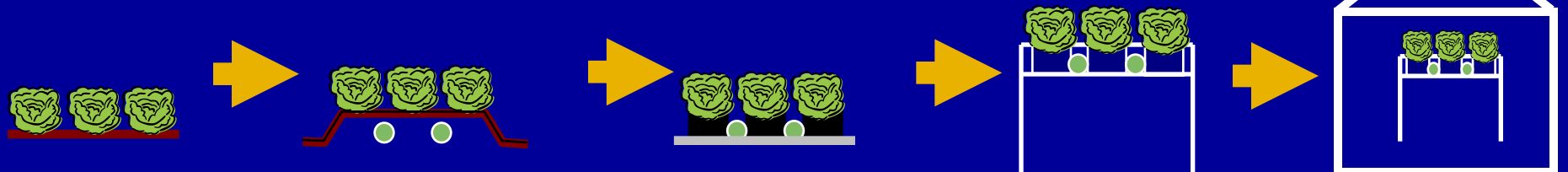
Water Use Efficiency (WUE)



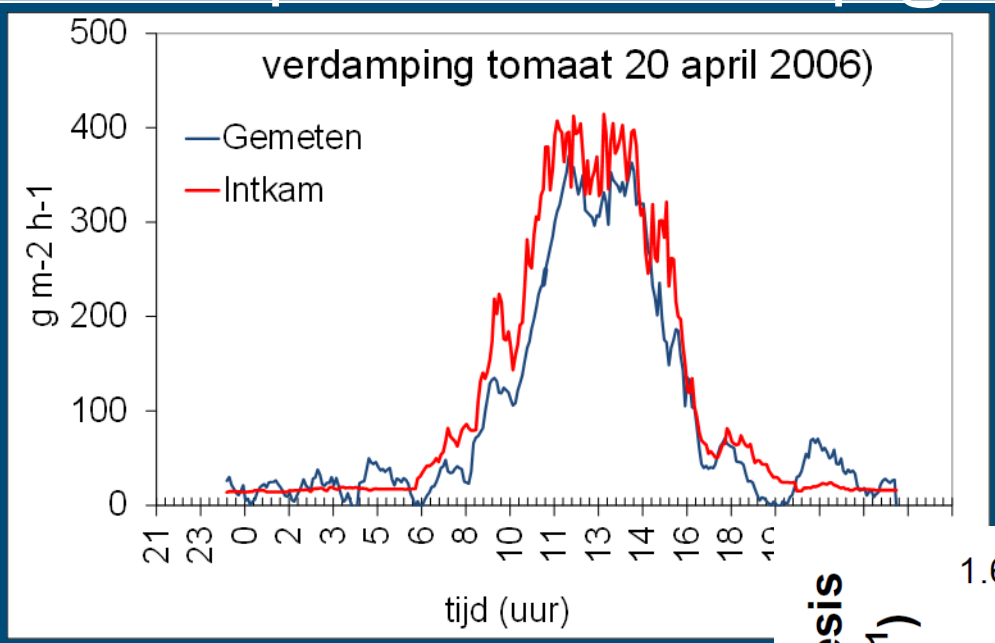


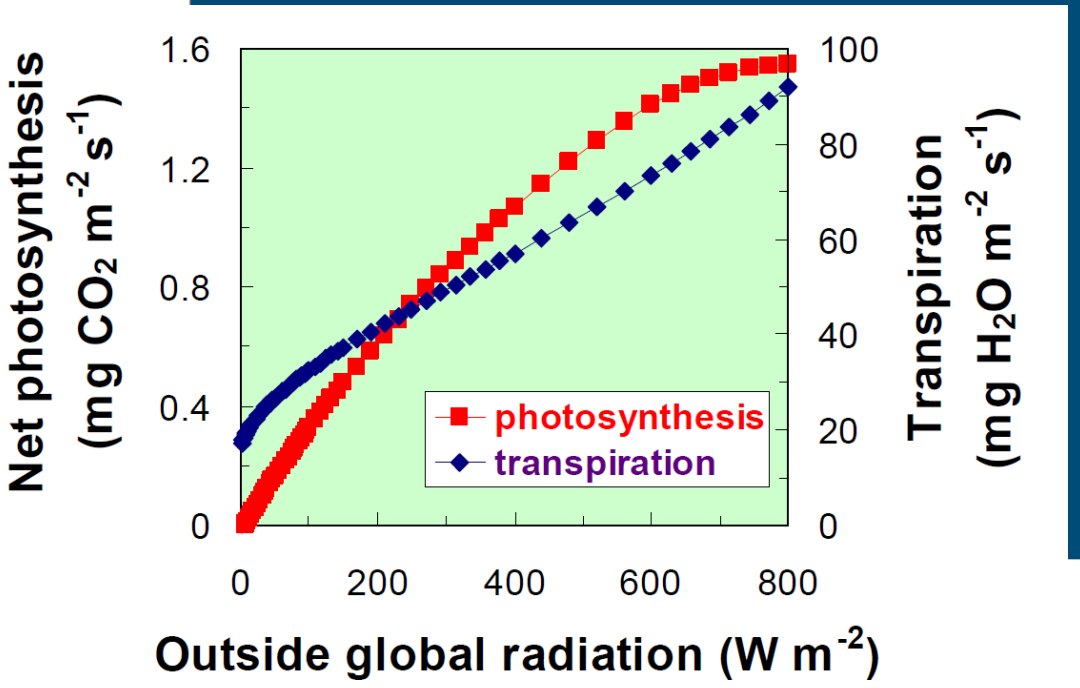



From soil to substrate & from open to covered



Transpiration and crop growth





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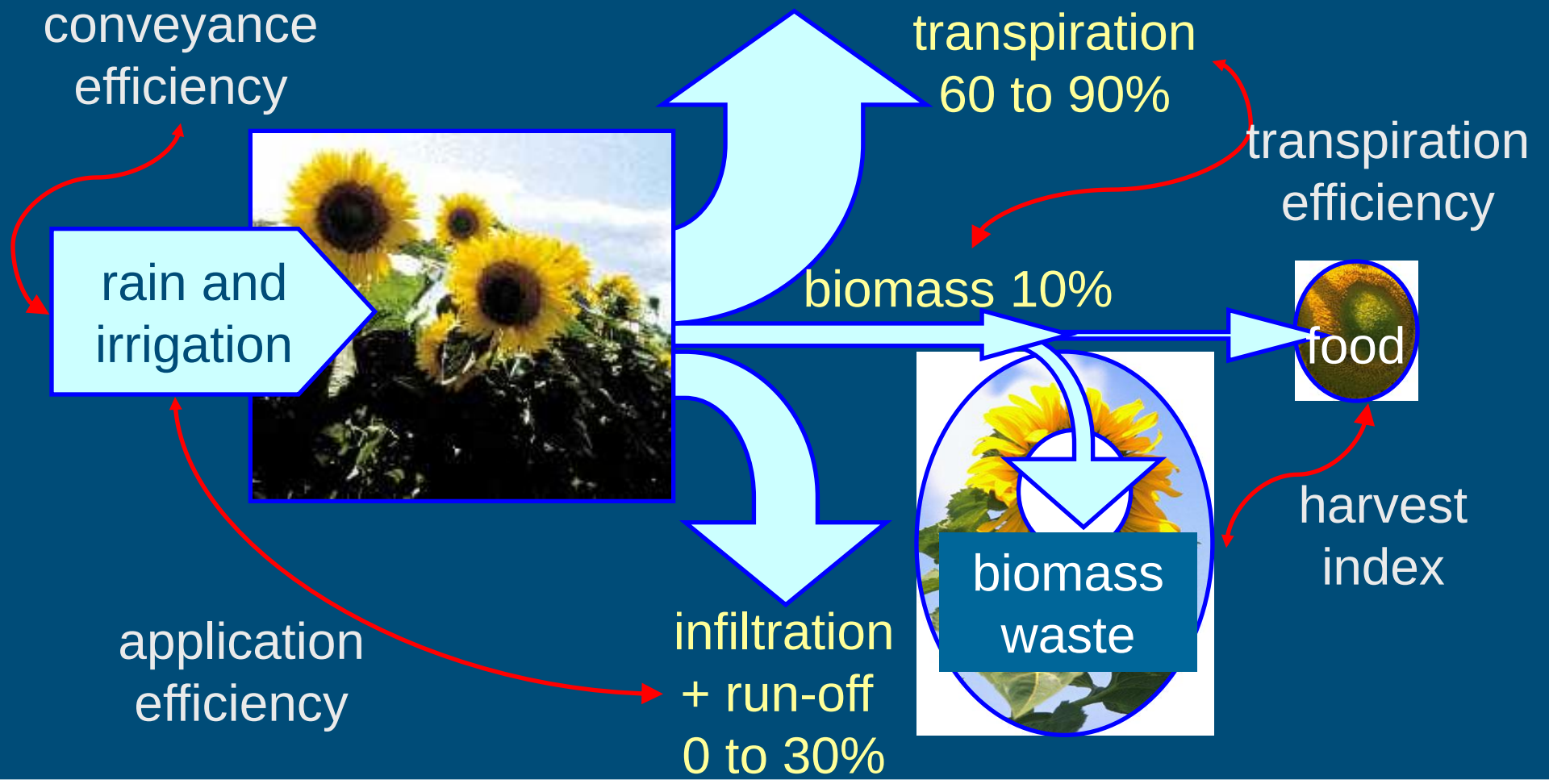
Water Use Efficiency

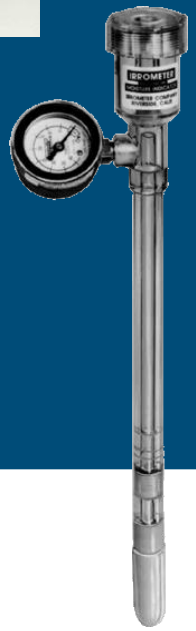


A good water cycle = a closed water cycle

- Obtain good irrigation water
  - Rain water
  - Other water
  - Purify, valorise
- Keep water in the system
