CALCULATION SAMPLE

ACCELERATE YOUR ROI WITH WATER COOLED LED INDOORS

When planning a new growing facility, whether it be a greenhouse or an indoor facility, a significant part of the project costs (10% greenhouse and 20% indoor) is seized by the cost of cooling.

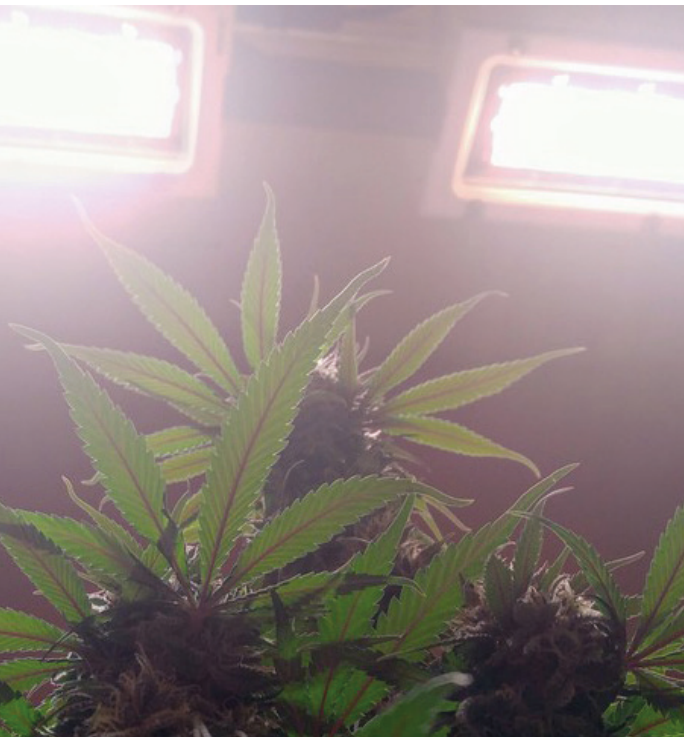
In an indoor facility, practically all of the heat caused by grow lights need to be removed. The maximum light intensity that can be used is often limited by the ability to get enough cool air to flow over the plants without disturbing or drying out the plants. This can be very challenging. Oreon's water cooled LED grow lights efficiently remove the heat of the fixtures from the grow room without disturbing the plants and offer an opportunity to save on HVAC running costs and initial investment.

Example:
An indoor growing facility wants to grow cannabis under a light level of 800 µmol/s/m^2. With a modern grow light of reasonable efficacy (3.3 µmol/J) this will require approximately 240W electrical power per m^2.

This 240W is divided in:
- 150W/m^2 of light
- 90W/m^2 is heat produced inside the fixture

Using an actively cooled LED solution with water the 90W/m^2 of heat generated inside the fixture is immediately removed from the room because of the water flow. An air cooled fixture, uses the ambient air to cool itself and therefor directly increases the temperature in the room. As a result, the 90W heat load stays in the room and need to be cooled by HVAC.

Beside the above-mentioned heat energy, it is important to realize that also the 150W/m^2 light energy will eventually convert into heat, either inside the plant through respiration, absorption, or absorption in the floor or walls. Therefor the heat load in the room will become:



Heat Load:
- Water cooled: 150W/m^2
- Air cooled: 150W/m^2 + 90W/ m^2 = 240W/ m^2

60% more heat load

The heat from the water cooled fixtures can be expelled to the outside air using dry coolers. These coolers consume approximately 0.5% - 1% of the electrical energy consumption of the fixtures itself. The result is that you save approximately 60% HVAC capacity. This saves money but also gives you more freedom in opti mizing light levels without overheating the plants.

On the next page we will give you an estimation of the reduction of cooling cost (both Capex and Opex) be cause of the water-cooling.

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Cooling Energy Costs:
The C.O.P. (Coefficient of Performance) of an air to air HVAC system is somewhere in the range of 3 to 4, for this example we assume 3.5. This means that for every 3.5 units of heat removed from the room, the HVAC will need 1 unit of electricity (and produce a total of 3.5 + 1 = 4.5 units of heat on the hot side). The water cooled system has less heat to be removed, but adds 1% of dry-cooler power.

Energy savings:
At an energy price of 0.1 USD/kWh, and 5000 lighting hours per year, the use of water-cooling will result in a total energy cost saving of: 0.0233*5,000*0.1 = 11.65 USD/m² per year.

Per fixture with a light output of 3350 µmol/s, this results in savings of 48.78 USD per fixture per year.

Investment savings:
Less heat in the room results in less HVAC capacity necessary. The investment cost per ton of refrigeration (T.O.R) is somewhere between 400 USD and 700 USD. For this example, we calculate with 500 USD/ton. A ton of refrigeration equals 3520W. So 1W of cooling equals 1/3520 = 0.000284 T.O.R.

Per fixture with a light output of 3350 µmol/s, this results in savings of 53.60 USD per fixture.

This gives:

• Water cooled:			
150W/m² divide by 3.5	=	42.9	W HVAC energy
	+	2.4	W dry cooler
• Air cooled:			
240W/m² divide by 3.5	=	68.6	W HVAC energy
• Savings:		23.3	W HVAC energy

• Water cooled:			
240W + 42.9W + 1.5W	=	285.3	W/m²
• Air cooled:			
240W + 68.6W	=	308.6	W/m²
• Savings:		23.3	W/m²
		0.0233	kW/m²

• Water cooled:			
150W = 0.0426 T.O.R/m²	=	21.33	USD/m²
• Air cooled:			
240W= 0.0682 T.O.R/m²	=	34.12	USD/m²
• Savings:		12.80	USD/m²

Total HVAC savings per fixture:
- **Capital Expenditures (Capex): $ 53.60**
- **Operating Expenditures (Opex): $ 48.78 / year**

Conclusion:
Installing a water cooled LED lighting system significantly saves HVAC cost. When comparing (quality equal) lighting solutions, you should always compare the total cost of ownership of each alternative to give you a financially solid foundation to make your decision. This means for each alternative:

- Investment in fixtures
- Investment in necessary HVAC
- Investment in water-cooling system (in case of water cooled fixtures)
- Running cost of the fixtures
- Running cost of the HVAC
- Running cost of the water-cooling

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