

The calculations are needed to calculate the size of fan required to change the air 20 times an hour. Users buy the fan slightly above the figure calculated to ensure adequate ventilation.

## **1.6.2 LED Lighting System**

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The LED Tri-Band grow lights (UFO 90W, 120W, 125W, 300W and 600W) only require half of the air flow that traditional Metal Halide and High Pressure Sodium lights require fans. All kinds of gardeners, retailers, and botanists can benefit from LED lighting:

## **1.7 Hydroponics**

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Hydroponics works when there is not even any soil at all. This application of hydroponics was used during World War II. Troops stationed on non arable islands in the Pacific were supplied with fresh produce grown in locally established hydroponic systems.

Later in the century, hydroponics was integrated into the space program. As NASA considered the practicalities of locating a society on another planet or the Earth's moon, hydroponics easily fit into their sustainability plans. This research is ongoing. But by the 1970s, it wasn't just scientists and analysts who were involved in hydroponics. Traditional farmers and eager hobbyists began to be attracted to the virtues of hydroponic growing.

A few of the positive aspects of hydroponics include:

- The ability to produce higher yields than traditional, soil-based agriculture.

- Allowing food to be grown and consumed in areas of the world that cannot support crops in the soil.
- Eliminating the need for massive pesticide use (considering most pests live in the soil), effectively making our air, water, soil, and food cleaner.

Commercial growers are flocking to hydroponics like never before. The ideals surrounding these growing techniques touch on subjects that most people care about, such as helping end world hunger and making the world cleaner. In addition to the extensive research that is going on, everyday people from all over the world have been building (or purchasing) their own systems to grow great-tasting, fresh food for their family and friends.

Educators are realizing the amazing applications that hydroponics can have in the classroom. And ambitious individuals are striving to make their dreams come true by making their living in their backyard greenhouse, selling their produce to local markets and restaurants.

**TABLE 1-9**

**LED PLANT GROWTH LIGHTING SYSTEM TARGET MARKETS**

- \* Home Hobbyists
- \* Nurseries
- \* Hydroponic Stores
- \* Researchers
- \* Florists
- \* Universities
- \* Commercial Greenhouses

LED Lighting has these tiny lights illuminate low power laptop screens. Energy efficient and scrolling displays on buses. LED traffic lights are red, yellow, and green. Lights are made from groups of small bulbs that illuminate together, resulting in a brighter, more visible traffic light and tremendous energy savings for cities.

Traditional, incandescent lights operate by heating a filament. This process generates unnecessary heat, consumes tremendous energy, and destroys the filaments in a small amount of time. By contrast, LED lights are based on diodes, which is a simple form of an electrical semiconductor. diodes create light by releasing photons in atoms.

**TABLE 1-10**

**LED DIODE-BASED LIGHTING ADVANTAGES:**

- \* Last longer than other forms of lighting
- \* Last longer than incandescent bulbs
- \* Use much less power to create illumination
- \* Are compact
- \* Fit in wrist-watches
- \* Fit onto flexible surfaces
- \* produce different spectrums of lighting
- \* Work for visible light applications
- \* Work for invisible light applications (e.g. electronics remote controls)

All of these advantages turn out to make them great for indoor gardens, as well. At USA LED Systems, highest quality LED grow lights incorporate specifically-chosen high-quality bulbs so they're optimal for plant growth.

# Plant Factory Grow Lights and Control Systems Market Shares and Forecasts

## 2.1 Plant Factories Market Driving Forces

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Visible natural light has a spectrum different from grow lights. Visible light is measured by lux or energy. Plant factory grow lights are different. Grow lights provide artificial light used for plant growth. The spectrum of growth lights is tuned to the plant growing task. Plant light has photons from the blue to red (400–700 nm) part of the spectrum. This is called growth light. Horticulture lamps address the role of light in the growth and development of plants. Plant growth is a function of photosynthesis.

The plant growth lights work in three different ways:

- \* To provide all the light a plant needs to grow
- \* To supplement sunlight, especially in winter months when daylight hours are short
- \* To increase the length of the "day" in order to trigger specific growth and flowering

Plant factories use growth light to automate and control growing. The ability to grow food consistently, locally represents a major breakthrough for humanity. Growth lights permit people to grow food in warehouses and in the home, dedicating unused space in a manner that is efficient for producing food.

Taking cost of transportation out of the food chain is a breakthrough of major propositions. The ability to make fresh, sanitary food available consistently presents a major shift in how people live and achieve quality of life. Growth lights increase the density of food production by a factor of ten. This is significant.

**TABLE 2-1**

**PLANT FACTORIES MARKET DRIVING FORCES**

- Demand for ability to grow food consistently
- Demand for ability to grow food locally
- Can grow food in warehouses
- Can grow food in the home
- Dedicating space that is efficient for producing food
- Fresh, sanitary food available consistently
- Food factories
- Ability to produce organic vegetables
- Ability to produce vegetables 24 hours a day
- Land available for farming depleting quickly
- New types of farming are evolving
- Growing of vegetables indoors all year round

Food factories produce organic vegetables. This represents a next step in the application of automated process to everyday life. Automated process for farming provides immediate help for food stores. Plant factories support farming practices that are not dependent on the climate. Food factories produce organic vegetables 24 hours a day. With the land available for farming depleting quickly, new types of farming are evolving. New farmland is depleting quickly.

A plant factory allows the growing of vegetables indoors all year round. It is a system that artificially creates the environment necessary for plants to grow by controlling the amount of culture solution, air, and light from light-emitting diodes (LED). Because the amount of light, temperature, humidity, and carbon dioxide (CO<sub>2</sub>) concentration levels can be optimized without being affected by the weather, the growth rate of vegetables is two to four times faster than those grown in open-air fields, and yields are ten to twenty times higher.

**TABLE 2-2  
PLANT FACTORIES MARKET POSITIONING**

- **Growth rate of vegetables is two to four times faster than those grown in open-air fields**
- **Yields are ten to twenty times higher**
- **Significant addition to automated process**
- **Major break through for humanity**
- **Leverage cheap energy from renewable sources**
- **Leverage solar energy and thin film batteries**
- **Take the cost of transportation out of the food chain**
- **Major shift in how people live and the quality of life**
- **Next step in the application of automated process to everyday life**
- **Automated process for farming provides immediate help for food stores that are depleting quickly**
- **Allow farming practices not dependent on climate**

**Source: WinterGreen Research, Inc.**