  - Recover nutrients and other components, valorise
  - Disinfect
  - recirculate
- Clean drain water
  - valorize

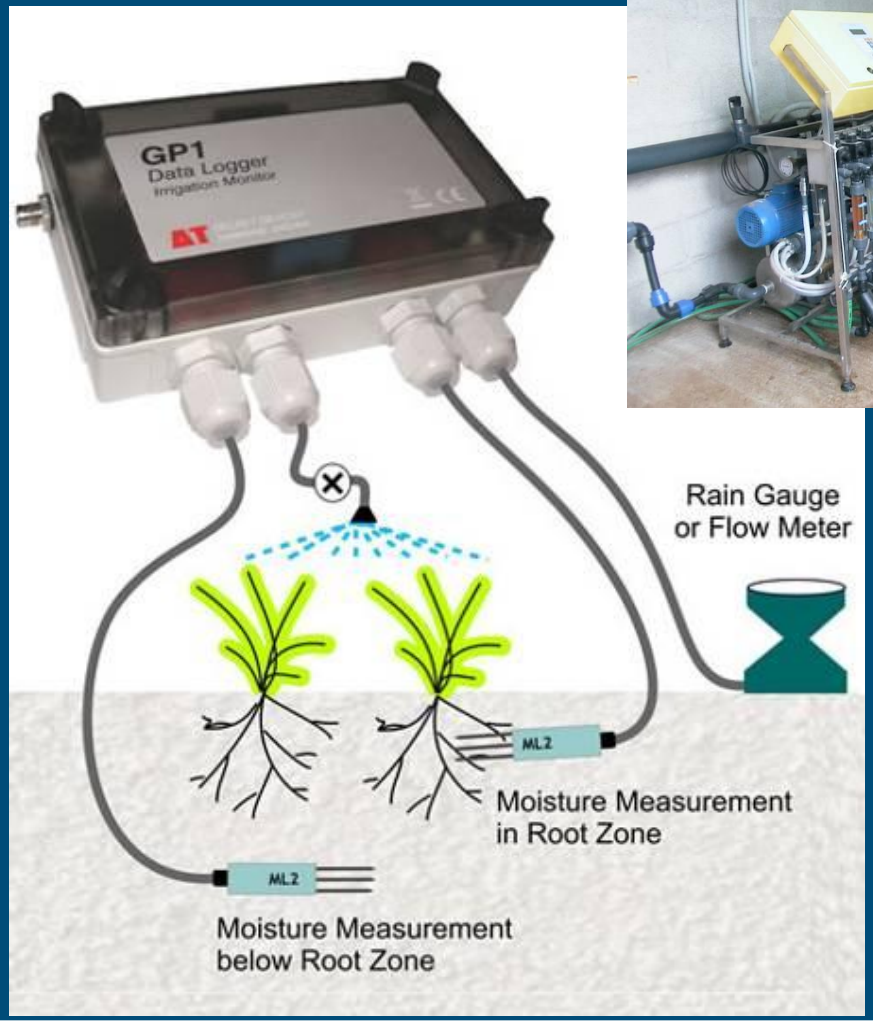
Technology is developing fast: Measurements and Sensors

- Robust tensiometers
  - Dielectric (without water column)
  - Wider range of matric potentials
  - Low service
- WET-sensor
  - Soil water content
  - EC
  - Temperature
- Wireless sensor networks
  - No (less) cables, flexible
  - Powered by solar cells
  - High density measurements (time and spatial)
  - Remote control (e.g. internet)



