Efficient Yields

Best practices on energy, water efficiency, and productivity

Efficient Irrigation Techniques and Water Reuse

March 28, 2023

PG&E

RESOURCE INNOVATION INSTITUTE

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Safety

Earthquake:
Drop
Cover
Hold

Evacuation
Plan

Review Emergency
Plan & Pack Go-Bag

Stretch,
Get Up & Move

Practice Social Distancing,
Wear A Mask &
Follow CDC Guidelines

Visit: www.pge.com/emergencypreparedness

Class Survey (feedback)

- Click on the survey link in the chat box
- Written comments are very helpful
- Other topics? Other classes you want?
- Survey also sent in follow up email after the class

SECTION 01

INTRODUCTION

POLL ALERT!

What size is your operation or standard operation you work with?

- < 2,500 ft^2
- 2,501 - 5,000 ft^2
- 5,001 - 10,000 ft^2
- 10,001 - 22,000 ft^2
- >22,000 ft^2

Agenda

Introduction & Purpose

Water 101

Efficient Irrigation Practices

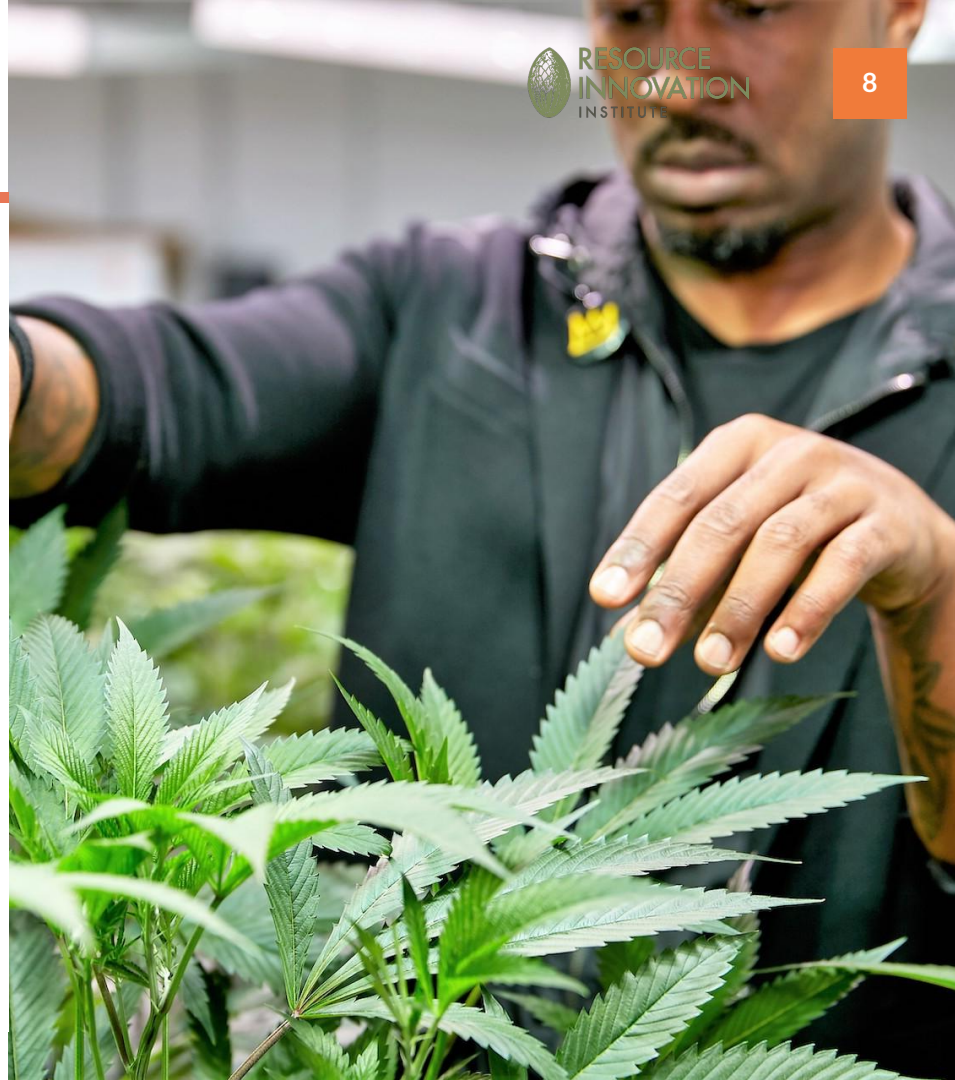
Efficiency Through Automation

Remediating Irrigation Water

Bringing it All Together

Tips & tools slide

Q&A



Today's Experts

Rob Eddy

RESOURCE INNOVATION INSTITUTE

Andy Lee

Grodan®

Derek Gambrel

REDWOOD REMEDIES

Irrigation Impacts More than Plant Water Status

- Overwatering and fluctuating substrate water content contributes to **plant disease**
- Over-fertilization and overwatering create plants more **susceptible to insects**, particularly aphids
- Insects can detect **stressed plants** and prefer feeding on them
- Overwatering can contribute to **increased dehumidification cost**
- Overwatering contributes to **algae and biofilms**, requiring increased sanitation protocols

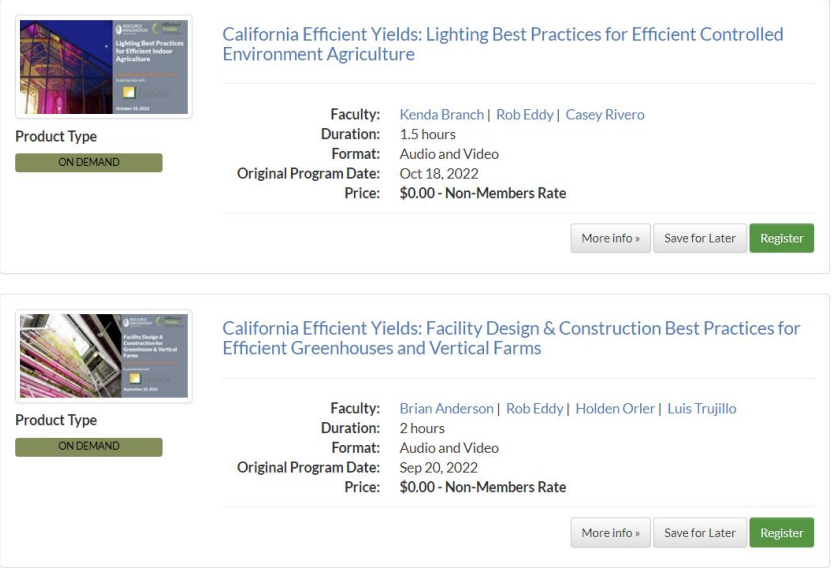
Access Your California Virtual Classroom

Continue Learning Online

Free guidance on efficient cultivation

All live workshops are available for on-demand viewing!

- Recordings of live workshops
- Tip clips
- Downloadable resources
- PG&E and state program tools



Create an account at resourceinnovation.org/California

Register for Upcoming Workshops

PG&E funded Workshops:

- April 18 | Managing Peak & Renewables
- May 2 | Case Studies in Efficiency

Register and access other free resources on the RII catalog

PG&E hosted Workshop:

May 9 | Code Breaker: Controlled Environment Horticulture (CEH)

2022 Energy Code

POLL ALERT!

What size is your operation or standard operation you work with?

Discuss Results

SECTION 02

WATER 101

Knowledge Check!

How much water that plants take up is used for photosynthesis?

- 1%
- 10%
- 50%
- 80%

California Cannabis Space

Licence Types

- Specialty cottage
- Specialty
- Small
- Medium
- Large
- Nursery
- Processor

Lighting Types

- Tier 1 – Up to 6 watts per sq. ft.
- Tier 2 – 6 to 25 watts per sq. ft.

Market Size

$4 billion legal market
$8 billion illicit market

Environment

- Indoor
- Greenhouse / Mixed Light
- Outdoor

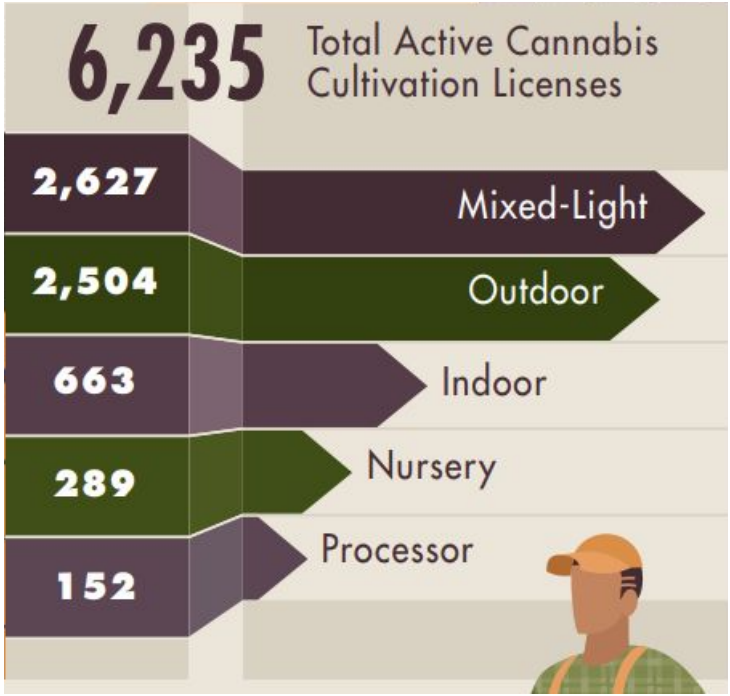


Image credit: CDFA 2020. License info: Cannabis.CA.gov

Water Consumption by Agriculture

US based CEA facilities have been estimated to use **22,000 gal (83kL)/acre/day** for irrigation[1], and greenhouses using evaporative coolers may use **8,000 gal/acre/day** (75 kL/ha/day) during the peak cooling season[2].

The USDA has estimated that **80% of water consumption in the US was from agriculture**[3], and as high as 90% in some western states.

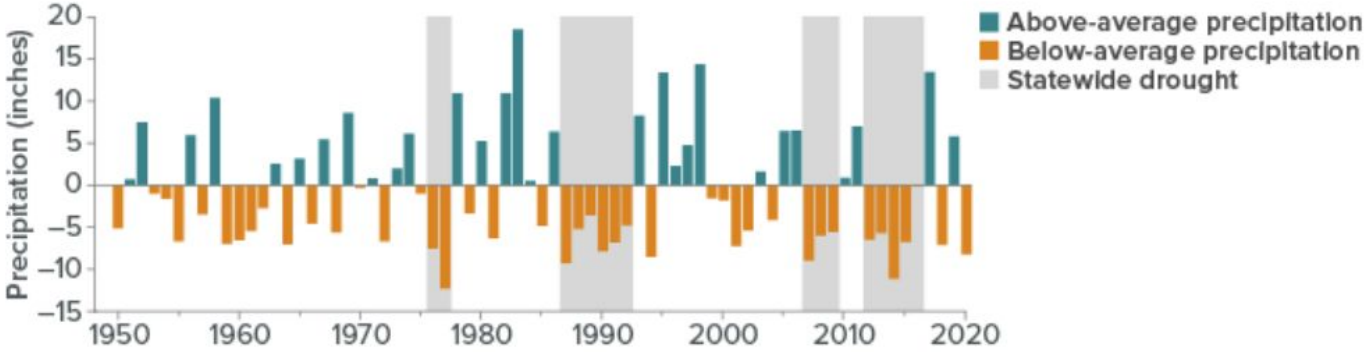
Another environmental challenge is that irrigation effluent of crops typically contains fertilizer and pest control chemicals that may pollute local ecosystems if released, particularly nitrogen and phosphorus known to cause algal blooms in surface waters

[1]Bilderback, et al., 2017
[2]RII, Water Circularity Best Practices Guide, 2023
[3]O'Neill and Dobrowolski, 2011

California Water

Cycles of Drought

- Water availability varies significantly year to year
- Recently multiple years of severe drought



Western Regional Climate Center California Climate Tracker, DWR California's Most Significant Droughts

Knowledge Check!

