

Designers Light Forum

Horticulture LED Lighting Solutions

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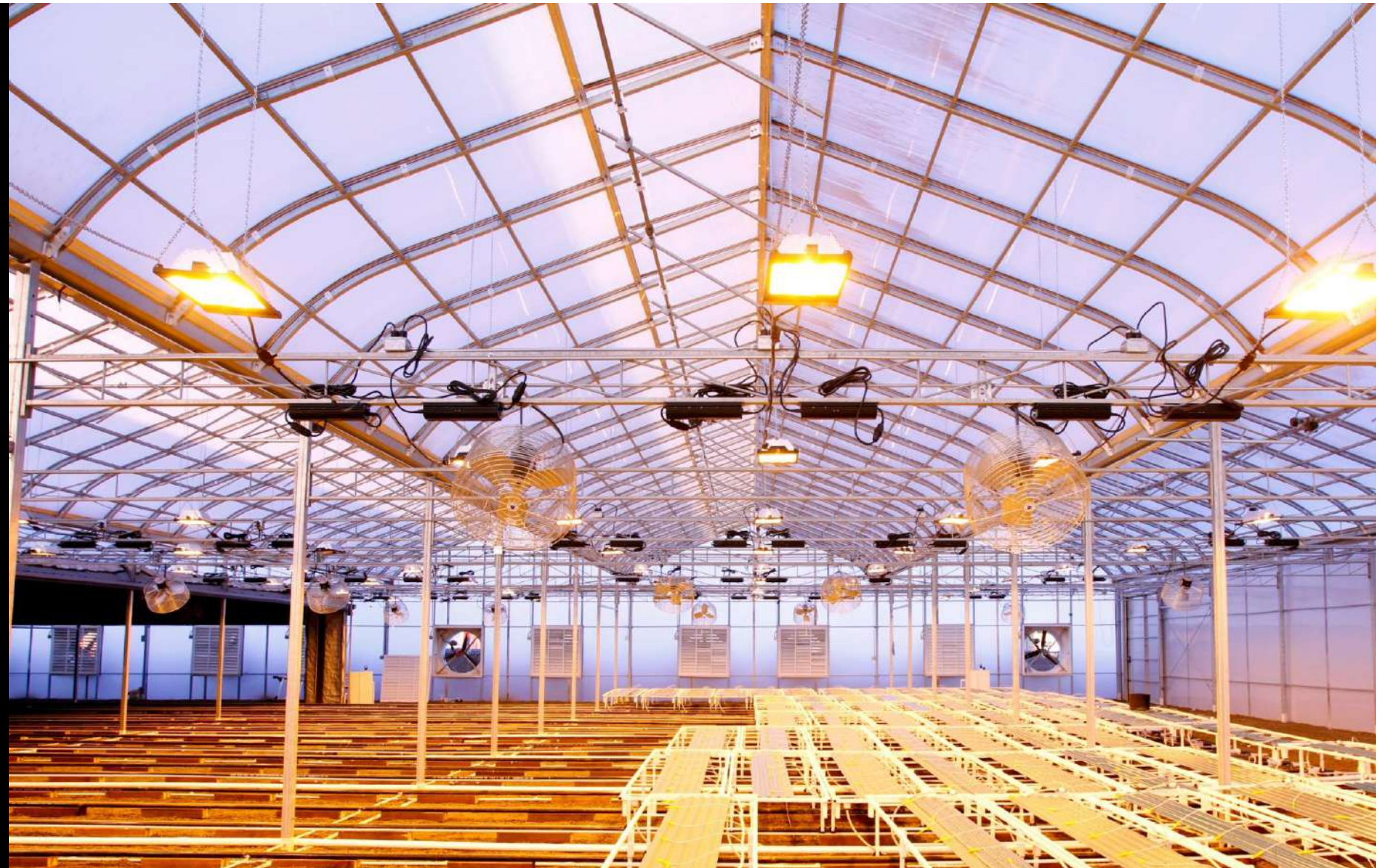
Learning Objectives

At the end of the this course, participants will:

- Discover how light is used in horticulture applications
- Learn about the pros and cons of various light sources used for horticulture
- Understand the different types of grow lighting fixtures
- Explore the potential markets for horticulture applications

Shedding
Light on
Horticulture
Lighting

Greg
Alaura
Growlite Product
Manager



Application Values

- Customer focus with world class customer support
- Unsurpassed quality and performance designed and built by lighting professionals
- Dedication to product innovation and validation in our UL certified lab
- Over 40 years of profitable growth
- Key grow markets:
 - Farming and agriculture
 - Horticulture
 - Legalized cannabis