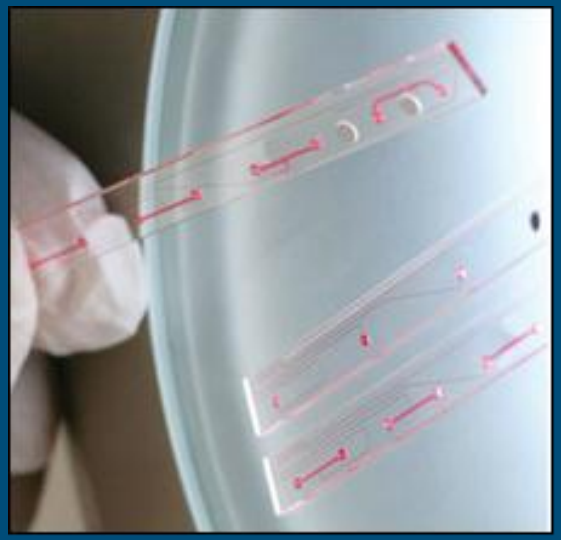
Technology is developing fast: Controllers

- Irrigation – Fertigation
  - Stand-alone operation
  - Parameterized
  - Wired or via GSM-link
- Activation On/Off
  - Timed
  - Sensor controlled
    - Water content, EC,
    - Tensiometer
    - Temperature, Rain gauge
    - Radiation …
  - Model based (f.i. ET)
  - Multiple valves
  - Multiple water sources

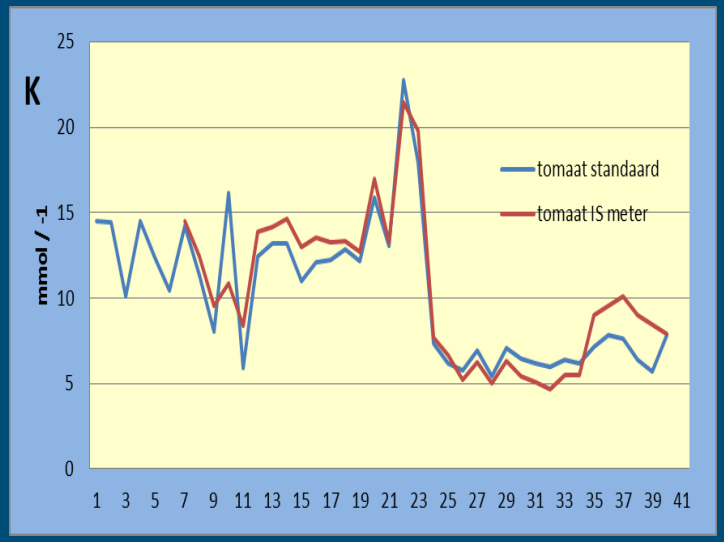


Ion Specific Control of Recirculation

Multi-ion electrode



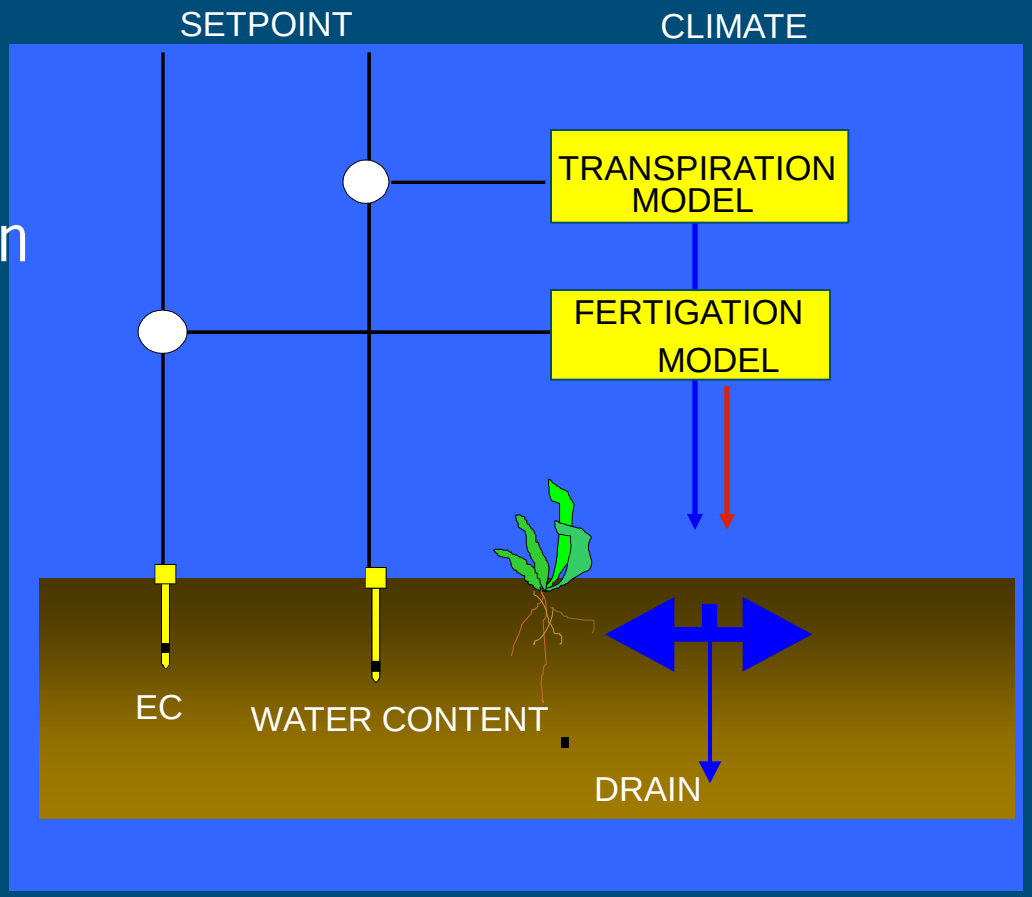
Capillary electrophoretic meter



An un-desired drop in K/Ca ratio was detected 6 days earlier

Soil Sensor Activated Control for Water Management (WATERMAN)