How much water that plants take up is used for photosynthesis?

- 1%
- ~~10%~~
- ~~50%~~
- ~~80%~~

SECTION 03

EFFICIENT IRRIGATION PRACTICES

POLL ALERT!

What controls the majority of your irrigation?

- Employee activates
- Timeclock
- Irrigation controller
- Climate control computer irrigation settings

Develop a Workplace Culture of Water Efficiency

- Instill a water conservation ethic
- Routinely share data on water usage, fertilizer usage
- Reward improvement
- Employees become “blind” to leaks they see everyday
- Start simple: A nozzle or hose leaking one drop per second will waste 113 gallons per month
- A single, poorly adjusted evaporative pad can waste 12,000 gallons a month in summer

Develop a Workplace Culture of Water Efficiency

- Accountability & documentation for maintenance
- Grab n' Go repair kits
- Repair supplies/tools kept close by
- Handheld moisture sensors for irrigation team
- Group calibration of irrigation decision-making
- Use good equipment and ergonomics
- Eliminate "water and forget it" mindset
- Establish accountability for automated systems

Your Unique Cultivation Requirements

Hand Watering With a Hose

Benefits:

- Customization by cultivar
- Intensive control
- Mitigating issues

Limitations:

- Time consuming
- Labor intensive
- Operator variability

Automated Watering

Benefits:

- Efficiency of time/resources
- Scalability
- Reduced labor cost

Limitations:

- Installation cost/maintenance
- Equipment reliability
- Enables complacency / crop loss

Plant Culture Impact on Irrigation

- Container Size
- Substrate
- Planting Density
- Genetics
- Growth Phase

Impact of Environment on Irrigation

- Lighting
- Temperature/Humidity
- Vapor Pressure Deficit (VPD)
- Air Flow

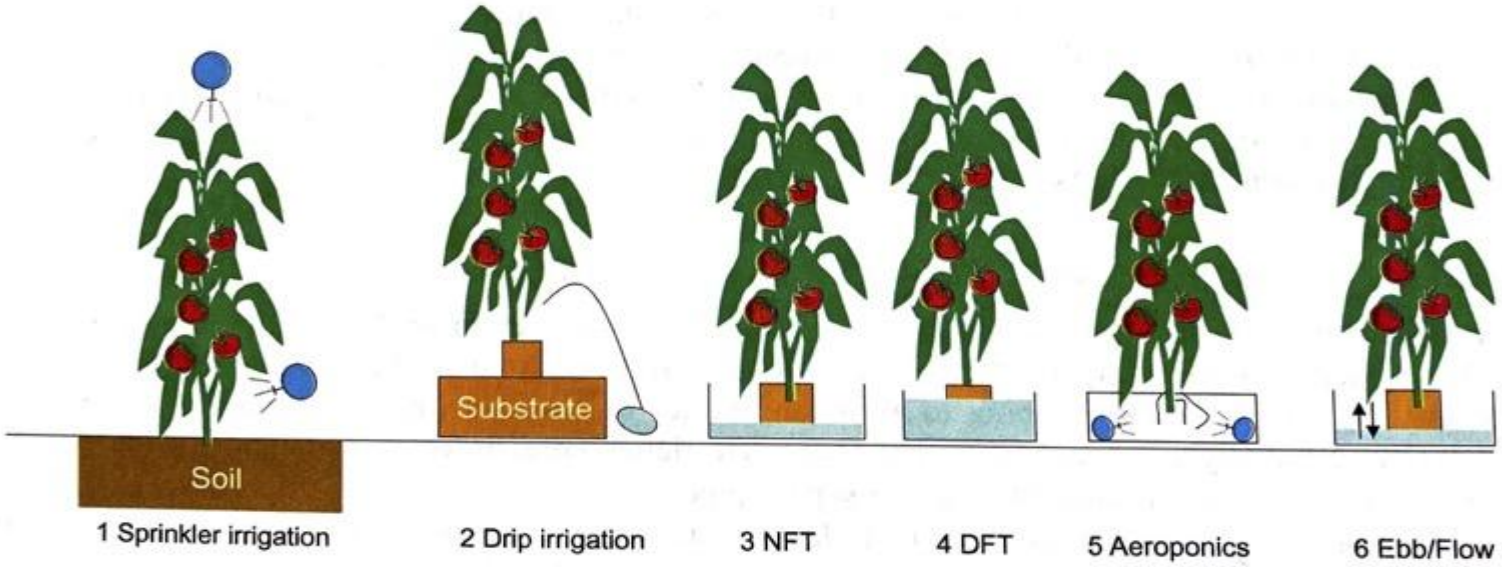
Other Grower Tips

- Perhaps design your cultivation system around your irrigation, not around your substrate?
- Group similar size plants together
- Half empty rooms require irrigation more often
- Build healthy root systems early
- Heft of pot watering check
- “Sense” plant water status comes with experience

Terms

Terms

- Hydroponic vs substrate culture
- Leachate, drain, runoff, leach, effluent, overflow
- Leachate treatment = dump water treatment

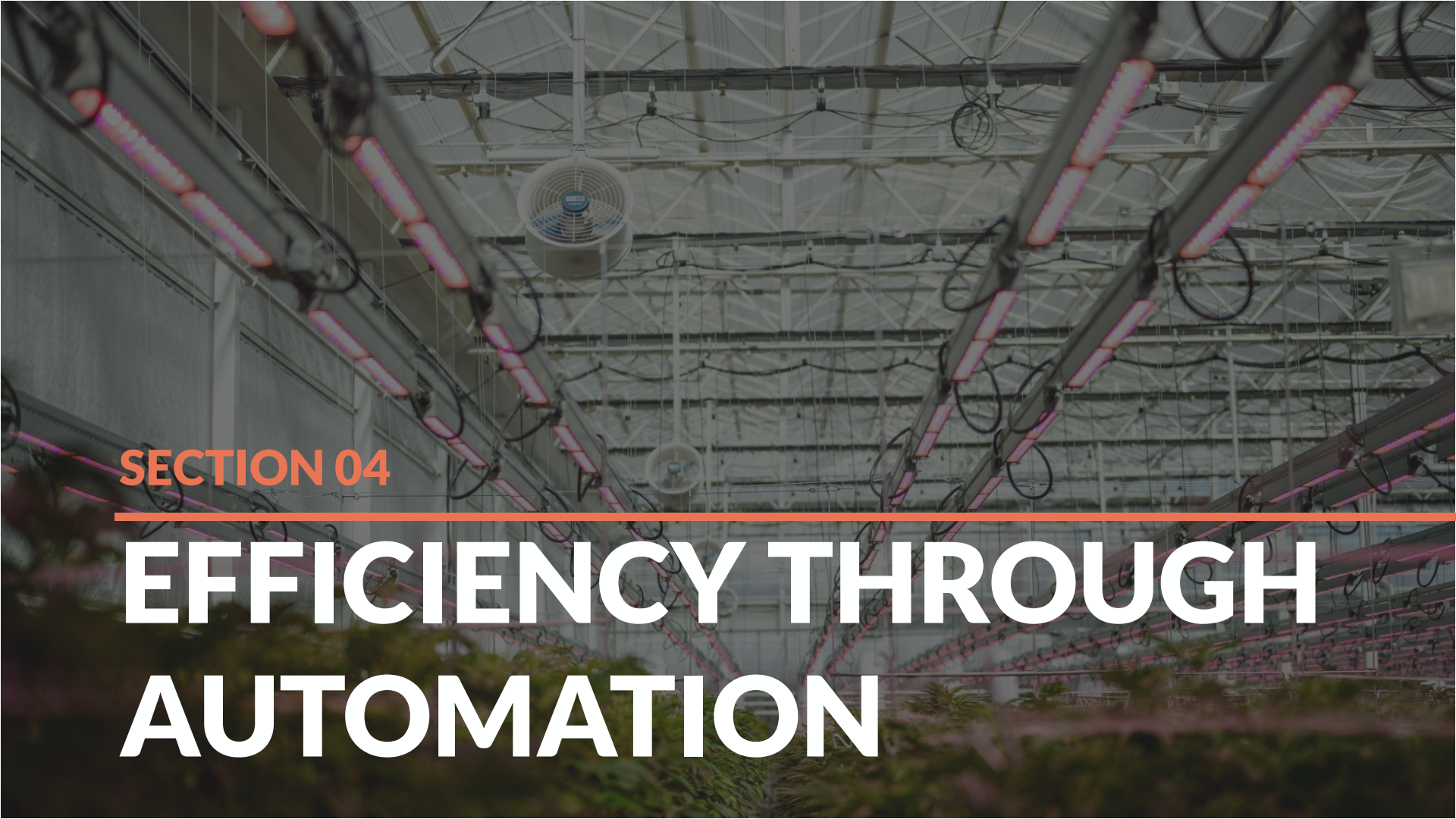


Raviv, 2019

POLL ALERT!

What controls the majority of your irrigation?

Discuss Results



SECTION 04

EFFICIENCY THROUGH AUTOMATION

POLL ALERT!
How is your water use measured?

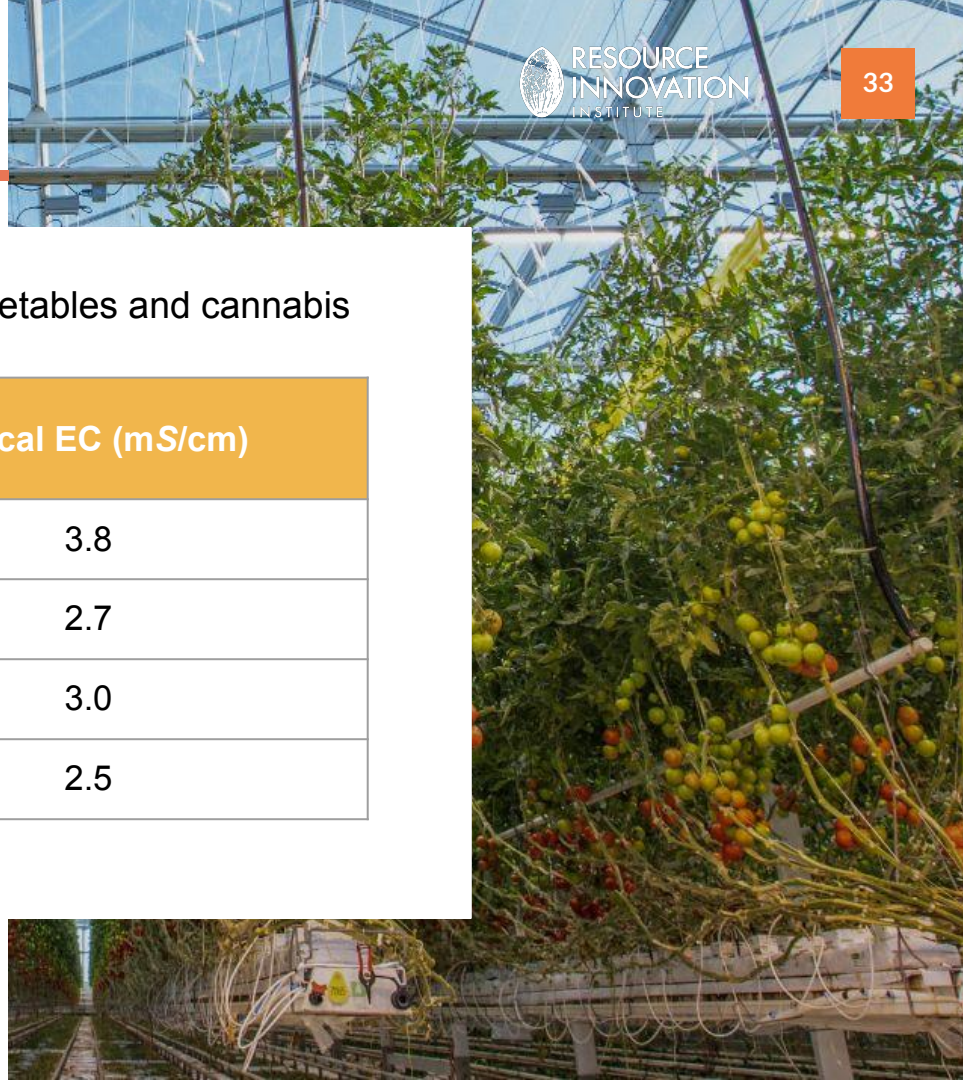
- No metering
- One meter - incoming water
- More than one meter
- Tracked by irrigation controller
- Tracked by climate control computer

