

Norsk Gartnerforbund

Transition from HPS to LED growlight

What to consider?

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Today's topics

- 1) LED status in Norway
- 2) Investment cost & payback time
- 3) Energy balance calculations and greenhouse climate
- 4) LED Light recipe



Estimated LED situation Norway

Tomato: ~90%

Cucumbers: 70-80%

Lettuce: 70-80%

Flowers Low





Part I: Investment Costs & Payback Calculations

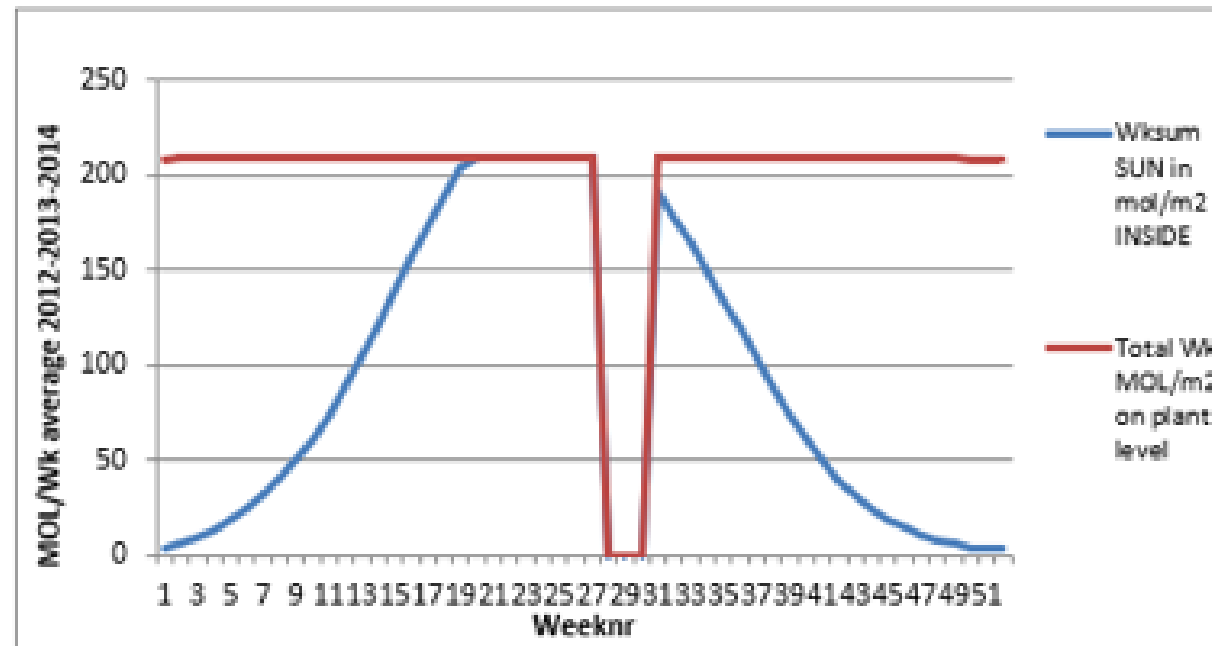


Is LED light a good business decision ?

What is the payback time for the investment ?

Does it make sense to continue changing HPS bulbs ?

Lighting situation
NOW



Lighting hours
Prices per kg

Yearly light plan



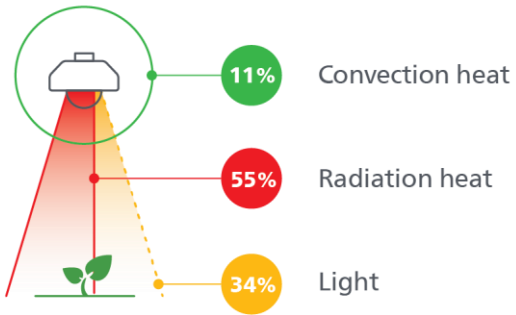
Part 2: Energy Balance Calculations and Climate control in the greenhouse