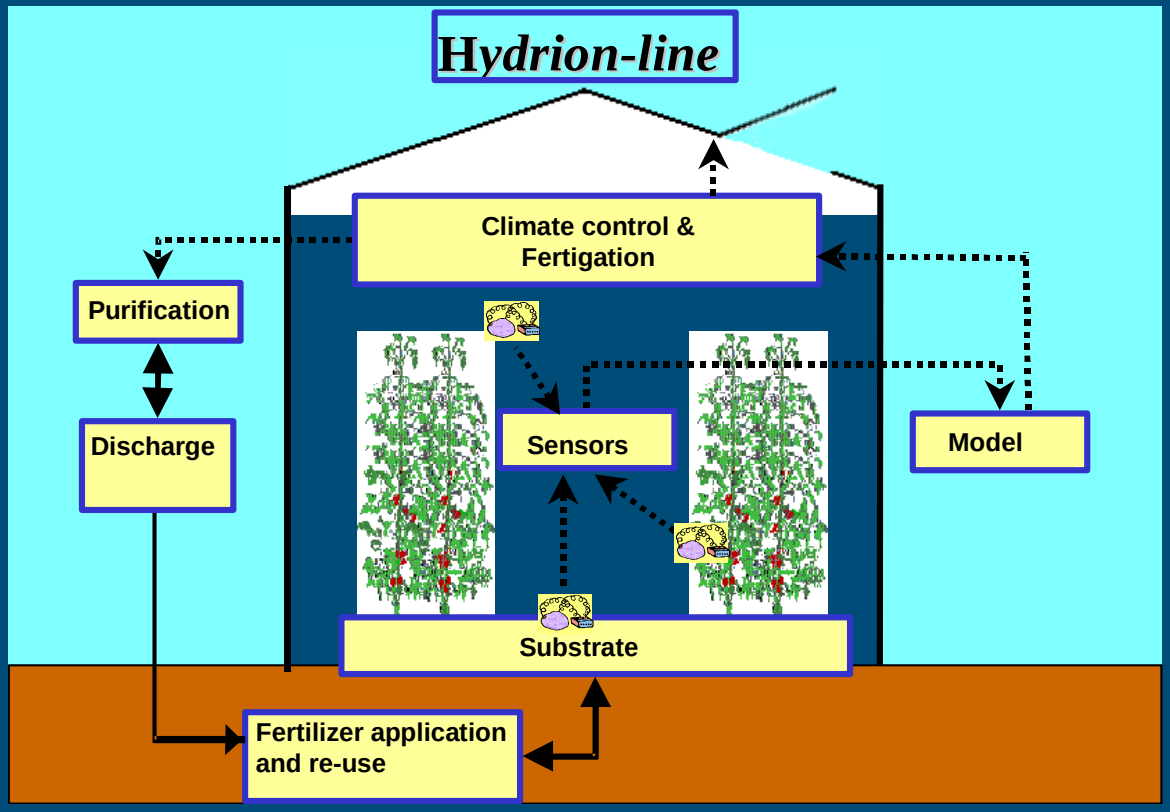
- Target: minimal drain in open crop production systems
- Virtual closed system
- Sensors for water and EC
- Models for ET and nutrient use



Feed-back & Feed-forward Control: Hydrion-line

- Measurement of individual ion concentrations
- Use of crop models
- Online selective dosage of nutrients

- Feed-back and feed-forward control demonstrated successfully
- Sensors not yet available (not robust, too expansive)



Desalinization

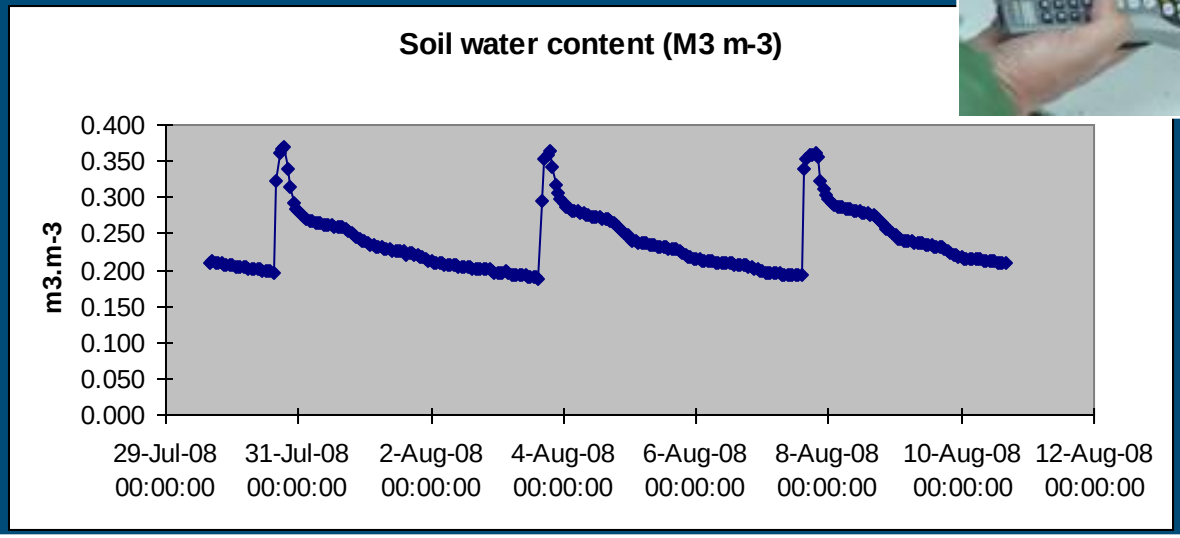
Desalinization plant of Carboneras. Will cover up to 1/3 of the water needs of **Almeria**'s horticultural production. Price of water: 0.5 €/m^3

Closed systems

- Protected horticulture
  - Chrysanthemums
  - Roses
- Open field
  - Soilless Leak
  - Berry fruit
  - Nurseries (containers, gullies)

Efficient irrigation/ fertilization strategies

Combine physics and physiological information



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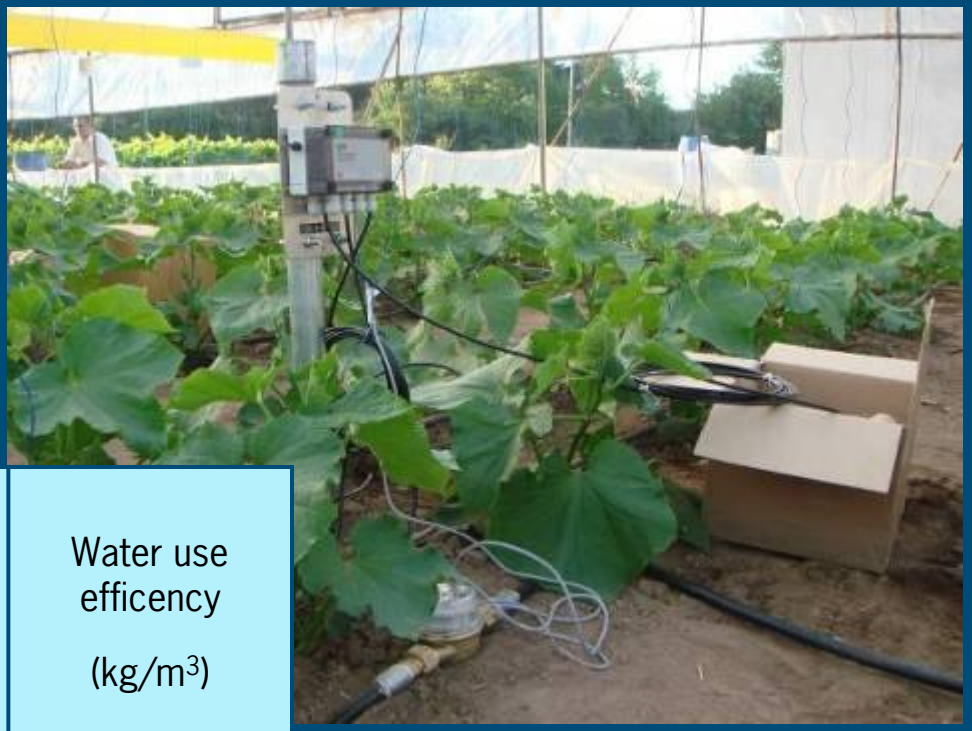
Decision support: deficit irrigation (Example Turkey, Izmir)