Grodan conduct its R&D in Netherlands within a consortia called ‘Cultivation for Compounds’

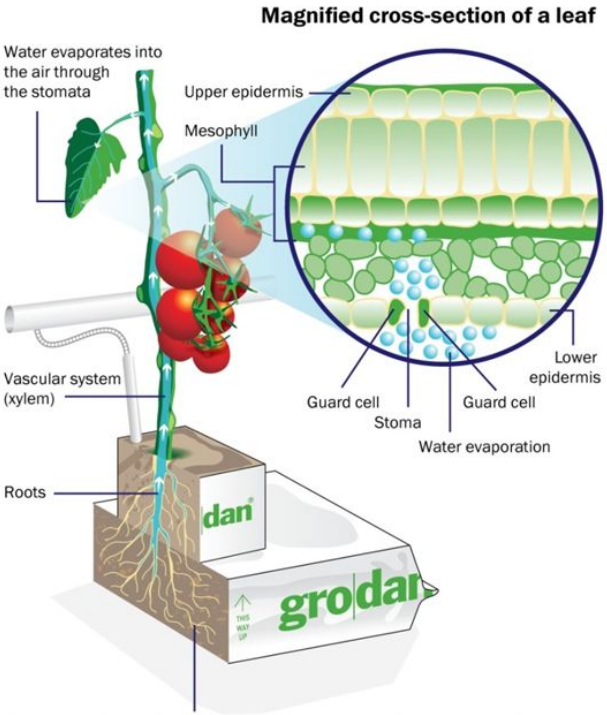
Water Use Per Crop

Data courtesy of Grodan for greenhouse grown vegetables and cannabis

Crop	Typical water usage (l/m^2/cultivation year)	Typical EC (m*S*/cm)
Tomato	1250 (30.7 gal/ft^2/yr)	3.8
Pepper	950 (23.3 gal/ft^2/yr)	2.7
Cucumber	1400 (34.3 gal/ft^2/yr)	3.0
Cannabis*	2200 (53.9 gal/ft^2/yr)	2.5



Irrigation: Why, When & How?



Why?

- Growth & transpiration

$$6H_20 + 6CO_2 \xrightarrow{\text{sun}} C_6H_{12}O_6 + 6O_2$$

When & How?

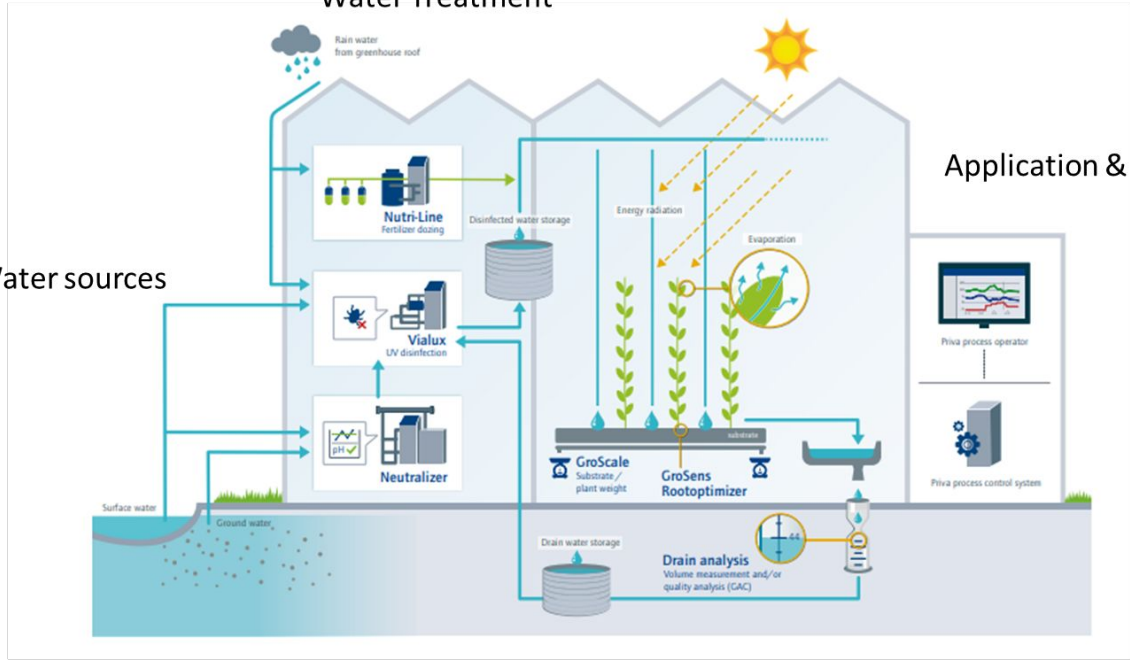
- Balance in the crop
- WC & EC management within the substrate
- Plant quality
- Root quality

Greenhouse (CEA) Touch Points for Today

Water Treatment

Water sources

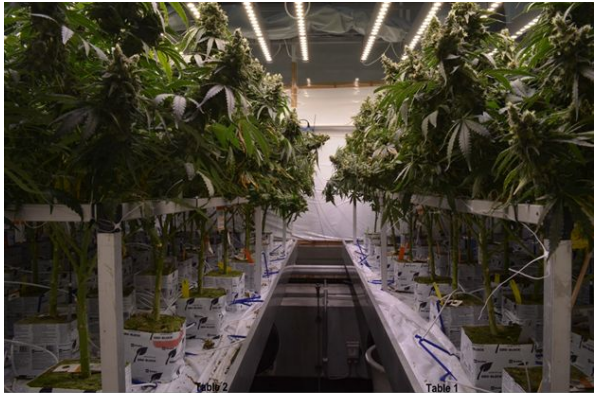
Application & Control



Collection

Application & Control

- Always soilless substrates
- Typically stone wool or coco
- Differences in crop steering, nutrient management, drain water recycling



Stone wool

coco

Application & Control

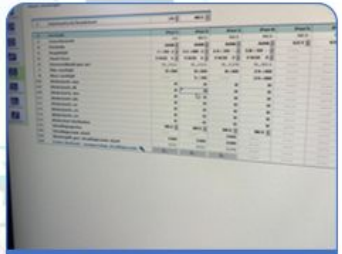
- Drippers used in CEA substrate systems are typically 2, 3, or 4 l/hr (~ .5, .8 or 1 gal/hr)
  - Trade off between re-saturation of the substrate (WC control) and refreshment of the substrate (EC control)
- What capacity to use depends on the system and the crop
- Always pressure compensated drippers for uniform opening and closing = uniform delivery on a bench / within a row
- i.e. Grodan recommend 2 x 2 litre per block located in opposite corners

Tip: chose drippers whose design 'breaks the water flow' (Left). Open channel designs (right allow water to run directly to bottom of the substrate resulting in uneven water distribution

Application & Control

Root zone sensors

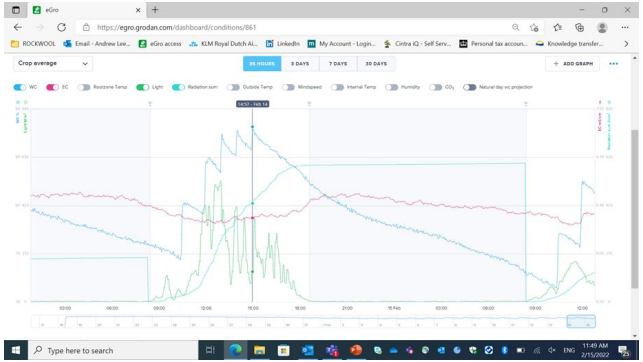
Generate graphical information



From which we fine tune computerised set-point control

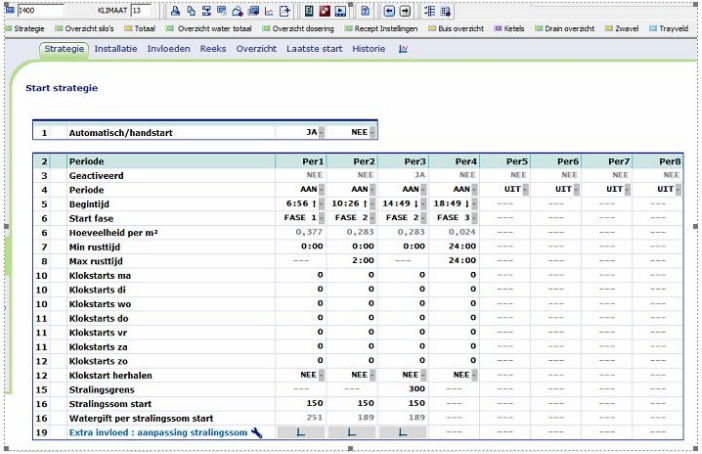
What should the sensor do?

- Provide reliable management information as to WC & EC in the substrate
  - WC accuracy 2%
  - EC accuracy 0.2 mS/cm
  - Display data graphically
- Allow the user to descriptively read in order to:
- Fine tune irrigation start time
- Fine tune irrigation stop time
- Determine frequency and volume of the irrigation cycles
- In essence supply only what is needed by the plant, working with minimal drain volumes

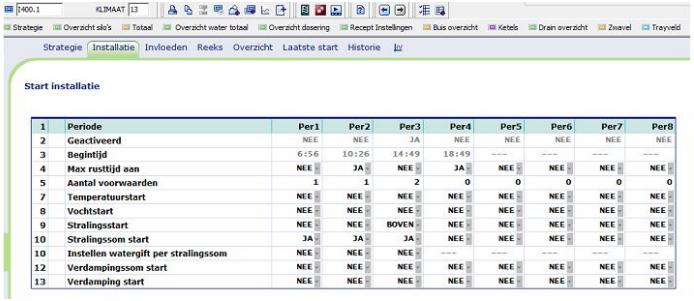


What should control do?