From HPS to LED - Mind the energy balance

- LED produces more PAR light and less heat – leads to significant energy saving

Energy Balance HPS

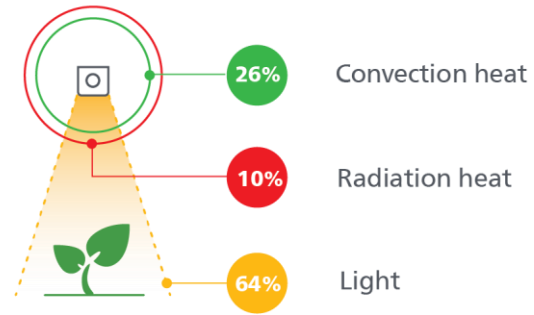
300°C / 570°F



up to 1.9 $\mu\text{mol}/\text{J}$

Energy Balance LED toplighting compact

55°C / 131°F



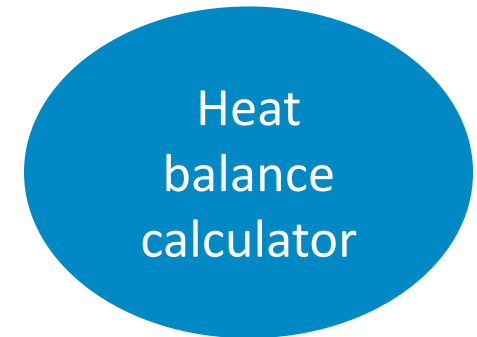
up to 3.8 $\mu\text{mol}/\text{J}$

Delphy

Flexibility in heat & light

Decoupled 'light' + 'heat' requires different mindset in steering greenhouse Temperature

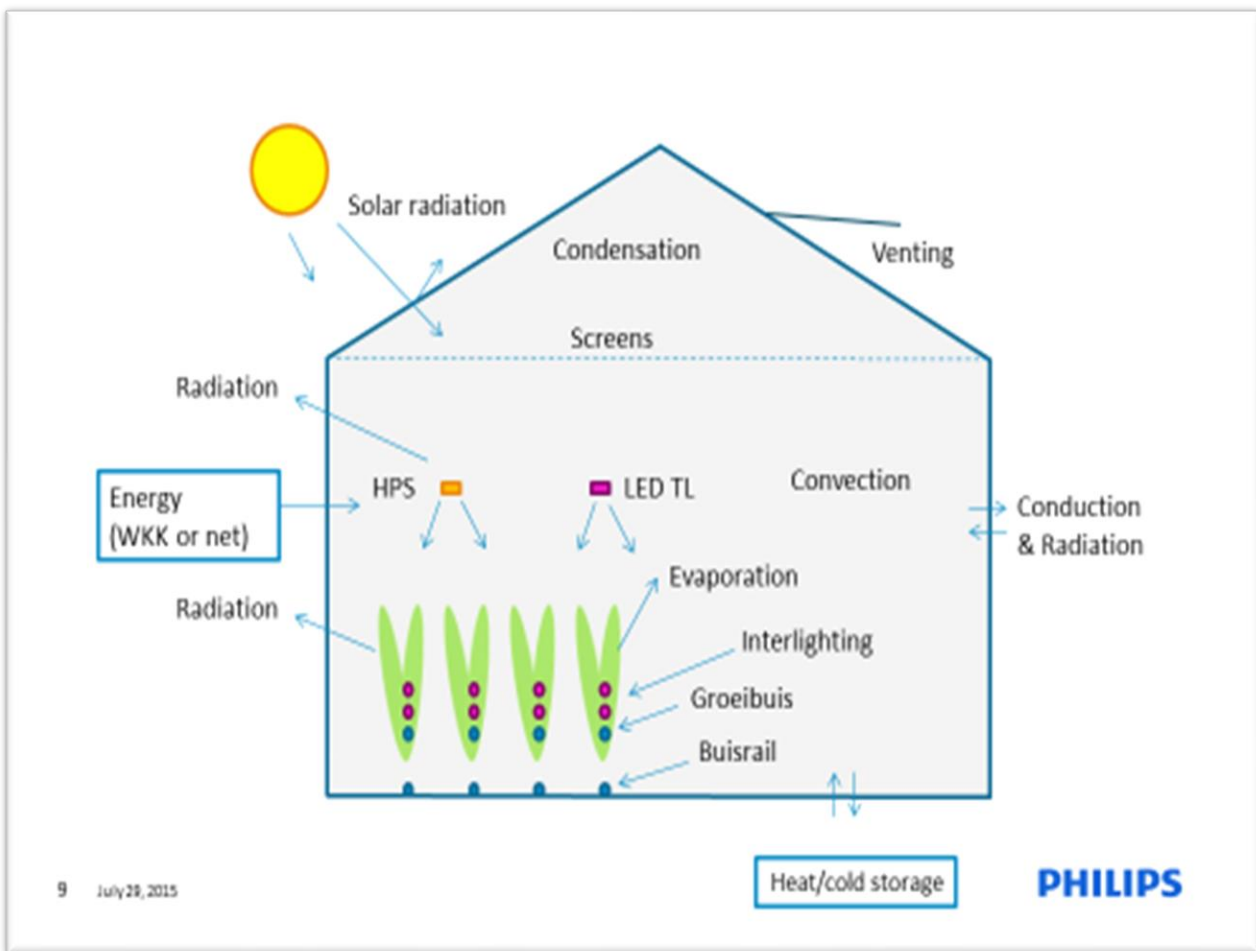
lighting solution	installed power [W/m ²]	efficacy [μmol/J]	light [W/m ²]	heat [W/m ²]	radiation [W/m ²]	convection [W/m ²]
<i>180 μmol/m²/s</i>						
HPS	104	1.9	35	69	57	12
Hybrid [50/50]	78	2.8	34	46	32.5	13
LED	52	3.8	33	19	5	14