	Irrigation water (mm)	Yield (kg/m^2)	Water use efficency (kg/m^3)
Full irrigation	692	27,8 a	46,2
Deficit 1	396	20,3 b	51,9
Deficit 2	451	22,8 b	51,8
Grower's practice	656	23,6 ab	43,8

FLOW AID

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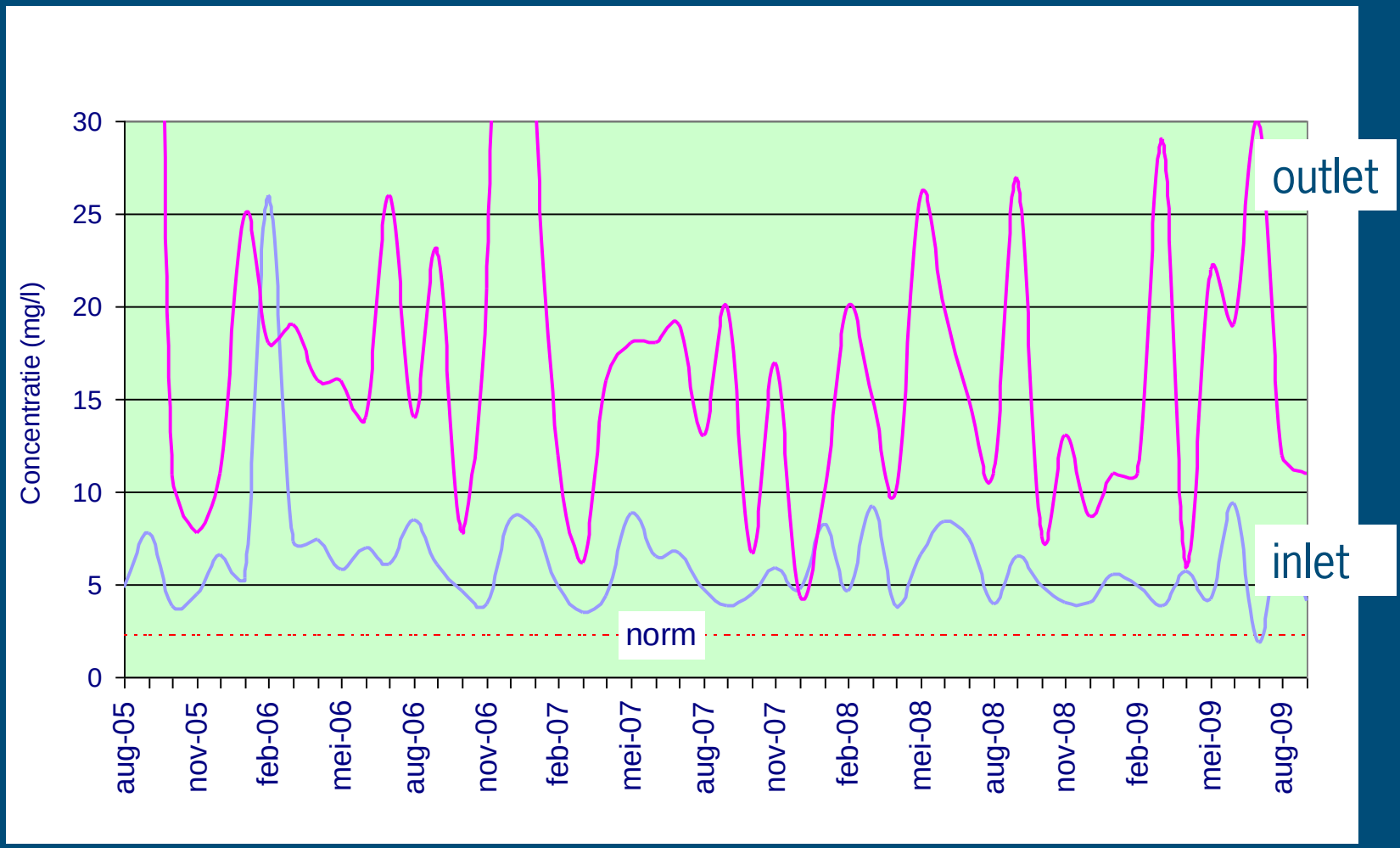
Why re-use of water and nutrient solutions?

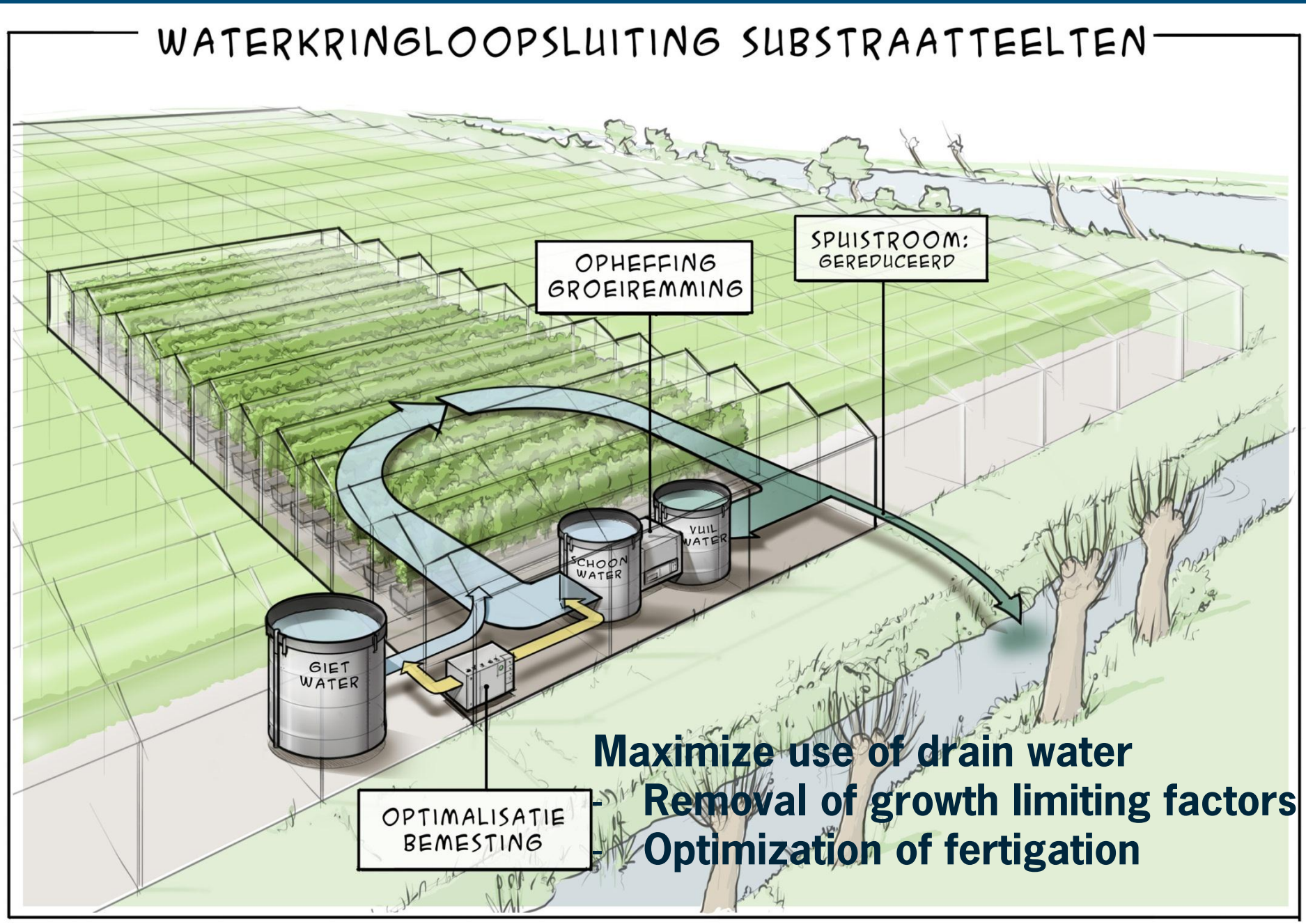
Apart from shared responsibility....