- Allow user to optimize irrigation start time
- Allow user to optimize irrigation stop time
  Usually in greenhouse production systems this is based on either light sum (J/cm2) or light intensity (W/m2), or maximum rest time
- Allow user to optimize irrigation volume
  Time (mins) &/or Volume (ml)
- Allow user to optimize irrigation frequency
  Usually on light sum (J/cm2) or maximum rest time



1	Automatisch/handstart	JA	NEE						
2	Periode	Per1	Per2	Per3	Per4	Per5	Per6	Per7	Per8
3	Geactiveerd	NEE	NEE	JA	NEE	NEE	NEE	NEE	NEE
4	Periode	AAN	AAN	AAN	AAN	UIT	UIT	UIT	UIT
5	Begintijd	6:56	10:26	14:49	18:49	---	---	---	---
6	Start fase	FASE 1	FASE 2	FASE 2	FASE 3	---	---	---	---
6	Hoeveelheid per m²	0,377	0,283	0,283	0,024	---	---	---	---
7	Min rusttijd	0:00	0:00	0:00	24:00	---	---	---	---
8	Max rusttijd	---	2:00	---	24:00	---	---	---	---
10	Klokstarts ma	0	0	0	0	---	---	---	---
10	Klokstarts di	0	0	0	0	---	---	---	---
10	Klokstarts wo	0	0	0	0	---	---	---	---
11	Klokstarts do	0	0	0	0	---	---	---	---
11	Klokstarts vr	0	0	0	0	---	---	---	---
11	Klokstarts za	0	0	0	0	---	---	---	---
12	Klokstarts zo	0	0	0	0	---	---	---	---
12	Klokstart herhalen	NEE	NEE	NEE	NEE	---	---	---	---
15	Stralingsgrens	---	---	300	---	---	---	---	---
16	Stralingssom start	150	150	150	---	---	---	---	---
16	Watergift per stralingssom start	251	189	189	---	---	---	---	---
19	Extra invloed : aanpassing stralingssom	L	L	L	---	---	---	---	---

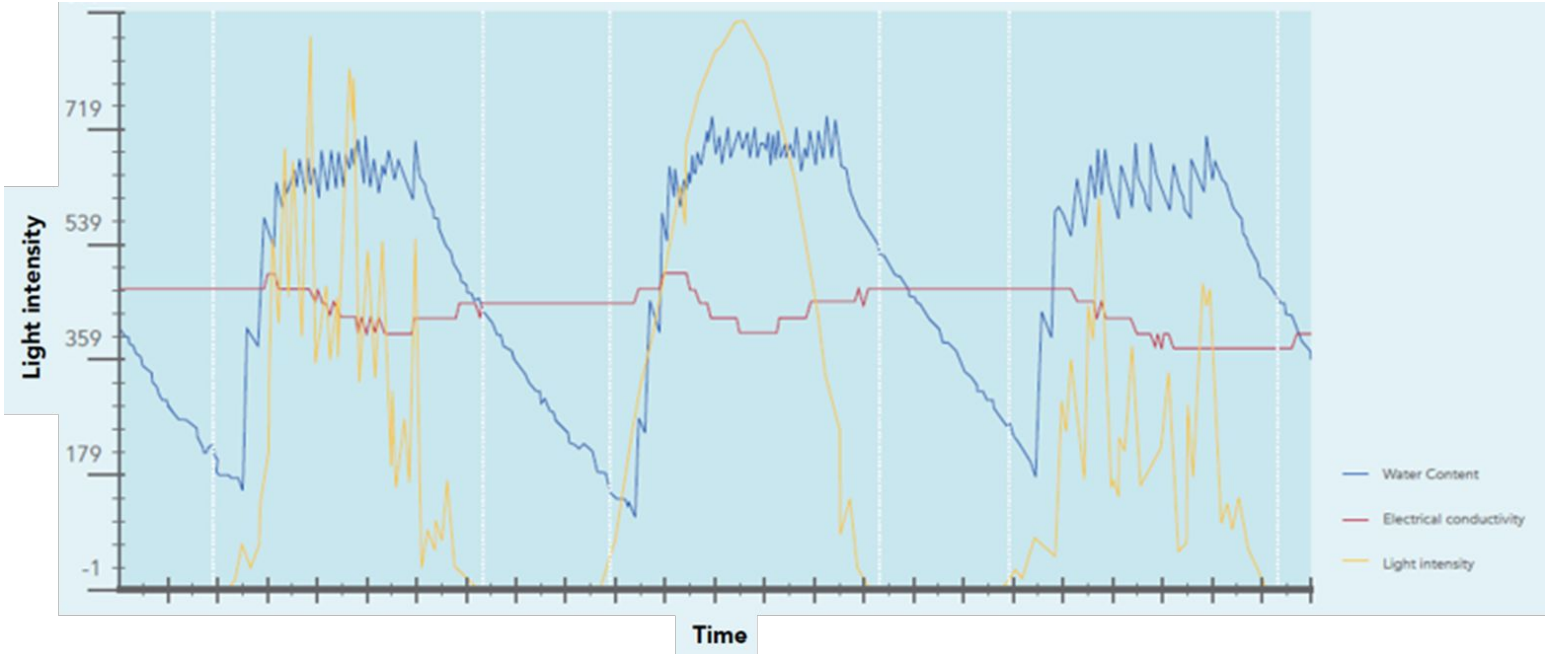


1	Periode	Per1	Per2	Per3	Per4	Per5	Per6	Per7	Per8
2	Geactiveerd	NEE	NEE	JA	NEE	NEE	NEE	NEE	NEE
3	Begintijd	6:56	10:26	14:49	18:49	---	---	---	---
4	Max rusttijd aan	NEE	JA	NEE	JA	NEE	NEE	NEE	NEE
5	Aantal voorwaarden	1	1	2	0	0	0	0	0
7	Temperatuurstart	NEE	NEE	NEE	NEE	NEE	NEE	NEE	NEE
8	Vochtstart	NEE	NEE	NEE	NEE	NEE	NEE	NEE	NEE
9	Stralingsstart	NEE	NEE	BOVEN	NEE	NEE	NEE	NEE	NEE
10	Stralingssom start	JA	JA	JA	NEE	NEE	NEE	NEE	NEE
10	Instellen watergift per stralingssom	NEE	NEE	NEE	---	---	---	---	---
12	Verdampingssom start	NEE	NEE	NEE	NEE	NEE	NEE	NEE	NEE
13	Verdamping start	NEE	NEE	NEE	NEE	NEE	NEE	NEE	NEE

Example of irrigation set points on a Priva process control computer

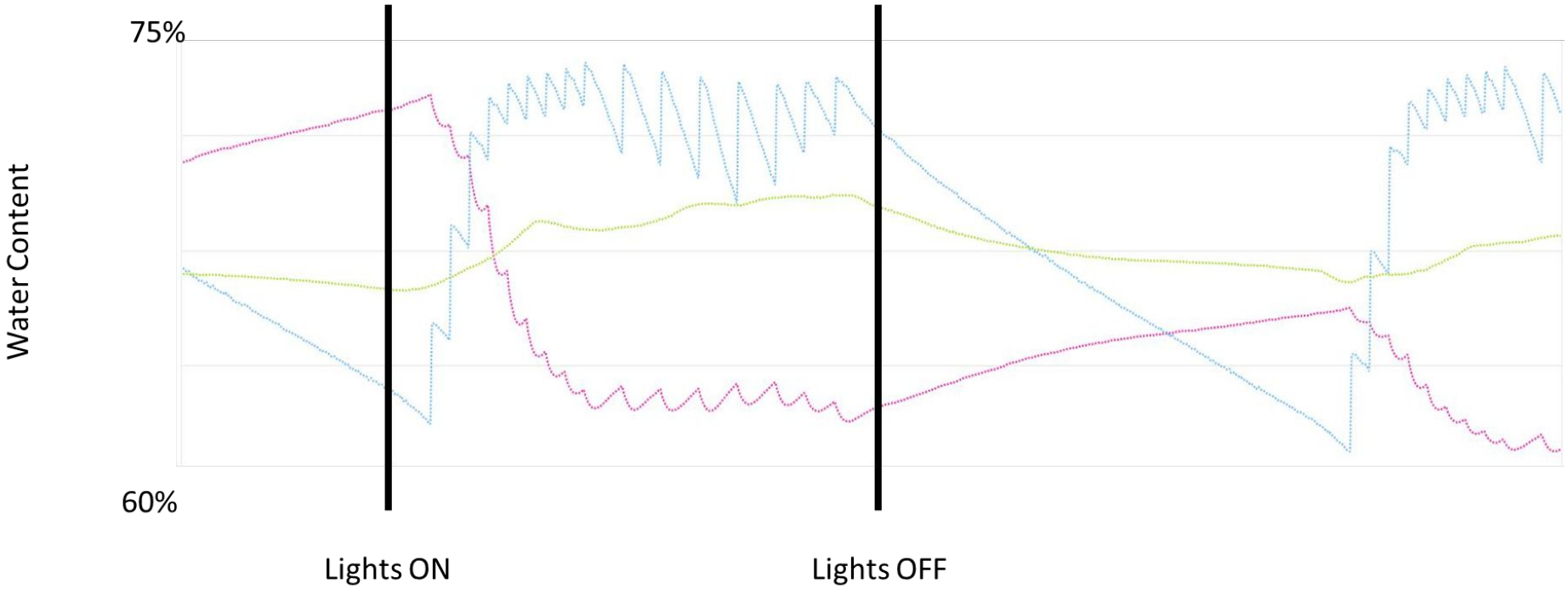
What should control do?

In a greenhouse situation we (may) need more control then in an indoor environment due to the influence of outside radiation. How to keep consistency when light levels vary?



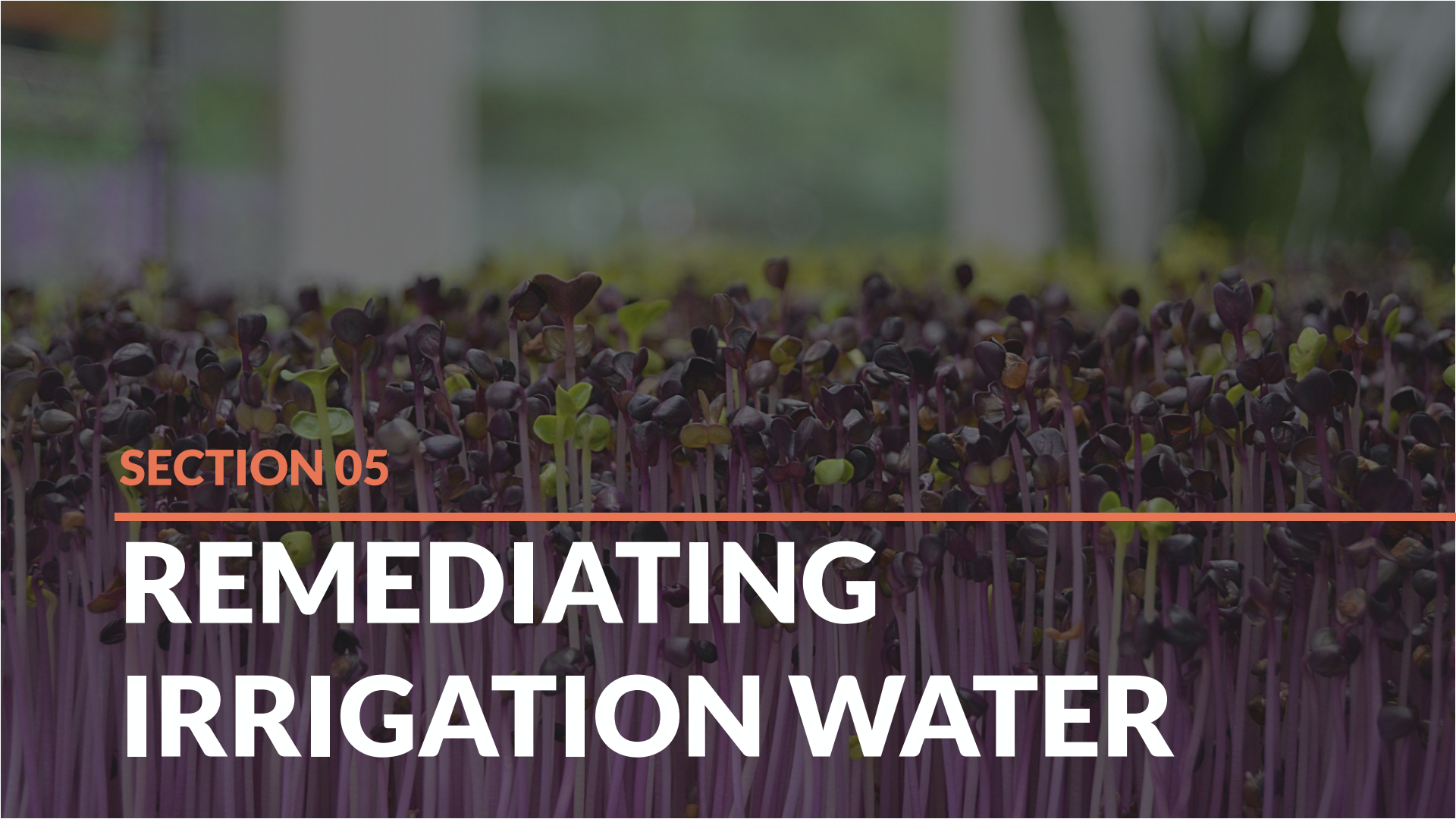
Growth Room

Start +1 hour lights on. Gift 3% (of substrate volume) every 30 mins until EC is stable. Then 3% every hour. Stop – 1 hour sunset



POLL ALERT!
How is your water use measured?