HPS: 2x installed power + 10x more radiation heat

LED: more screening + less venting + restore heat balance

Evaluate what is needed to steer your crops with LED



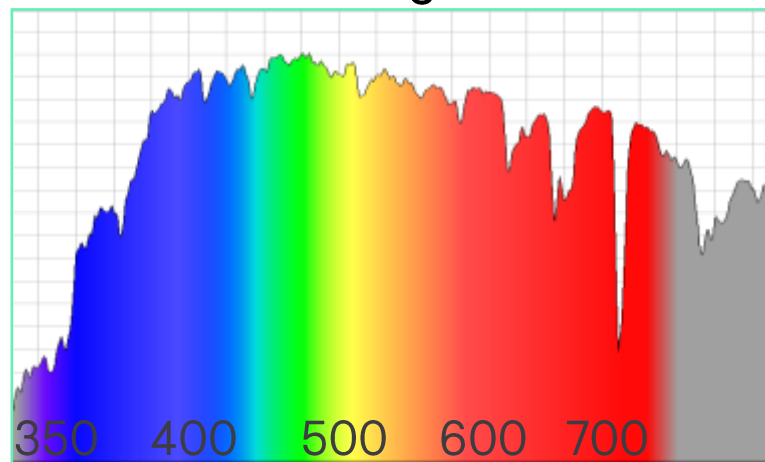
	HPS	LED
Radiant heat	✓	✗
Screens open	✓	✗
Vents open	✓	✗
Rail pipes on	✓	✓
Grow pipes on	✗	✓
Snow pipes on	✗	✓
Daytime Temp.	22°C	23-24°C
Dehumidifier	✗	✓
Air circulation	✗	✓