Primary Goals of Indoor Horticulture

- Technology meets nature
 - Recreating the outdoor environment indoors
- Creating the optimal controlled environment
 - Light, Air, Water/Food
 - LIGHT = WEIGHT
- Produces greater yield, better quality in less time
- Reduces harvest fluctuations due to inclement weather
- 5 to 20 cycles per year depending on crop type and growing style



Measure Light for Plants

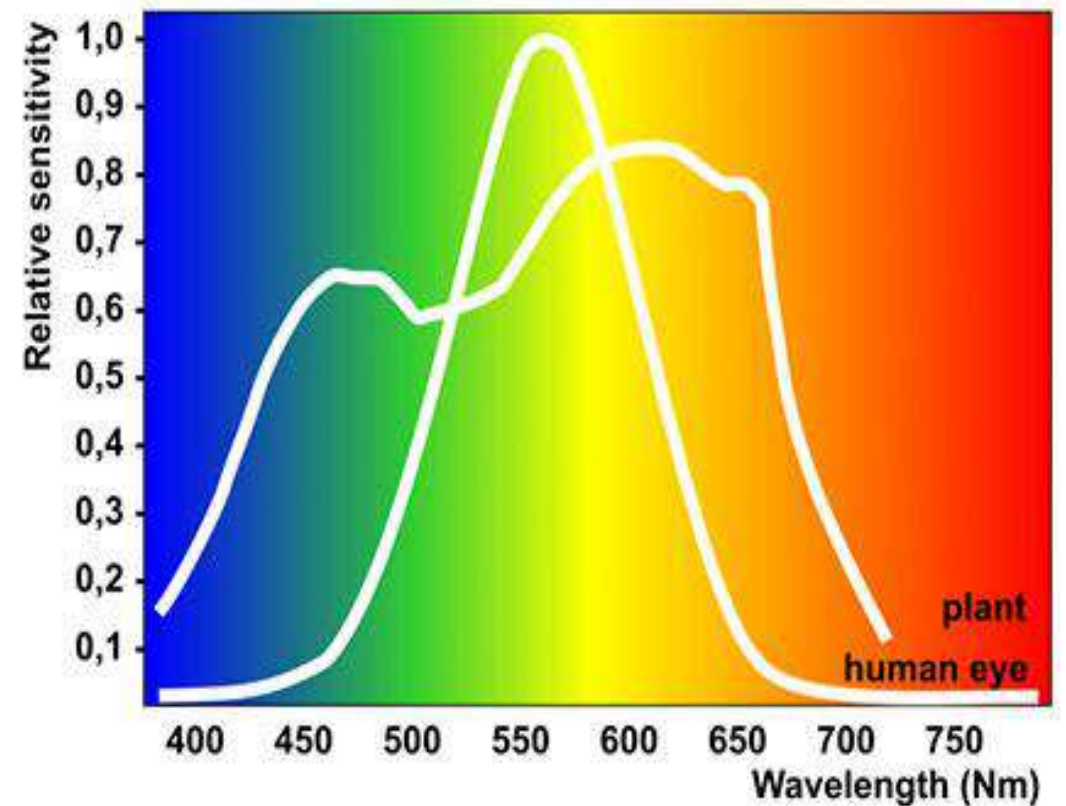
Lumens are for Humans, PAR is for Plants

- Photosynthetic Active Radiation (PAR) measures the range of light wavelengths needed for photosynthesis
- Range of 400-700 nanometers covers the visible light spectrum
- Plants obtain the most light energy from the red and blue portions of the spectrum
 - Greens and yellows are the least utilized
 - PAR value helps determine whether or not plants are receiving the correct light spectrum
- Different light sources have different ratios of PAR production
- Higher PAR values generally mean increased growth and healthier plants



Human Eye and Plant Responses To the Visible Light Spectrum

- The human eye is most sensitive to green light and perceives more shades of green than any other color in the spectrum
- Plants “see” the same visible wavelengths as the human eye
- The plant response curve developed McCree in 1972 shows the increased sensitivity to the blue and red portions of the spectrum