Discuss Results



SECTION 05

REMEDIATING IRRIGATION WATER

Knowledge Check!

What are the two most important measurements an irrigation sensor should take?

- pH and EC
- Water content and pH
- Water content and EC
- Sodium level and EC

Is it possible to recycle drain water?

- Recycling drain water has been going on for years (in greenhouse hydroponic vegetable cultivation)
- Requires certain tools
- Suited to the scale / size of your facility

Typical commercial greenhouse Netherlands

Is it possible to recycle drain water?

- Ensure the availability of sufficient clean irrigation water
- Reduce fertilizer costs
- Protect the environment
- Comply with legislation

Eutrophication of surface caused by fertilizer run-off from process of food crop production

Why recycle drain water?

Feeding regime used in all Grodan R&D trials

	EC	N-NO3	N-NH4	P	K	Ca	Mg	S	B	Fe	Mn	Cu	Zn	Mo
	mS/cm	Mmol l-1							□mol l-1					
Veg	2.2	13.3	1.8	2.0	6.0	3.8	3.2	3.2	40	60	10	1.0	3.0	0.5
Gen	2.5													

Typical EC	Cost / EC unit	Typical usage (m^2)	Total costs without recycling drain water (m^2)	Total costs with drain water recycling (m^2)
2.5 mS/cm	0.6 euro cents ($0.65)	2,200 (23,681 sq ft)	3,30 euro ($0.33/ft^2)	2,31 euro ($0.23/ft^2)

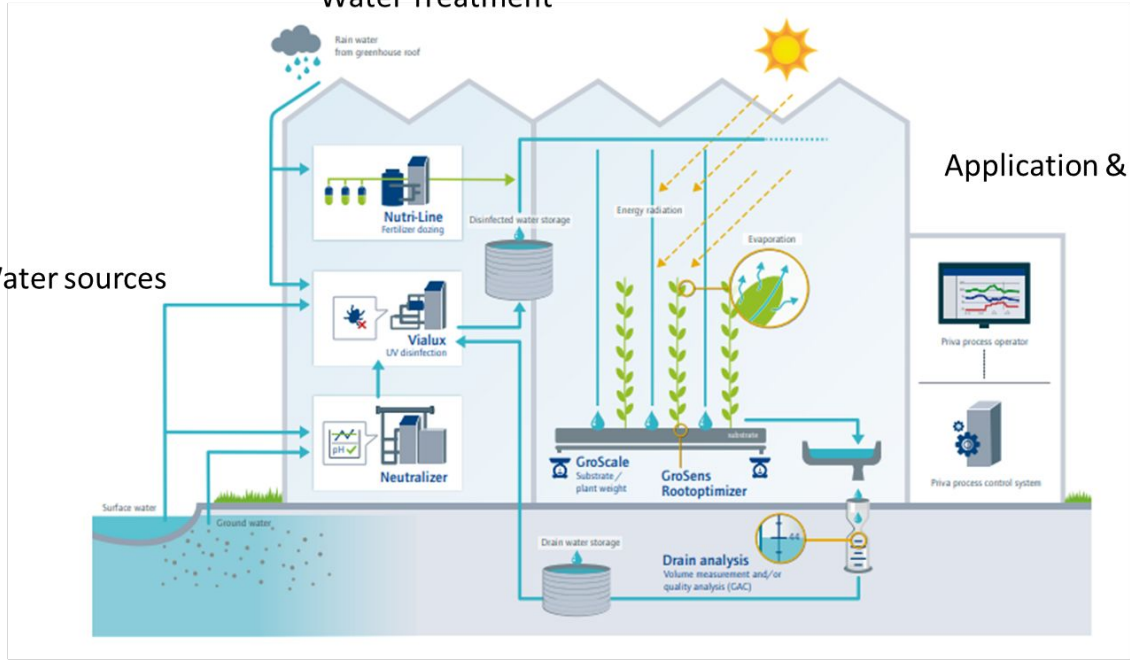
Based on 30% drain water recycling
Tip: Working with structurally higher irrigation EC & substrate EC allows more possibilities for recycling the drain water!

Greenhouse (CEA) Touch Points for Today

Water Treatment

Water sources

Application & Control



Collection

Water Sources

- Best primary water source is rain water
- Alternative bore water or well water
- Surface water (river, pond) should never be used - as it's quality can change rapidly!
- Monitor primary water supply once per year (unless you change it)

Water quality levels for hydroponic crop production

Quality level	EC (mS/cm)	Na or Cl (mmol/l)	Na (ppm)	Cl 9ppm)	Suitability of hydroponics	
1	<0.5	<1.5	<34	<53	++	All crops
2	0.5 - 1.0	1.5 - 2.5	34 - 57	53 - 87	+	Not suitable for recirculation*
3	1.0 - 1.5	2.5 - 4.0	57 - 92	87 - 142	+/-	Should not be used*

Water Treatment - Primary Water Supply

Know the quality of your primary water supply!

- Be aware of the iron content >0.01 mmol/l or 0.6 ppm action is required to remove it, usually aeration
  - > 0.02 mMol/l or 1.2 ppm you will need to use reverse osmosis (RO)

- Some form of pre-acidification before fertilizer mixing tank will be required if high concentrations of bicarbonate >1.0 mMol/l or 61 ppm are present
  - Bicarbonate buffers the pH so a little bicarbonate 0.25 - 0.50 mmol/l or 15 - 30 ppm is good as it stabilises the pH of the irrigation water

- High levels of sodium in your primary water supply will need to be removed via RO
- Sodium can also be selectively removed from the drain water with systems such and NoNa+ from Ridder, leaving 'good nutrients behind'

Storage of Water

- In an ideal world you should have sufficient rain water storage - In Europe minimum 500m^3 / ha required by law

- Drain water storage tanks inside (temperature control) and covered
  - Dirty tanks pre-treatment
  - Clean tanks post-treatment
  - Capacity based on your expected maximum run-off in 24 hrs

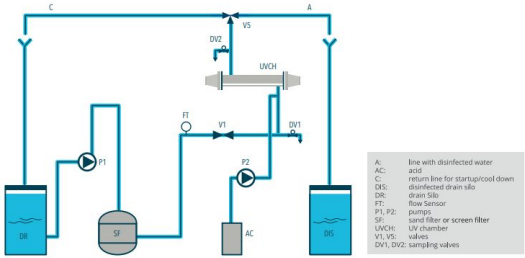
Water Treatment - Disinfection Drain Water

- UV: is by far the most common method of drain water treatment used in hydroponic crop production
  - Simple, effective & cheap
  - 150 J/cm^2 for bacteria & fungi
  - 250 J/cm^2 for virus

- Be aware of the T-10 value (i.e. the clarity of drain water & the ability of UV light to pass through it)

- Tips:
  - Look to systems which modulate water flow based on measured T10 values
  - Design so that you can monitor effectiveness of treatment

First flush drain water from stone wool (left) and coco substrates (right)



Schematic layout of the disinfection process

Ridder Vitalite (other systems are available)

Water Treatment - fertilizer dosing

- Primary water supply is combined with clean recycled drain water to a pre-set EC in the water room (*we call this EC Supply or 'ECs*)
  - In automated control systems a typical setting for ECs will be 0.8 mS/cm
  - Meaning with target irrigation EC 2.5 mS/cm I only add 1.7 mS/cm fresh nutrients via the fertilizer dosing unit
  - Towards end of cultivation ECs can be increased* to lower the stored volumes in the drain basins

- Fertilizer stock tanks should always be covered as light degrades chelated nutrients

- Ensure mixing tank of the dosing unit is sized to allow correct pH adjustment prior to distribution to the crop

Water Treatment - fertilizer analysis when recycling nutrients

- Take regular (weekly) analysis of the drain water
- This ensures that the adjustments you make are small and timely
- Send samples to a reputable laboratory for analysis. Most will also provide feedback on adjustments required for A & B stock tanks

Groen Agro Control
LABORATORIUM/ONDERZOEK & ADVIES

Sample	Slab tomato crop		Tomato Grower
Date	day-Month-year		Distributieweg 1
Crop	Tomato (TOI)		2645 EG Delfgauw
Customer	1234	**Sample nr.** 123456	Netherlands

Element		pH	EC	NH4	K	Na	Ca	Mg	Si	NO3	Cl	SO4	HCO3	H2PO4	Fe	Mn	Zn	B	Cu	Mo
				mM											µM					
Analysis		6.7	4.0		2.2	4.7	11.3	9.6	0.4	10.3	11.1	10.5	1.2	0.6	91.6	5.2	78.0	318.0	2.4	2.6
Analysis (EC(c))			3.7		2.8	4.7	14.5	12.3	0.4	13.2	11.1	13.4	1.2	0.8	117.3	5.2	99.9	407.1	3.1	3.3
Target		5.5	3.7	0.5	8.0		10.0	4.5		23.0		6.8		1.0	25.0	7.0	7.0	50.0	0.7	
Standard feed			2.6	1.2	9.5		5.4	2.4		16.0		4.4		1.5	15.0	10.0	5.0	30.0	0.8	0.5
Corrections	Analysis				3.0		-0.8	-0.3		3.0		-1.0			-7.5		-2.5	-15.0	-0.4	
	Extra			0.8						0.8										
Drip water			**2.6**	**2.0**	**11.5**		**4.3**	**2.0**		**18.2**		**3.1**		**1.5**	**7.5**	**10.0**	**2.5**	**15.0**	**0.4**	**0.5**
Tap/well	%from:																			
Surface water	%from:																			
Recirculation 30	%from:		2.5	0.1	3.1	2.1	5.7	4.4	0.2	7.4	5.2	4.7	0.5	0.6	44.2	4.1	26.0	144.0	1.1	1.2
Injection concentrations				2.0	10.6		2.6	0.7		16.0		1.7		1.3	4.5	8.8	1.5	9.0	0.2	0.2