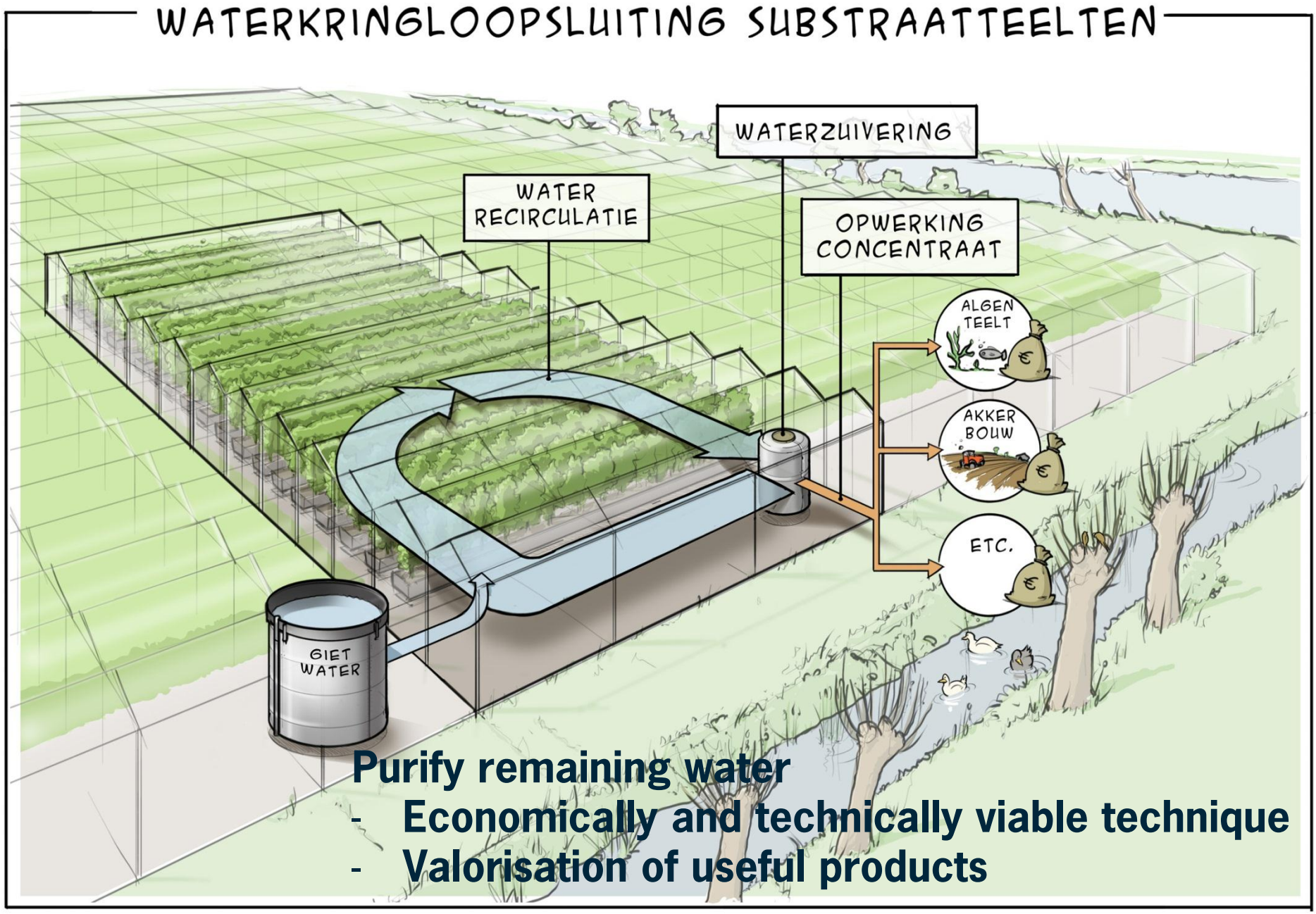
EU legislation "Water Framework Directive":

- "Good chemical and ecological quality of surface and ground water"
- Development of technically and economically viable measures and techniques that enable the closure of the water cycle
- (Nearly) zero emission of chemicals and nutrients

N (mg/l) in surface water glasshouse polder




WATERKRINGLOOPSLUITING SUBSTRAATTEELTEN
OPHEFFING GROEIREMMING
SPUISTROOM: GEREDUCEERD
SCHOON WATER
VUIL WATER
GIET WATER
OPTIMALISATIE BEMESTING
Maximize use of drain water
- Removal of growth limiting factors
- Optimization of fertigation



Purify remaining water

- **Economically and technically viable technique**
- **Valorisation of useful products**

Increasing re-use of water / avoid discharge

- Low-sodium water intake
  - Rainwater
  - additional water, i.e. RO
- Low-sodium fertilizers
- Break down growth inhibitors
  - with advanced oxidation (H_2O_2 + UV)
- Flush at start of cultivation
  - and re-use
- Rinse (sand-)filters
  - with rainwater instead of water with nutrients
  - re-use water, deposit dirt
- Limit diseases and chemicals
  - Sanitation, spraying techniques
  - biological control
  - UV or disinfection systems
- Limit technical mal-functioning
- Avoid un-balanced nutrient ratios, depletion, accumulation
  - Nutrient management
  - Frequent lab analyses
  - Ion-selective electrodes