Conversion Chart

Lux/Fc to Umol, PPF, PAR Conversion Chart

Light Level in Lux or Footcandle		Lamp Source									Grow Application	
		CMH			HPS		MH		Fluorescent			
		Competitor 4200K	Competitor 3100K	Growlite CSI	Typical Competitor	Growlite Real Red	Typical Competitor	Growlite Tru Blue	Growlite Real Red 3000K	Typical Competitor 5000K		Growlite Tru Blue 6500K
lux	fc	umol	umol	umol	umol	umol	umol	umol	umol	umol		
108000	10000	1670	1840	1980	1310	1490	1520	1620	1300	1400	1810	
105300	9750	1629	1794	1931	1278	1453	1482	1580	1268	1365	1765	
102600	9500	1587	1748	1881	1245	1416	1444	1539	1235	1330	1720	
99900	9250	1545	1702	1832	1212	1379	1406	1499	1203	1295	1675	
97200	9000	1503	1656	1782	1179	1341	1368	1458	1170	1260	1629	
94500	8750	1462	1610	1733	1147	1304	1330	1418	1138	1225	1584	
91800	8500	1420	1564	1683	1114	1267	1292	1377	1105	1190	1539	
89100	8250	1378	1518	1634	1081	1230	1254	1337	1073	1155	1494	
86400	8000	1336	1472	1584	1048	1192	1216	1296	1040	1120	1448	
83700	7750	1295	1426	1535	1016	1155	1178	1256	1008	1085	1403	
81000	7500	1253	1380	1485	983	1118	1140	1215	975	1050	1358	
78300	7250	1211	1334	1436	950	1081	1102	1175	943	1015	1313	
75600	7000	1169	1288	1386	917	1043	1064	1134	910	980	1267	
72900	6750	1128	1242	1337	885	1006	1026	1094	878	945	1222	
70200	6500	1086	1196	1287	852	969	988	1053	845	910	1177	
67500	6250	1044	1150	1238	819	932	950	1013	813	875	1132	
64800	6000	1002	1104	1188	786	894	912	972	780	840	1086	
62100	5750	961	1058	1139	754	857	874	932	748	805	1041	
59400	5500	919	1012	1089	721	820	836	891	715	770	996	
56700	5250	877	966	1040	688	783	798	851	683	735	951	
54000	5000	835	920	990	655	745	760	810	650	700	905	
51300	4750	794	874	941	623	708	722	770	618	665	860	
48600	4500	752	828	891	590	671	684	729	585	630	815	
45900	4250	710	782	842	557	634	646	689	553	595	770	
43200	4000	668	736	792	524	596	608	648	520	560	724	
40500	3750	627	690	743	492	559	570	608	488	525	679	
37800	3500	585	644	693	459	522	532	567	455	490	634	
35100	3250	543	598	644	426	485	494	527	423	455	589	
32400	3000	501	552	594	393	447	456	486	390	420	543	
29700	2750	460	506	545	361	410	418	446	358	385	498	
27000	2500	418	460	495	328	373	380	405	325	350	453	
24300	2250	376	414	446	295	336	342	365	293	315	408	
21600	2000	334	368	396	262	298	304	324	260	280	362	
18900	1750	293	322	347	230	261	266	284	228	245	317	
16200	1500	251	276	297	197	224	228	243	195	210	272	
13500	1250	209	230	248	164	187	190	203	163	175	227	
10800	1000	167	184	198	131	149	152	162	130	140	181	
8100	750	126	138	149	99	112	114	122	98	105	136	
5400	500	84	92	99	66	75	76	81	65	70	91	
2700	250	42	46	50	33	38	38	41	33	35	46	
0	0	0	0	0	0	0	0	0	0	0	0	

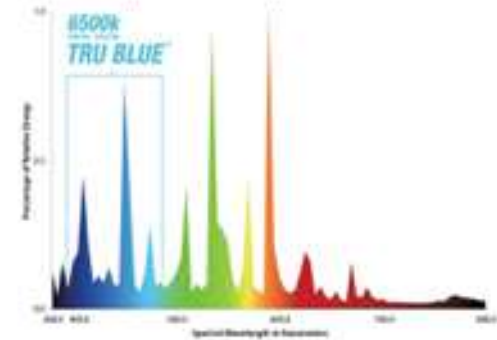
- Foot-candles and lux are used to measure the intensity of light in a given application but have had limited use in horticulture light measurements
- Different light sources have differing ratios of PAR to FC
- Full spectrum light sources generally have higher PAR ratios
- LEDs are not included due their absolute nature and unique chip arrangements