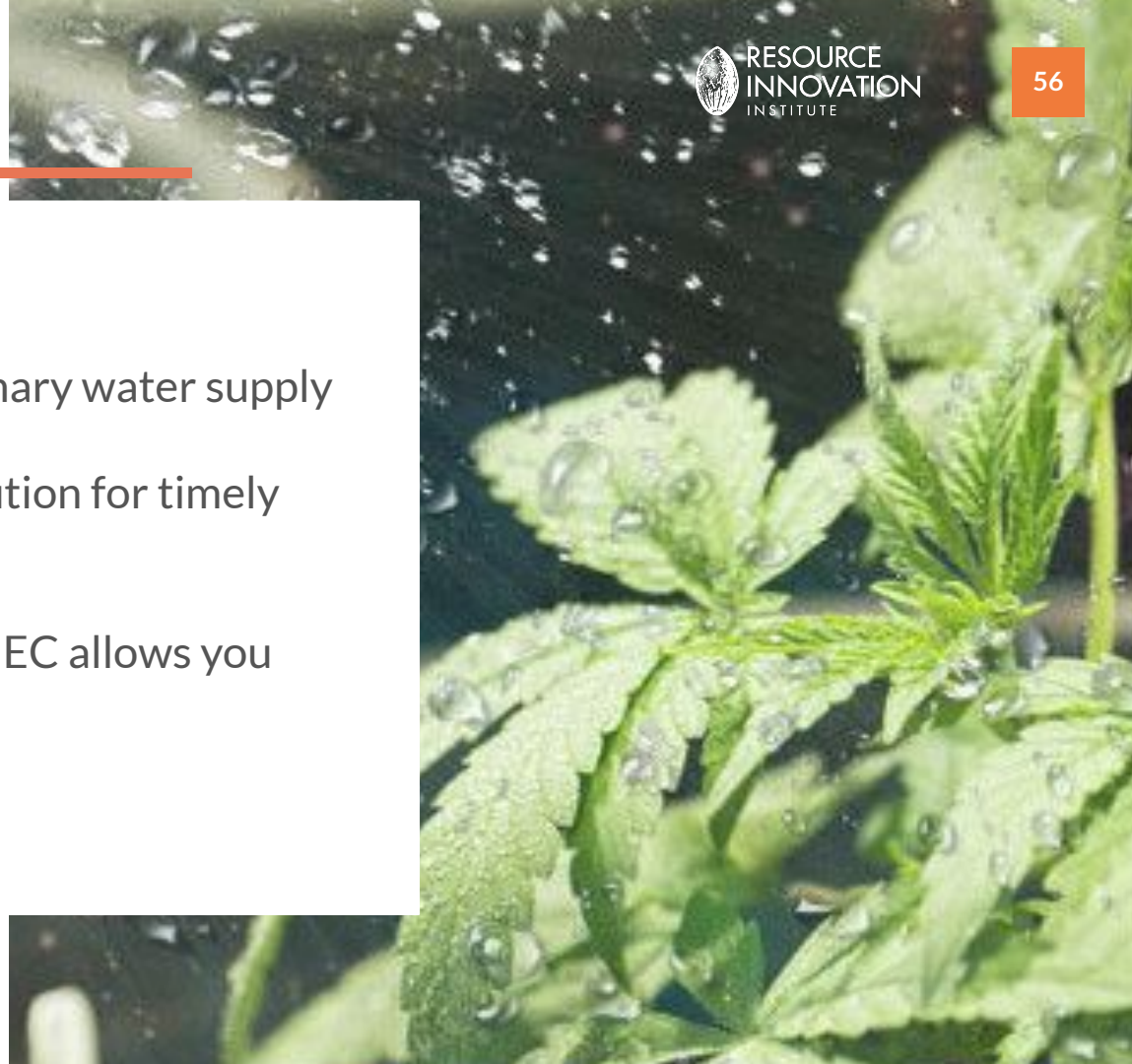
Water			***Solid Fertiliser***			***B-Tank***			***Remarks:***
Tap/well		%	***A-Tank***						Extra adjustments have been made:
Scheme code			Calcium nitrate	55.4	kg	Nitric acid	0.0	liter	+ 0.8 mmol/l NH4NO3 to adjust for the
Rain	70	%	Ammonium nitrate	11.7	liter	Potassium nitrate	43.1	kg	high pH value
Surface		%	Magnesium nitrate	0.0	kg	MonoPotPhos	18.1	kg	
Recirculation	30	%	Potassium nitrate	28.8	kg	Magnesium sulphate	16.2	kg	
						Potassium sulphate	18.6	kg	
System									
EC drip water	2.6	mS/cm							
Tank A volume	1000	liter	Fe-chelate 3.0 %	837	g	Mn sulphate 32.0 %	148	g	
Tank B volume	1000	liter		675	ml	Zn sulphate 23.0 %	42.7	g	
Concentration factor	100	x				Borax 11.0 %	85.8	g	
						Cu sulphate 25.0 %	5.6	g	
						Na-Molybdate 40.0 %	3.6	g	

Disclaimer: This recipee is made under the condition that no liability is claimed by the user

Example of a report for tomato crop from Normec Groen Agro Control, Netherlands. Program is called ‘Netfeed’

Summary

- To measure is to know
- Know the make up of your primary water supply
- Take regular analysis drain solution for timely adjustments
- Working with higher irrigation EC allows you more space for corrections
- Consider scale & complexity



Knowledge Check!

What are the two most important measurements an irrigation sensor should take?

- ~~pH and EC~~
- ~~Water content and pH~~
- Water content and EC
- ~~Sodium level and EC~~

SECTION 06

BRINGING IT ALL TOGETHER

Priorities

- **Restore water quality** for protection of plants
- **Remove biofilm** for protection of people, plants, and equipment
- **Reduce reject** water for protection of environment
- **Recover nutrients** to protect the operation's bottom line

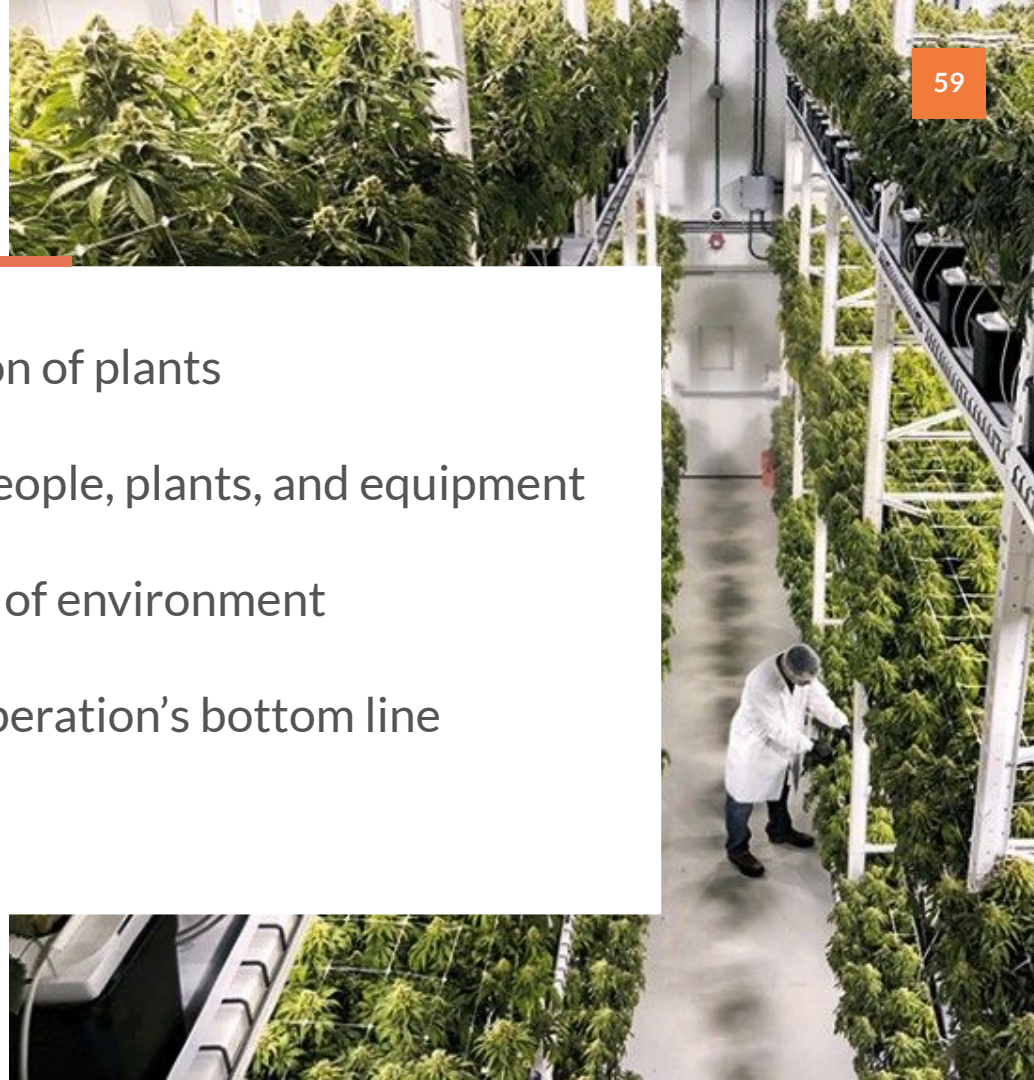
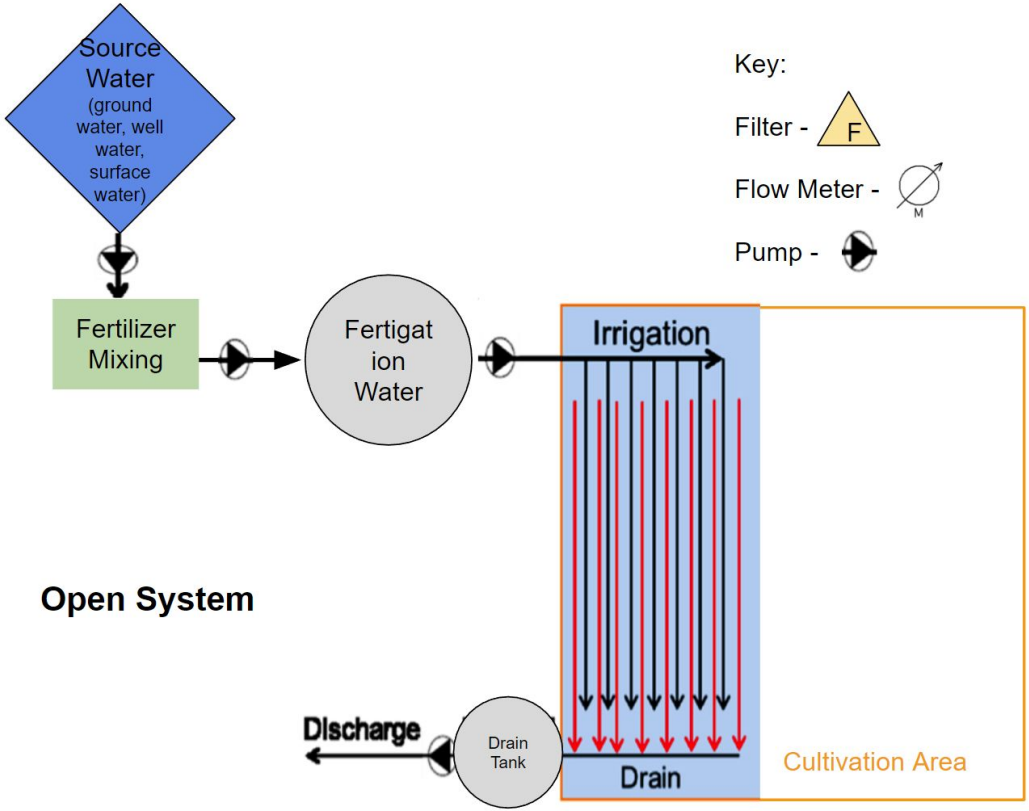