Sustainable (rain) water use

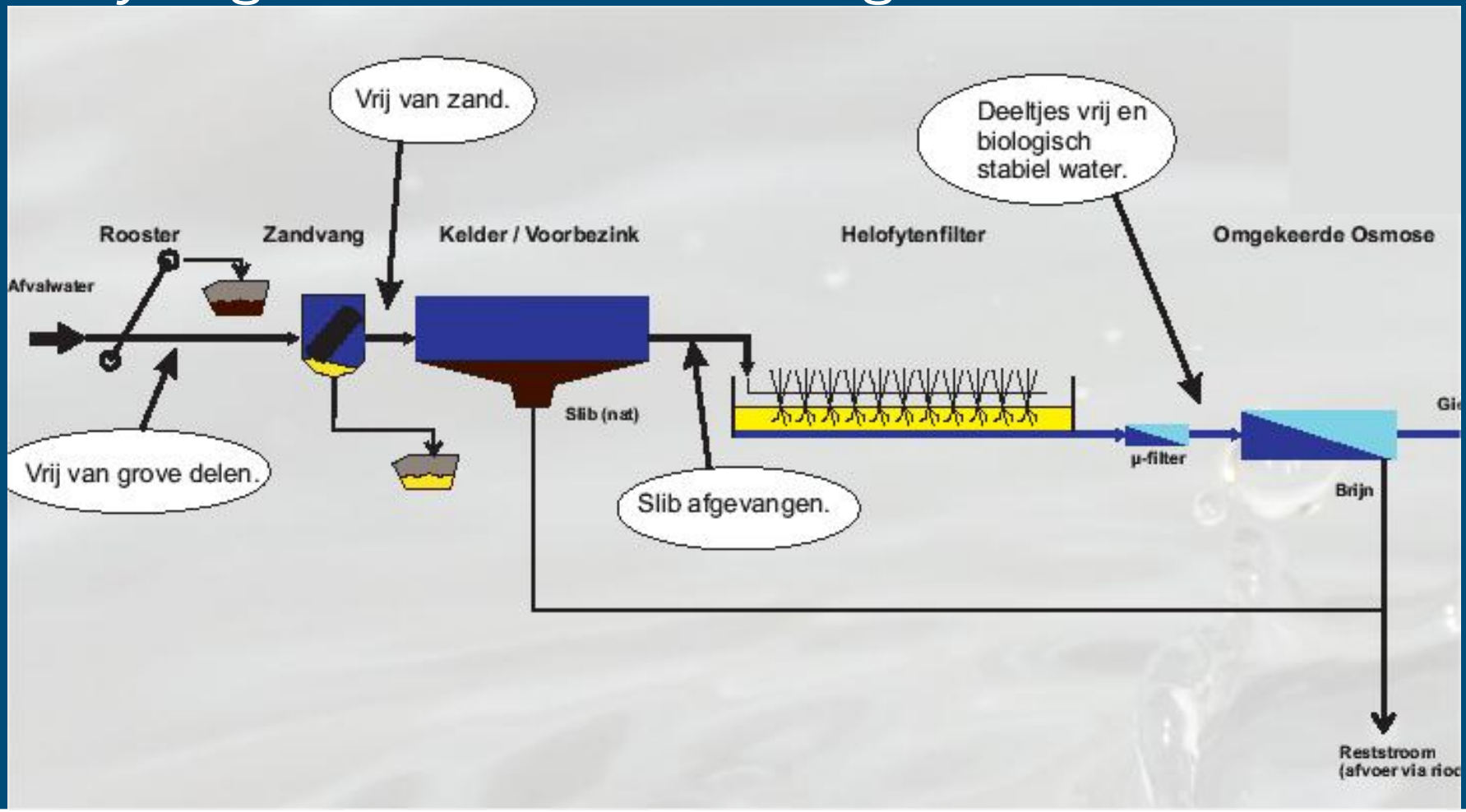
Rainwater storage	rainwater	additional water
500 m^3/ha	43%	57
1500	63	37
3000	97	3

(Example with roses on substrates)

The regional level

AquaReuse:

Recycling of waste water on a regional scale



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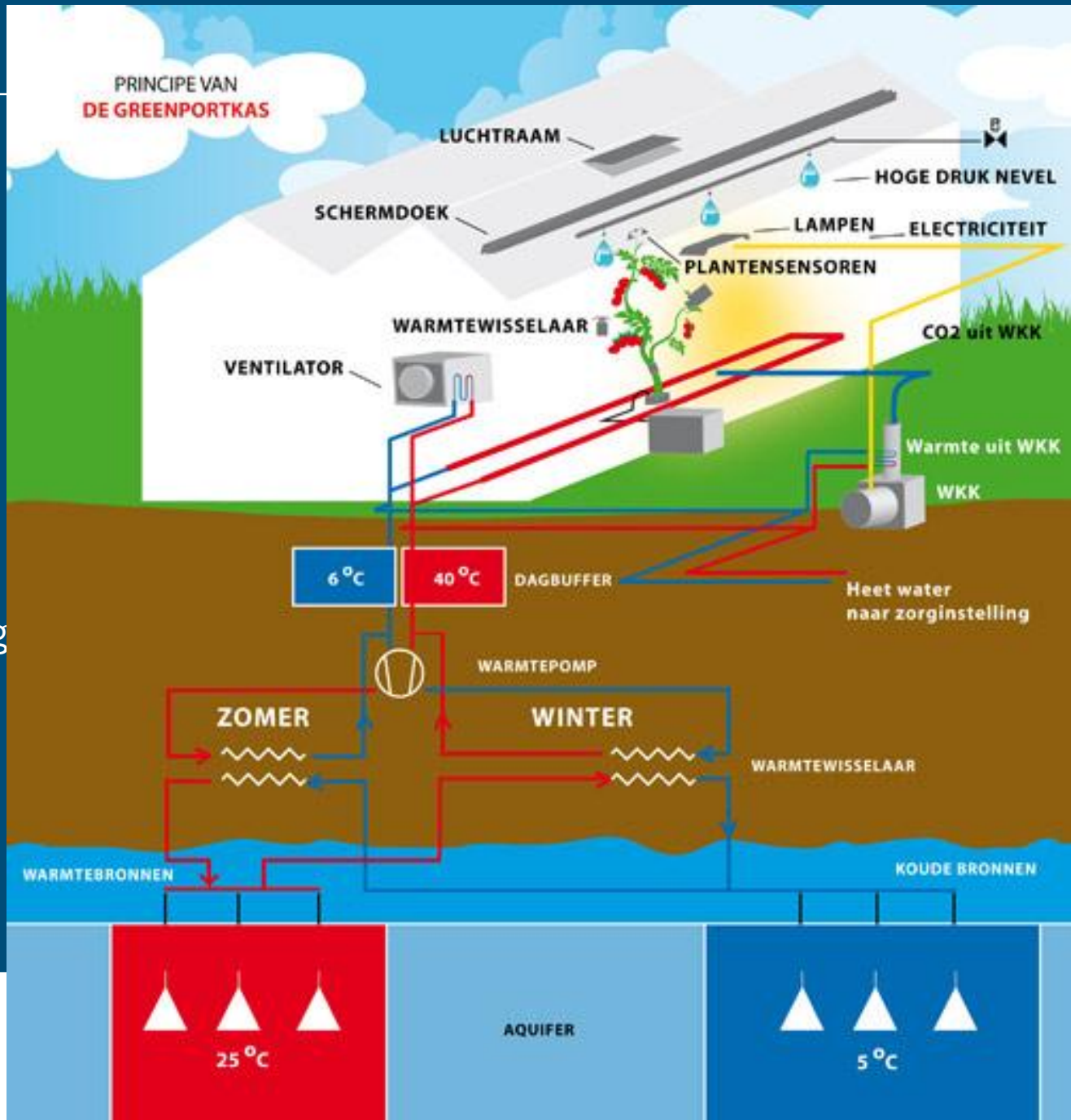
http://www.aquareuse.nl/