Lighting Sources

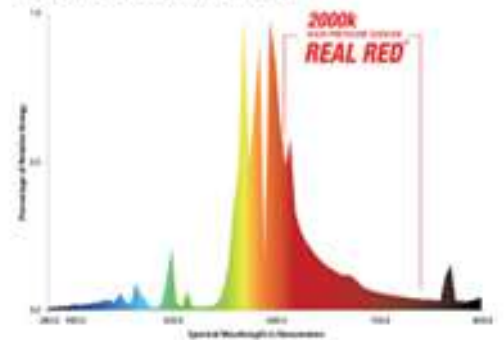
Metal Halide and High Pressure Sodium

- Metal Halide and High Pressure Sodium are still the standards in the indoor grow industry
- MH lamps are used for clones and vegetative cycles, heavy in the blue portion of the spectrum
- HPS lamps are used for flowering/fruitletting cycles, emphasis on the red portion
- Proven technology and results for the last three decades
- High energy use, but a properly designed HID fixture will provide the more usable light per watt than any other light source
- Ceramic Metal Halide is a new HID technology that provides full spectrum light for less wattage

Color Spectrum Graph



Color Spectrum Graph



Ceramic Metal Halide Full Spectrum Light Quality

- CMH full spectrum unlocks the true genetic potential of any crop
- Full spectrum light quality more closely replicates the sun's output vs any other light source on the market
- Lamps available in a standard single-end mogul base or double-end for use in both new and existing fixtures
- The electronic digital ballast will operate from 120-277VAC
- Active display shows voltage & wattage