Table 4.1 Summary of the selection criteria for water quality treatment systems

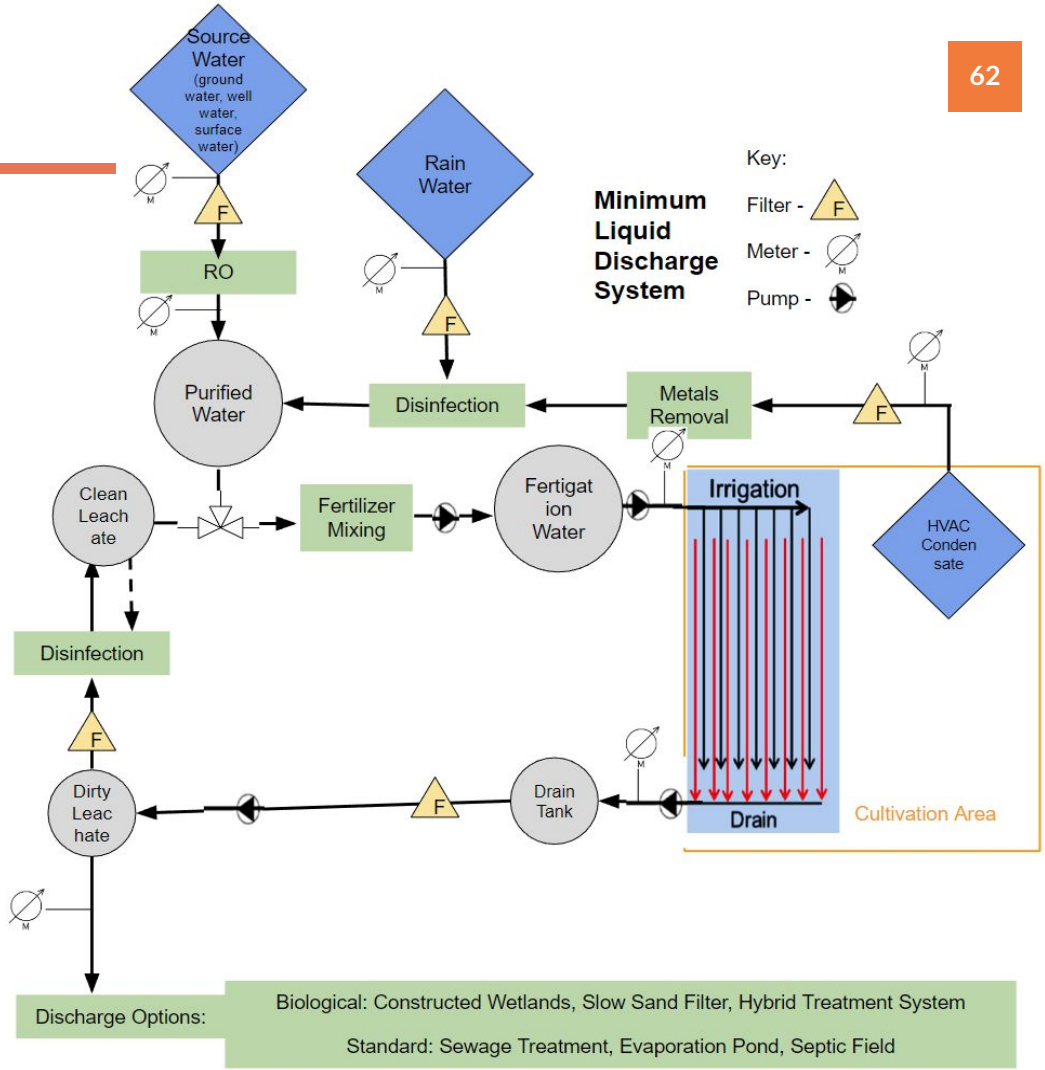
West and Huber, 2018

Category	Technology	Treatment Range					Pre-treatment required?	Phytotoxic Residuals?	Footprint	Costs		Page reference
		Solids/ organic material	Pathogens	Nutrients		Agri-chemicals				Capital	Operating	
				N	P							
Physical	Filtration - coarse	√	No	No	No	No	No	No	Small - medium	$-$$	$	28-31
	Filtration- micro	√	√	R/O	R/O	R/O or nano-	Yes	No	Medium	$$-$$$	$$	28-31
	Rapid media filters	√	No	No	Media dependent	Media dependent	Coarse	No	Small	$-$$	$	32-33
	UV	No	√	No	No	No	Yes	Few	Small	$$-$$$	$	34-35
	Heat	No	√	No	No	No	No	No	Medium	$$$	$$$	36-37
Chemical	Chlorine	√	√	No	No	Some	Yes	Phytotoxic	Small	$-$$	$-$$	37-40
	Chlorine dioxide	√	√	No	No	Some	Yes	Phytotoxic	Small	$-$$	$-$$	37-40
	ECA	√	√	No	No	Some	Yes	Phytotoxic	Small	$$	$-$$	37-40
	Bromine	√	√	No	No	Some	Yes	Phytotoxic	Small	$-$$	$-$$	37-40
	Hydrogen peroxide	√	√	No	No	Some	Yes	No	Small	$-$$	S-$$	41-42
	Ozone	√	√	No	No	Some	Yes	No	Medium	$$$	SS	43-44
	Advanced oxidation	√	√	No	No	Some	Yes	No	Medium	$$$	$$$	45
	Copper; Silver	No	√	No	No	No	Yes	Possible	Small	$$	$$	46-47
Biological	Slow filters & fluidized beds	√	√	No	No	Possible	Coarse	No	Medium	$$	$	48-50
	Constructed wetlands	√	Variable	√	Variable	√	Coarse	No	Small-large	$$-$$$	$	51-52
	Woodchip Bioreactors	√	√	√	Some	Likely	Coarse	No	Medium	$-SS	$	53-54
	Hybrid Treatment Systems	√	√	√	√	Likely	Coarse	No	Medium	SS-$$$	$	55-58
	Bioswales	√	Variable	√	Variable	Potentially	Coarse	No	Medium	$-SS	$	59-61
	Vegetated Filter Strip	√	Zero discharge				Coarse	No	Medium	$	$	62-63
	Land Application	√	√	√	√	√	No	No	Storage	$	$	64-65

Schematic: Open Discharge Facility



Schematic: Minimum Liquid Discharge Facility



SECTION 07

UTILITY & STATE ASSISTANCE

New Service Installation or Upgrade

- ✔ Submit and track your application at www.yourprojects-pge.com
- ✔ Design your project in accordance with PG&E Greenbook www.pge.com/greenbook
- ✔ Call Customer Service to determine best billing rate 1-800-743-5000
- ✔ Questions? Call Building and Renovation Service Center at 1-877-743-7782

What is AESAP

TRC's **Agriculture Energy Savings Action Plan (AESAP)** offers incentives and financing for energy-saving projects involving the retrofit or installation of energy consuming equipment.

CEA Rebate and Incentives for:

- Grow lighting and controls
- Greenhouse heat curtains and IR film
- Boiler, pipe insulation, heat recovery
- Irrigation upgrades and more!

AESAP:

- Provides rebates and incentives on energy efficient equipment upgrades
- Offers technical assistance and incentives for more complex projects
- Provides Integrated Demand Side Management support and services
- Provides services at no cost to customer

www.AgEnergySavings.com

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TRC

AESAP Rebate Process

AESAP
AGRICULTURE ENERGY SAVINGS ACTION PLAN

1. Equipment Purchase

You purchase the equipment, making sure it complies with all requirements (TRC can help)

2. Submit Application

You send AESAP documentation with, a paid invoice, install and operational date

3. Application Review

Program team reviews and completes the paperwork

4. Signature Stage

Paperwork will be sent to you for final signature

5. Rebate Issuing

Rebate check will be issued and sent to you

Customer defined

1-2 months
upon application submission

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AESAP Custom Incentive Process

AESAP
AGRICULTURE ENERGY SAVINGS ACTION PLAN

1. Assessment

AESAP meets with you for a no-cost energy audit or to discuss opportunities. AESAP will review the preliminary analysis with you prepare necessary reports

2. Application

You sign the program participation agreement and AESAP submits required paperwork to PG&E for review and approval

3. Installation

You install project based on approved parameters

4. Verification

AESAP verifies project completion and submits final report

5. Incentive Issuing

Final paperwork is processed, and incentive is delivered

3+ months — **Customer defined** — **2+ months**

Timeline varies based on several factors, including scope of project, project complexity or installation timeline. CPUC selected projects will require additional review time

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TRC

On-Bill Financing

On-Bill Financing helps eligible customers pay for energy-efficiency retrofit projects with **0% interest and zero penalty loans**.

- Loans range between $5,000 and $4,000,000 per premise
- Loan periods of up to 120 months
- Loan repayment amount will be in line with the monthly energy savings from the upgrade
- Energy bill shouldn't increase due to equipment investment
- Once loan is paid off, savings on your bill will be realized

GoGreen Financing

Administered by the State of California and supported by the state's investor-owned utilities, the Small Business Financing (SBF) program offers financing with attractive terms for energy-efficiency improvements to existing businesses. Participating finance companies offer quick approval with monthly payments to meet your budget.

- $100,000 up to $5 million, competitive interest rates, terms up to 10 years
- Up to 30% of financed amount can be for non-energy upgrades
- For Small Businesses with 1) 100 or fewer employees or 2) Annual revenues less than $15 million or 3) Meet SBA size requirements

Visit GoGreenFinancing.com to learn more.

Contact Us

We're here to help your business

Name *(Required)*

First

Last

Email *(Required)*

Phone *(Required)*

Business Name

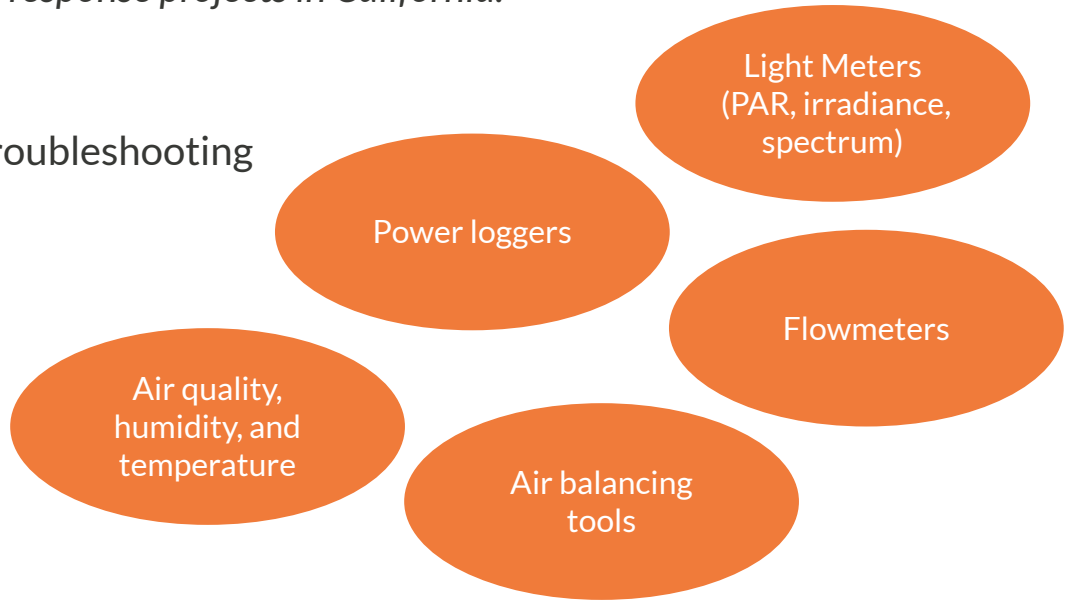
Facility Address

Street Address

Energy Measurement Tool Lending Libraries

Wide selection of energy and building measurement tools to customers and professionals working on energy efficiency, demand reduction and demand response projects in California.