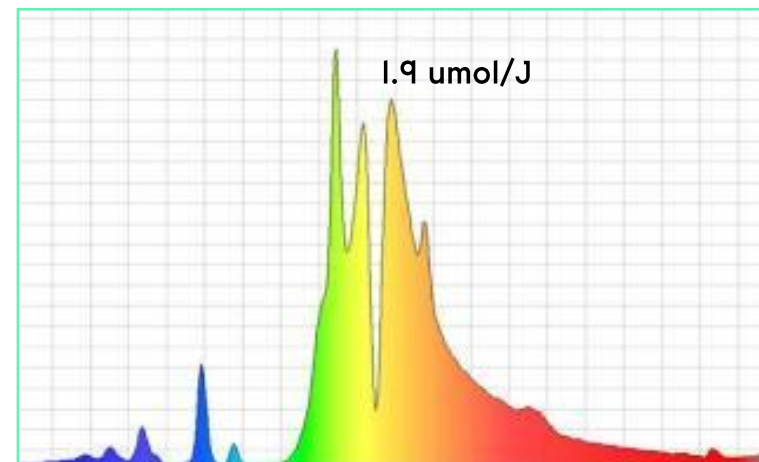
Part 3: LED Light recipe for optimal result

Spectra: Sunlight vs. HPS vs. LED

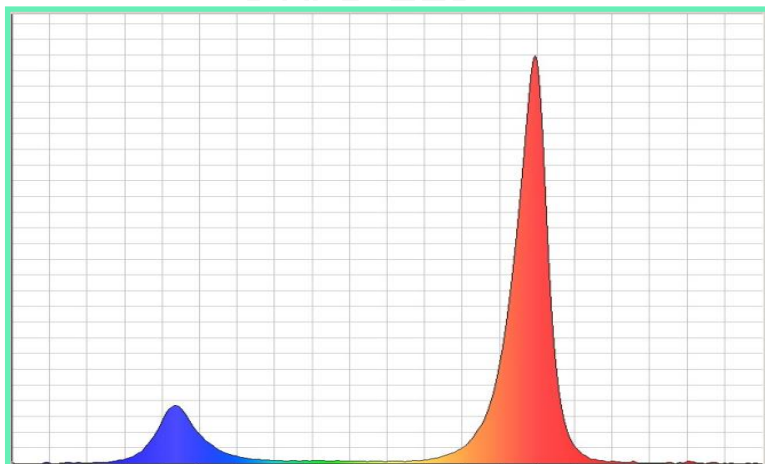
Sunlight



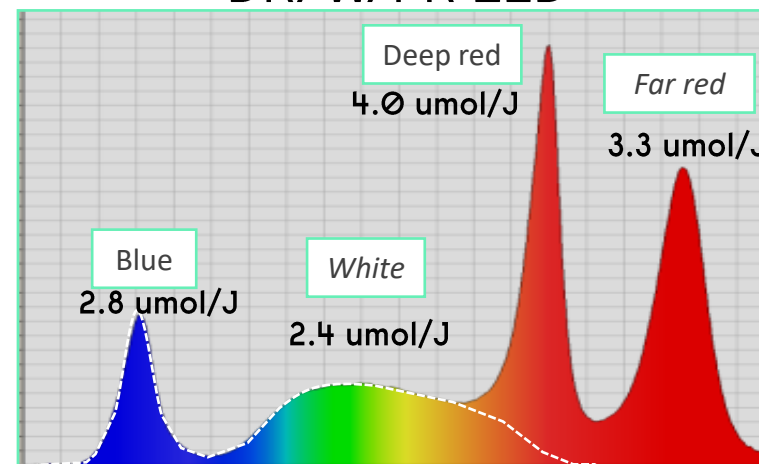
HPS



DR/B LED



DR/W/FR LED





Typical Responses to Spectral Changes



Increasing Blue




Increasing Far-Red




Tomatoes, Cucumber, Lettuce, Flowers

The right light recipe is key to success

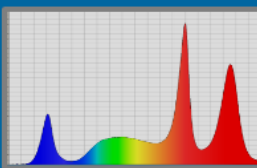
light level



timing

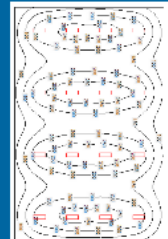



spectrum



position

uniformity *position top/inter*





Classified

Achievable Light Use efficiency per type

LUE = $\frac{\text{Total production (grams/ m}^2\text{)}}{\text{PAR light during growth period (Mol/ m}^2\text{)}}$