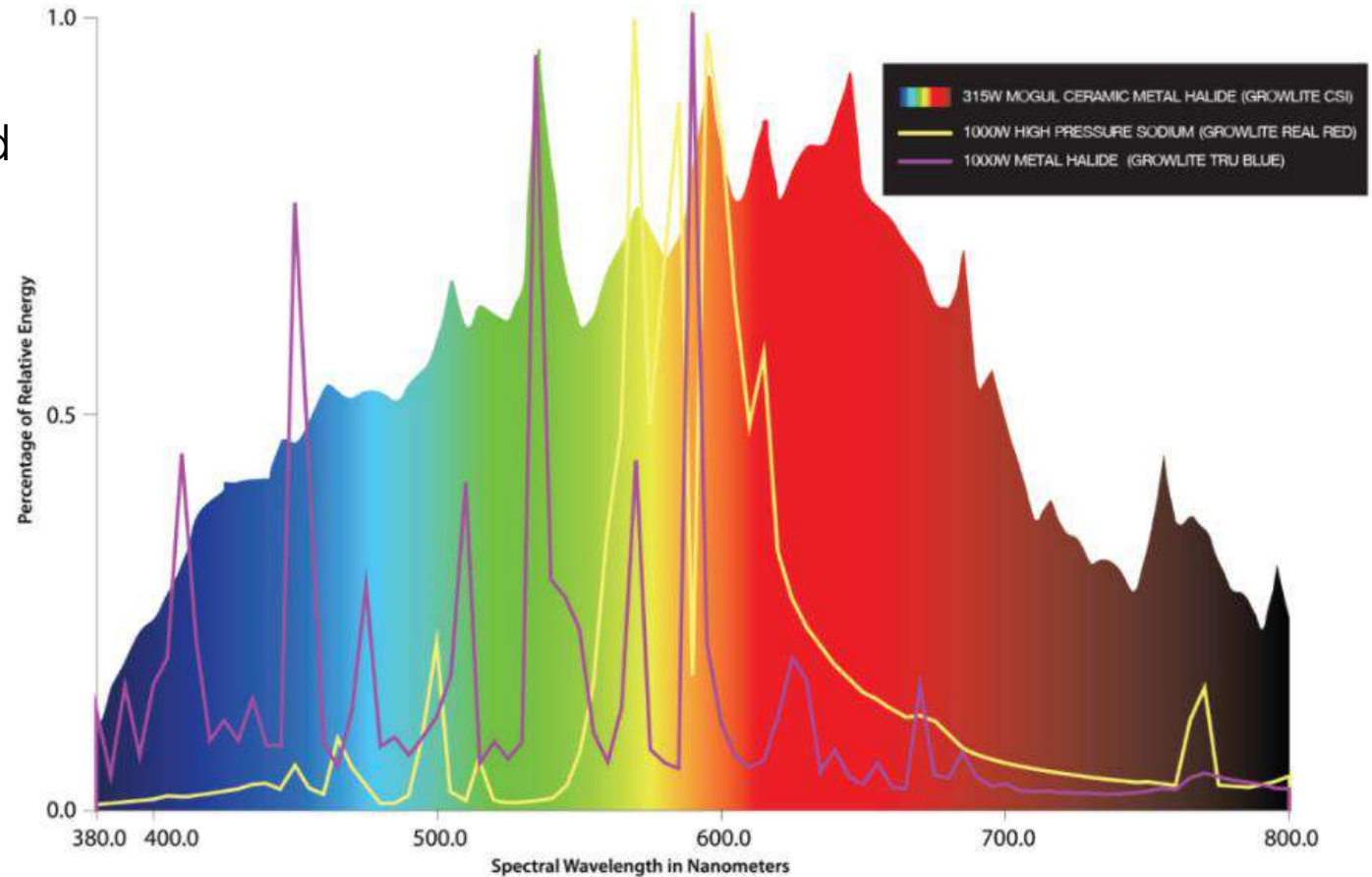


OPEN RATED
MOGUL CERAMIC METAL HALIDE
315
CERAMIC SPECTRUM INTEGRATION

HID Lamp Spectrums

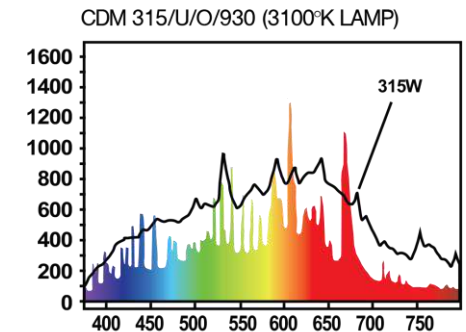
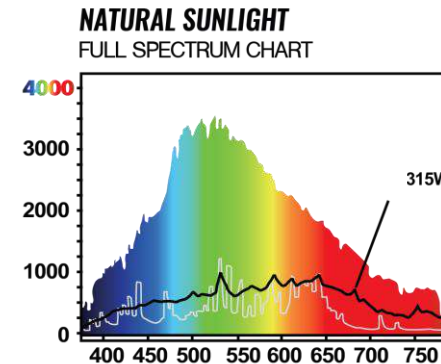
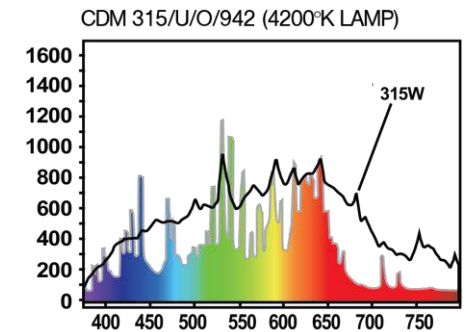
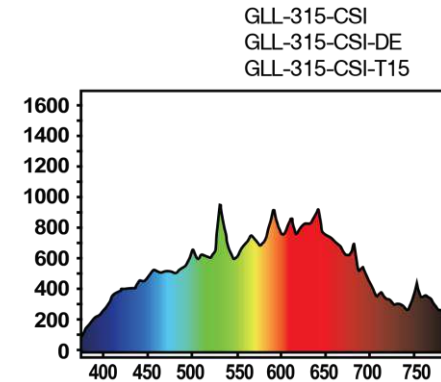
CMH vs HPS vs MH

An overlay of traditional MH and HPS spectral curves onto a CMH that has been optimized for horticultural applications shows how much more red and blue photon energy new HID technologies can provide



Know Your Full Spectrum Philips vs Growlite vs Natural Sunlight

A comparison of CMH designed for general lighting applications with a CMH optimized for horticulture, and natural sunlight shows the goal of the ideal light that we are trying to re-create for indoor grow facilities



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Lighting Sources

Induction and Fluorescent

- Fluorescent and Induction lighting use the same phosphor engineering to produce light
- Induction, also known as 'Electrode-less' fluorescent, has a superior life when compare to T5HO lamps
- Both light sources provide a much less intense light that is well suited for delicate clones
- Neither produce the intensities needed for flowering or fruiting without approaching the same wattages as HID
- In current practice, fluorescents are limited in use to the propagation and cloning applications and are rapidly being replaced by LED