- FREE tool lending programs
- Assistance in tool selection and troubleshooting
- PG&E: pge.com/tools
- SCE: sce.myturn.com/library



Statewide Programs for Producers

California Energy Design Assistance (CEDA)

- Statewide Program serving PG&E, SCE, SoCal Gas, SDGE
  - Program participants receive the following complimentary services:
    - Comprehensive Whole Building Energy Analysis
    - Assistance identifying and evaluating energy-saving measures
    - Analysis of energy costs and paybacks
    - Incentives for New Construction and Major Renovations projects
  - CEDA Pathways: Mixed Fuels or All-Electric
    - Mixed Fuels for customers who want the option of both gas and electricity
    - All-Electric program option offers higher incentives if customers do not install gas service
  - Learn more: CaliforniaEDA.com

California Department of Tax and Fee Administration (CDTFA)

- Cannabis producers qualify for some Equipment Exemptions under agricultural programs
- Learn more: cdtfa.ca.gov/industry/cannabis.htm

Panel Q & A

CONTACT US

RESOURCE INNOVATION INSTITUTE

Visit us at
www.ResourceInnovation.org

P.O. Box 5981
Portland, Oregon 97228
rob@resourceinnovation.org
carmen@resourceinnovation.org
mary.mcdonald@pge.com

Reducing Leachate and Dump Water

Leach Fraction is amount that drains out of pot divided by amount applied at irrigation. Typical rates are 10-20%, but as high as 60% in some cases. Dump water is volume of hydroponic solution that is discarded after using for multiple days.

Reducing Leachate:

- Pressure regulated drippers and presenting clogs
- Substrates with higher water holding capacity
- Track EC of leachate and/or substrate

Reducing Dump Water:

- Smaller containers
- Adding aggregate to take up volume of container
- Diluting strength of “topping off” water to 25-50%
- Genetics

Water Quality

Ultimately, water quality determines WUE, as it determines how many irrigation cycles remediated water can be applied. The accumulation of sodium (Na), nutrient imbalances and disease organisms are primary concern.

- Physical, Chemical and Biological Water Quality
- Disinfection vs purification
- Fertigation water is difficult to remediate and harmful
- Recirculated water needs to be more pure, especially of Na

Benefits of Efficient Irrigation & Remediation

- Reduce, Remediate and Recycle
- Good business practice (fert costs)
- Comply/Prepare for Regulations
- Marketing to consumers
- Community

What should control do?

Figures are shown for illustrative purposes only - its the thought process to follow!

1400.1 KLIMAAT 13

Strategie | Overzicht silo's | Totaal | Overzicht water totaal | Overzicht dosering | Recept Instellingen | Buis overzicht | Ketels | Drain overzicht | Zwavel | Trayveld

Strategie | Installatie | Invloeden | Reeks | Overzicht | Laatste start | Historie

Start installatie

1	Periode	Per1	Per2	Per3	Per4	Per5	Per6	Per7	Per8
2	Geactiveerd	NEE	NEE	JA	NEE	NEE	NEE	NEE	NEE
3	Begintijd	6:56	10:26	14:49	18:49	---	---	---	---
4	Max rusttijd aan	NEE	JA	NEE	JA	NEE	NEE	NEE	NEE
5	Aantal voorwaarden	1	1	2	0	0	0	0	0
7	Temperatuurstart	NEE	NEE	NEE	NEE	NEE	NEE	NEE	NEE
8	Vochtstart	NEE	NEE	NEE	NEE	NEE	NEE	NEE	NEE
9	Stralingsstart	NEE	NEE	BOVEN	NEE	NEE	NEE	NEE	NEE
10	Stralingssom start	JA	JA	JA	NEE	NEE	NEE	NEE	NEE
10	Instellen watergift per stralingssom	NEE	NEE	NEE	---	---	---	---	---
12	Verdampingssom start	NEE	NEE	NEE	NEE	NEE	NEE	NEE	NEE
13	Verdamping start	NEE	NEE	NEE	NEE	NEE	NEE	NEE	NEE

Description: Effectively what i have done is use 4 Periods (Per) within the permitted 24 hrs.
In Start installation screen

In Per 1 I have told the computer it can irrigate from sunrise (line 3). I have told it only ONE start condition needs to be active (line 5) in order for irrigation to happen. That start condition is light sum J/cm^2 (line 10). This is the irrigation start strategy for a 'bright day'.
In Per 2 I have set this +4 hour after sunrise (line 3). I have told it only 1 start condition needs to be active (line 5) in order for an irrigation to happen. It can start on maximum rest time (line 4) OR light sum J/cm^2 (line 10). This is the irrigation start strategy for a dark day.
In Per 3 I have set this to start - 4 hours sunset (line 3). I have told it TWO start conditions need to be active (line 5) in order for an irrigation to happen. These are BOVEN - 'OVER' a certain light intensity W/m^2 (line 9) AND that there needs to be a certain light sum J/cm^2 accumulated. If one condition is not reached this effectively stops irrigation. What this means is that irrigation stops earlier on a dark day and continues for longer on a bright day.
Per 4 I have set this to start at sunset to effectively re-set the system for the next day.

1400 KLIMAAT 13

Strategie | Overzicht silo's | Totaal | Overzicht water totaal | Overzicht dosering | Recept Instellingen | Buis overzicht | Ketels | Drain overzicht | Zwavel | Trayveld

Strategie | Installatie | Invloeden | Reeks | Overzicht | Laatste start | Historie

Start strategie

1	Automatisch/handstart	JA	NEE

2	Periode	Per1	Per2	Per3	Per4	Per5	Per6	Per7	Per8
3	Geactiveerd	NEE	NEE	JA	NEE	NEE	NEE	NEE	NEE
4	Periode	AAN	AAN	AAN	AAN	UIT	UIT	UIT	UIT
5	Begintijd	6:56	10:26	14:49	18:49	---	---	---	---
6	Start fase	FASE 1	FASE 2	FASE 2	FASE 3	---	---	---	---
6	Hoeveelheid per m²	0,377	0,283	0,283	0,024	---	---	---	---
7	Min rusttijd	0:00	0:00	0:00	24:00	---	---	---	---
8	Max rusttijd	---	2:00	---	24:00	---	---	---	---
10	Klokstarts ma	0	0	0	0	---	---	---	---
10	Klokstarts di	0	0	0	0	---	---	---	---
10	Klokstarts wo	0	0	0	0	---	---	---	---
11	Klokstarts do	0	0	0	0	---	---	---	---
11	Klokstarts vr	0	0	0	0	---	---	---	---
11	Klokstarts za	0	0	0	0	---	---	---	---
12	Klokstarts zo	0	0	0	0	---	---	---	---
12	Klokstart herhalen	NEE	NEE	NEE	NEE	---	---	---	---
15	Stralingsgrens	---	---	300	---	---	---	---	---
16	Stralingssom start	150	150	150	---	---	---	---	---
16	Watergift per stralingssom start	251	189	189	---	---	---	---	---
19	Extra invloed : aanpassing stralingssom	L	L	L	---	---	---	---	---

In the start strategy screen

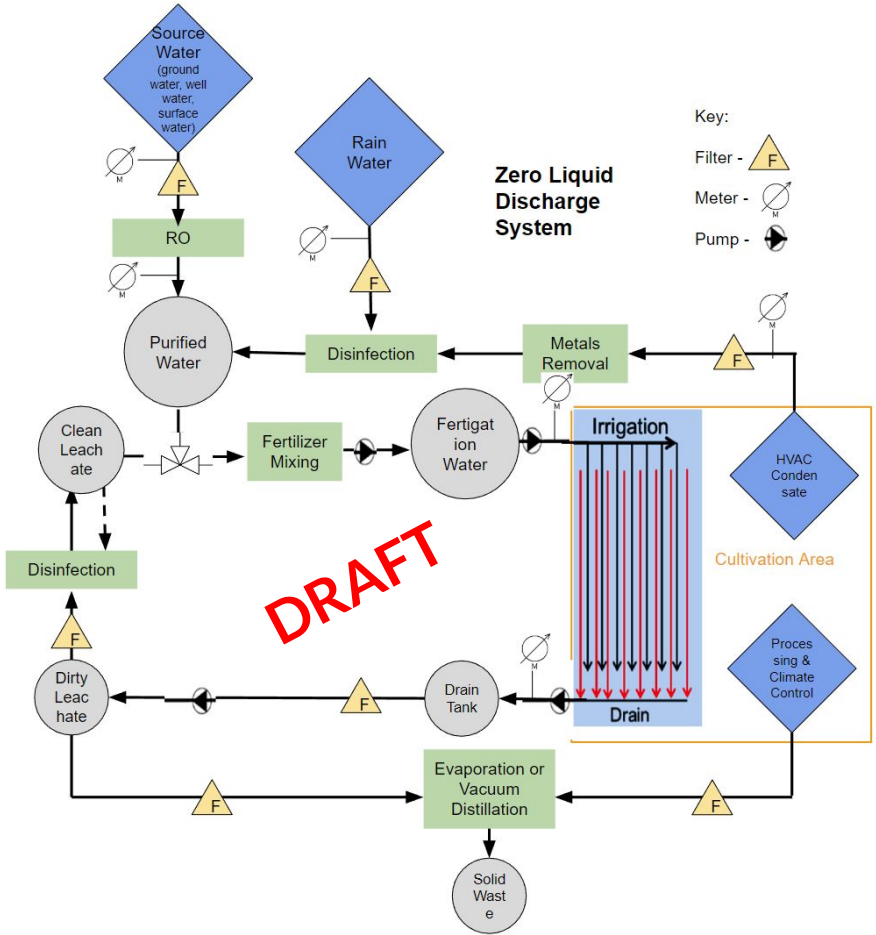
I set the volumes I wish to apply in each Per (line 6). These are defined as 'FASE' in Priva. Note in each Per I can vary the FASE (volume). I would use larger volumes in the morning because to get back to the same day level WC% I need to account for the decrease WC% over night plus what the plant is transpiring (& removing from the substrate) at that moment.

In Per 1 I set my J/cm^2 to 150 J/cm^2 (line 16). Irrigation will happen in Per 1 ONLY when 150 J/cm^2 has been accumulated.
In Per 2 I set my maximum rest time at 2 hours (line 8) what this effectively means in this illustrative example is that on a very dark day irrigation will happen at 10:26, 12:26 & 14:26 hrs. I keep my J/cm^2 start at 150J/cm^2 (line 16). So this would trigger irrigation every 150 J/cm^2 irrespective of the maximum rest time on a bright(er) day
In Per 3 I set my light sum J/cm^2 (line 16) to 150 J/cm^2 and light intensity 'Over' at 300 W/m^2 (line 15). Irrigation will continue for as long as **both conditions** are met

Purpose of Today's Workshop

Efficient Yields
Best practices on energy, water efficiency, and productivity

- Educate producers and their project partners on water efficiency and conservation methods.
- Convey scientific insights and industry expertise directly to producers and find the best ways to translate them in the context of their local ecosystem.
- Assist craft producers and their design and construction project partners, irrigation specialists and contractors with what they need to know to stay competitive and comply with regulations.

Schematic: Zero Liquid Discharge (ZLD) Facility

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