Individual fruit weight [grams]	Range of production Non-lit hi Tech [kg/m ² /year]	Light Use Efficiency range [gram/mol]
10	20-25	3.5 – 4.5
20	25-32	4.5 – 5.5
40	38-48	6.5 – 8.5
100	55-65	9.5 – 11
125	58-68	10 – 12
150+	60-75	10 – 12.5




Classified


Spectrum Effect: Cucumber

- Plant height
- Leaf shape
- Leaf Size
- Internode length
- Leaf stem length
- Shape of the plant
- Openess of the crop


Higher LUE and yield



Red + Blue



White light



FR 10%

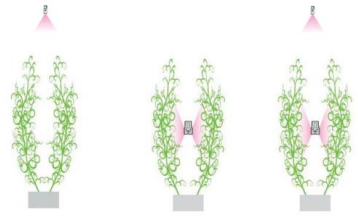
Classified

Supplemental lighting - position

General recommendation:
At least 50% of daily light sum (including sunlight) should be from the top of the crop
Ask plant specialist advise to discuss what is the best option per situation

Interlight
– Best results with higher light intensities
 IL: max 30% of total intensity
– Better fruit color (darker)
– More speed on fruits

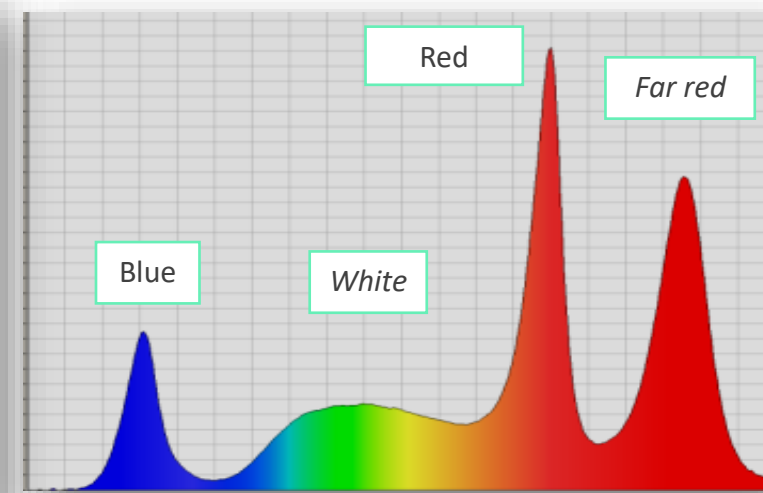