Lighting Sources LED Lighting

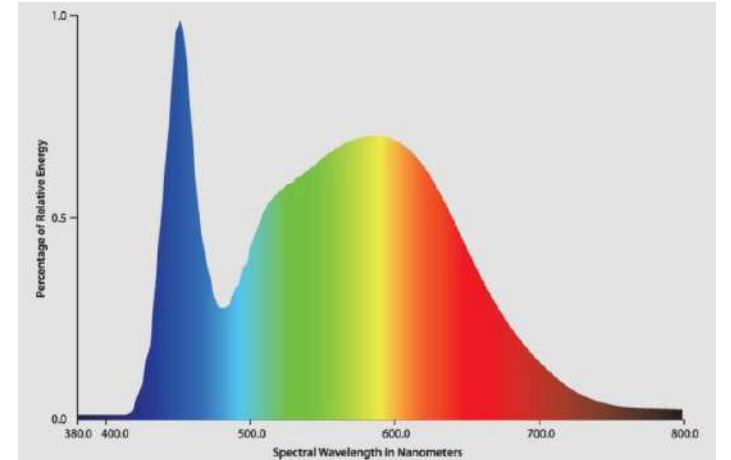
- Current LED grow lights are currently being effectively used for both indoor and greenhouse applications
- LEDs can produce precise “light recipes” that are more difficult to achieve with other light sources
- Viable solution for most grow applications
- LED fixtures produce less heat due to using less wattage
- A grower must reinvest in the entire LED system every five years emergency maintenance or repair is not possible
- The time to replace or repair a component or fixture can be disastrous for the crop
- LEDs require labor or other mechanisms to maintain proper distance to canopy



Lighting Sources

LED Lighting

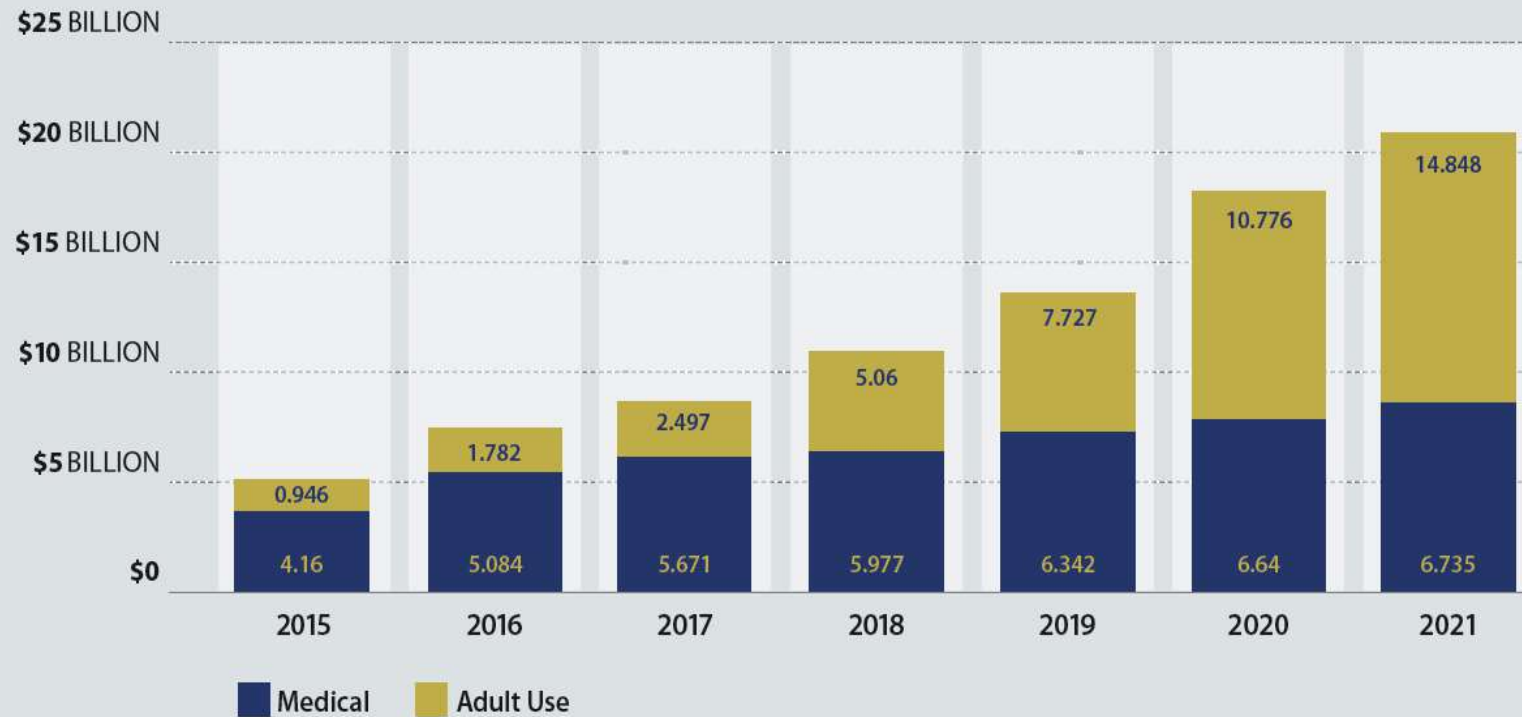
- Full spectrum LED grow lights for all growth phases
- Build grower's confidence in using LED in the appropriate stages of plant development
- High **blue spike** in the spectral output is perfect for clone racks and veg rooms, as well as leafy plant growth
- Light recipe optimized for vigorous root development, closely stacked internodes & strong , straight stems