Greenportkas Venlo

- (Semi)closed greenhouses
- Storage of heat and cold
- Efficient use of water, CO_2
- Heat supply to nearby settlement and swimming pool



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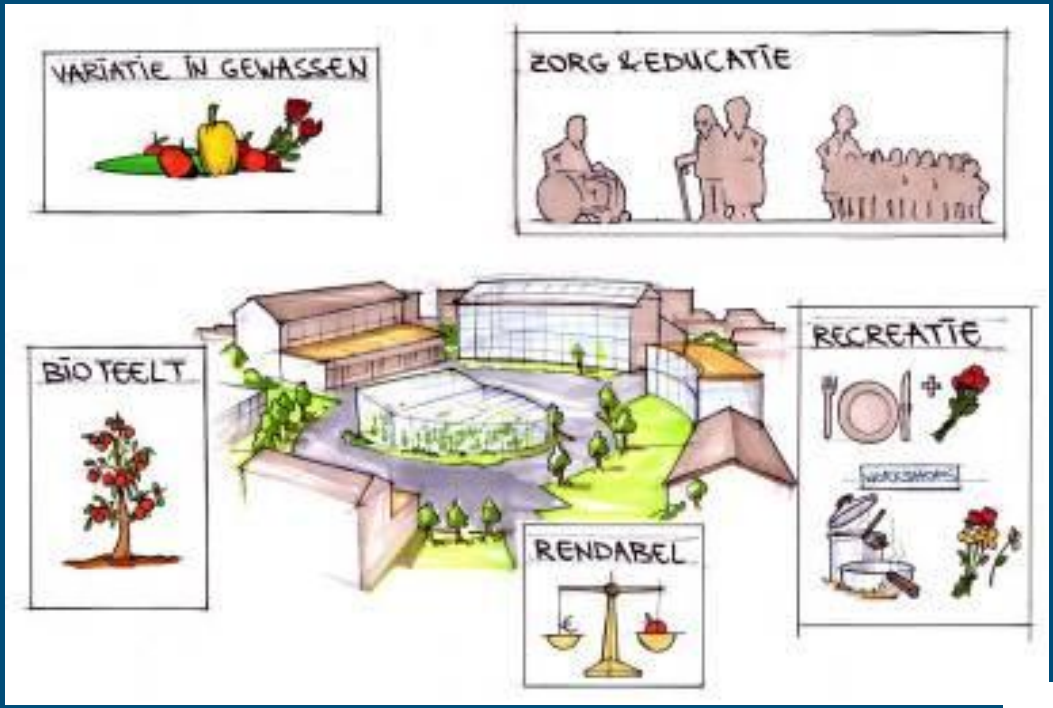
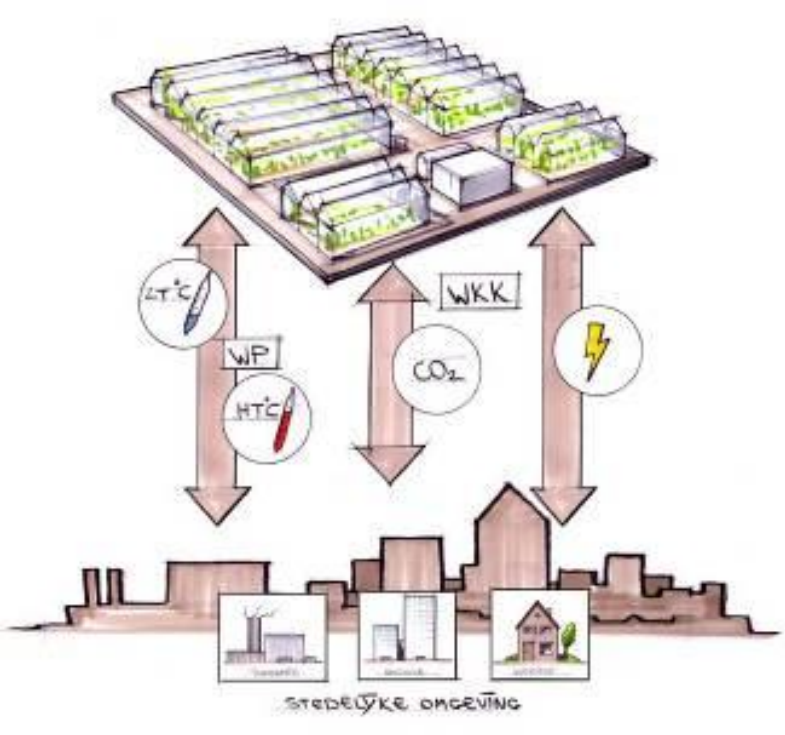
Greenhouses in urban areas

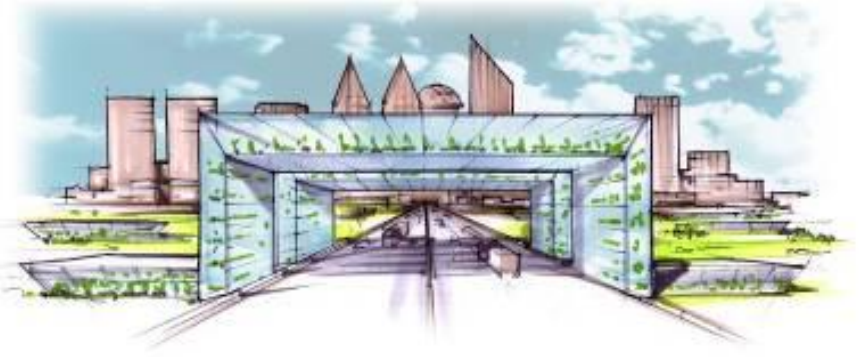
Multifunctional



Greenhouse in the energy grid



Integrated in cities



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Integrate solutions at local and regional level

- Quantity & quality
- Integrated approach
  - Link local and regional
  - More degrees of freedom
  - More robust solutions

- Build network & commitment
- Desalination
- Soilless agriculture
- Adequate enabling technologies
  - Economies of scale
- Couple with other water users (e.g. industry)
- Demonstration project
  - Convince stakeholders
  - Get economic parameters
  - Knowledge build-up

Thank you for your attention

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