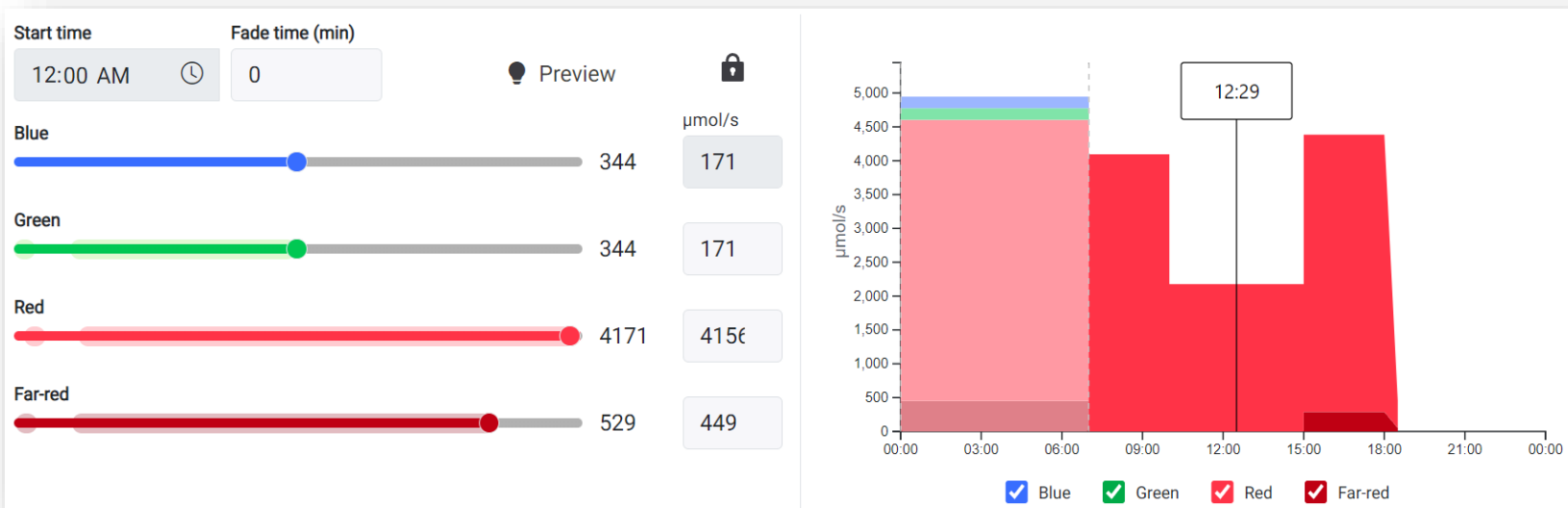
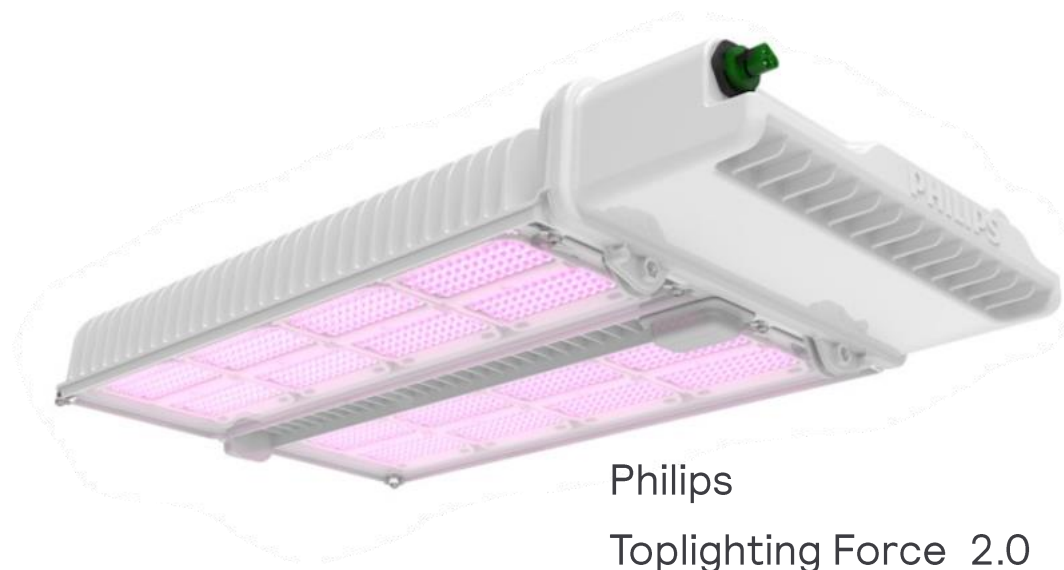
In general, Interlight-results in tomato are more promising compared to cucumber. Most likely due to better vertical light penetration on cucumber



Specific Interlight usecase in Canada:
- use Interlight only in minicucumber (80-140g)
- crossing between umbrella and highwire system
More information available on request

Steerable LED Spectra

1. Decreased energy consumption
2. Increased PAR sums
3. Crop steering
4. Crop choice



Wrap-up & Questions?

- 1) Higher efficacies offer appealing payback times for LEDs
- 2) Flexibility in Light & Heat – often more heat is needed
- 3) Activation of crop by ambient heat instead of radiant heat with LEDs
- 4) Different crops different Light recipes. Benefits with color controllable LEDs → energy savings and crop steering

Thank you!



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