Legal Cannabis Spending

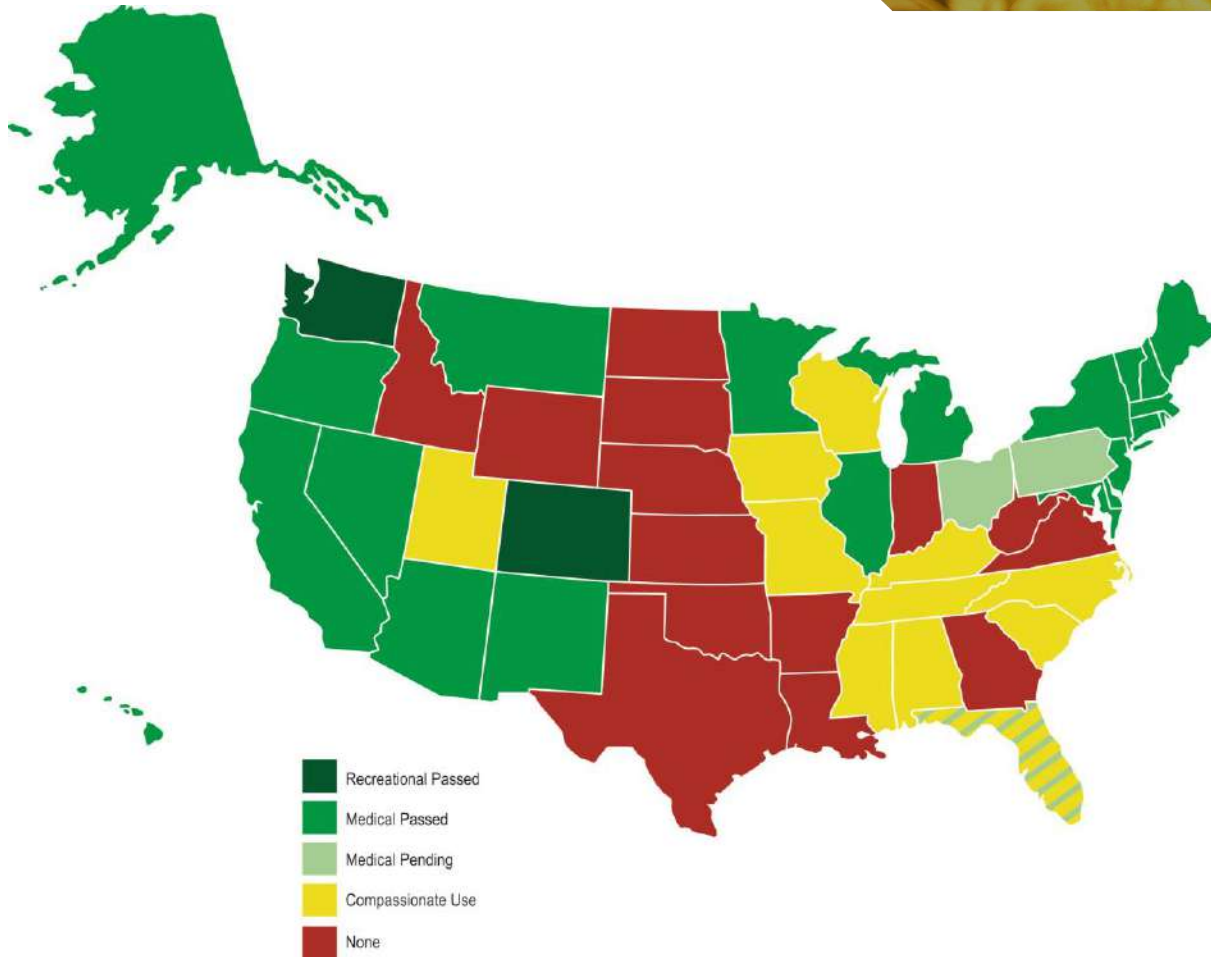
Watch This Market Grow

► North American Legal Cannabis Spending 2015-2021



Cannabis Legislation

State Laws on Usage and Sales



September 2014

Greenhouse Farming

Watch This Market Grow

2012
Census of
Agriculture

2017 Results due
Feb 2019



70% Sales Up
42% Facility Upgrades
Over \$1.24B in Sales

53,000 Acres
75,000 Greenhouse Farms



Double-ended
Open style fixture
Typical in
Greenhouses
Primary



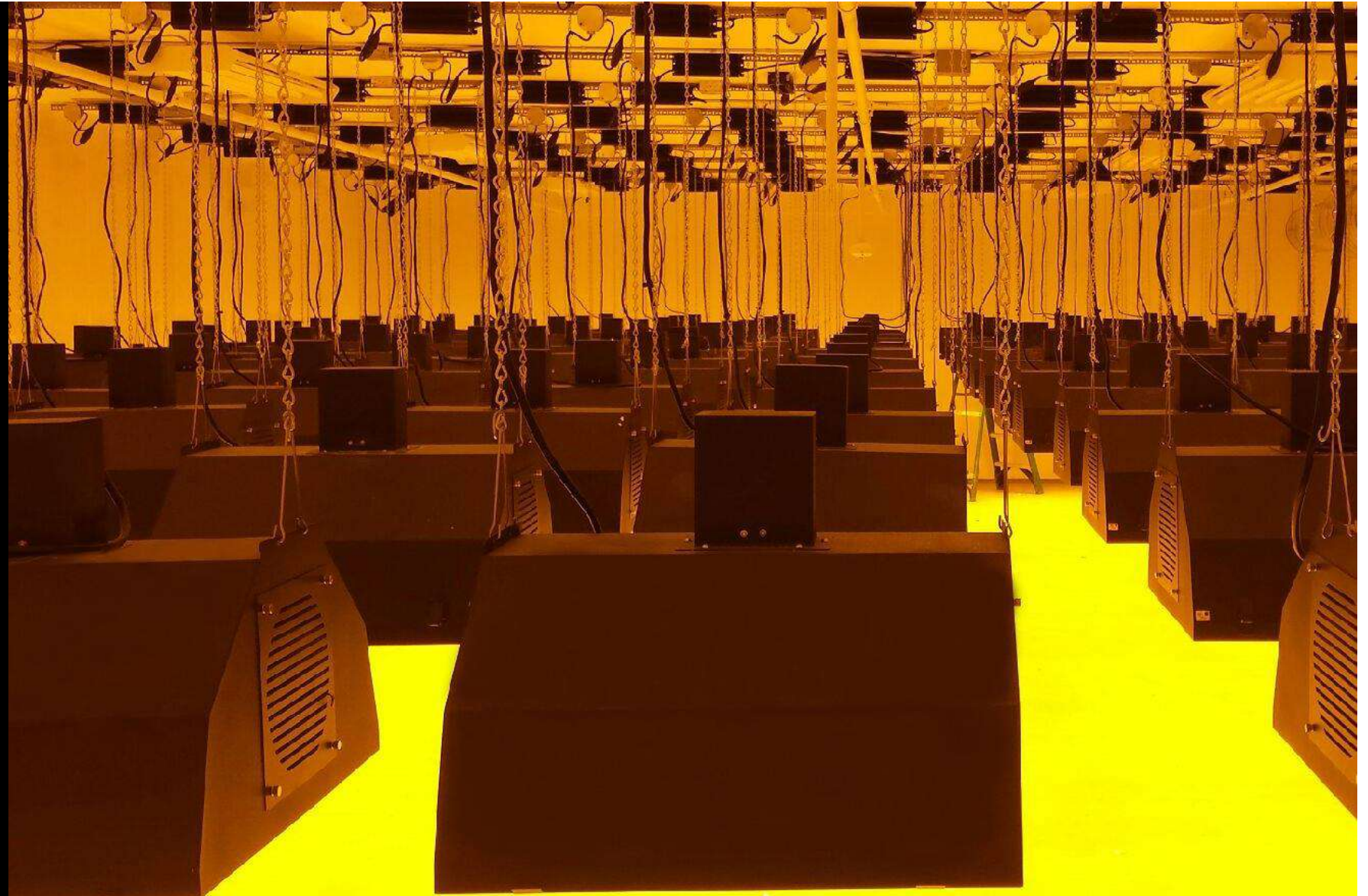


Single-ended
Open style fixture
Typical in
Greenhouses
Supplemental





Single-ended
Vented style
fixture Typical
in Indoor
Rooms



Professional Horticulture Controls

Customize Your Grow by Room

- Control each zone independently
- Consistent, repeatable results
- Integrate controls for lighting, HVAC, fertigation and security in one system
- Store and reuse recipes with a push of a button
- Identify and repeat successful runs; improve system management and operating protocols



This concludes The American Institute of Architects Continuing
Education Systems Course

