BioTherm

Heating Systems
Hydro Sciences
Optimized Air

2019 BROCHURE

1-800-GET-HEAT
www.BioThermSolutions.com

We are BioTherm

GREETINGS...

In 1980, we were teenagers working in a startup company with one innovative product, BioTherm Microclimate Heating. We had no idea that this would become our life's work, and that we would be presenting you with more and more solutions to enhance your growing business. That first invention was foundational to us as we have continued to work hard to create new products to serve you, to make your job of growing plants easier.

Our first product, BioTherm Microclimate Heating

It is now 2019, thirty-nine years have gone by in the blink of an eye! We are so enthusiastic to see the growth and diversification of horticulture. The industry is dynamic, with the advent of new crops being cultured and bright new people entering the space. We are delighted and proud to have a role in the burgeoning optimism that is horticulture today. Greenhouse growing is integral to the future, and BioTherm's products are an important part of successful operations.

We are proud of the products you'll find in this booklet, and we invite you to engage us in discussions about how they can help you in your operation. More importantly, we are singularly committed to your satisfaction and success with the solutions we provide. We are also very pleased to be partnering with the best greenhouse professionals in the game. We work hard to team up with the premiere greenhouse manufacturers and horticultural distributors around the world to deliver cleanly integrated solutions with your success in mind.

Inside, you'll find our greenhouse "Heating Systems," of course. We can deliver robust heating solutions in ways so flexible and efficient, there is no need to look any further. This year we are introducing our "Hydro Sciences" division to bring you integrated solutions for controlling irrigation water temperature as well as the exciting new Toob infusion systems for delivering stable dissolved oxygen levels for maximized production. Finally, our new "Optimized Air" division provides dehumidification, cooling, and engineered Co2 enrichment systems. All of these products can work independently or in combination.

The future of greenhouse production is brighter than ever, and our team is committed to bringing growers innovative solutions that work as hard as they do. For example, look for a new, redesigned, pre-assembled "Roll and Grow" heating mat to premiere in 2019!

Here's to your growing enterprise!

-Jim Rearden & Mike Muchow

BioTherm

BioTherm Heating Systems

Our greenhouse heating systems are tailored to each grower's specifications, and our innovative technology meets the needs of even the most demanding projects – whether new construction, major upgrades, or retrofits.

Dan Whittemore, BioTherm Engineer, at Pure Greens in Salida, Colorado.

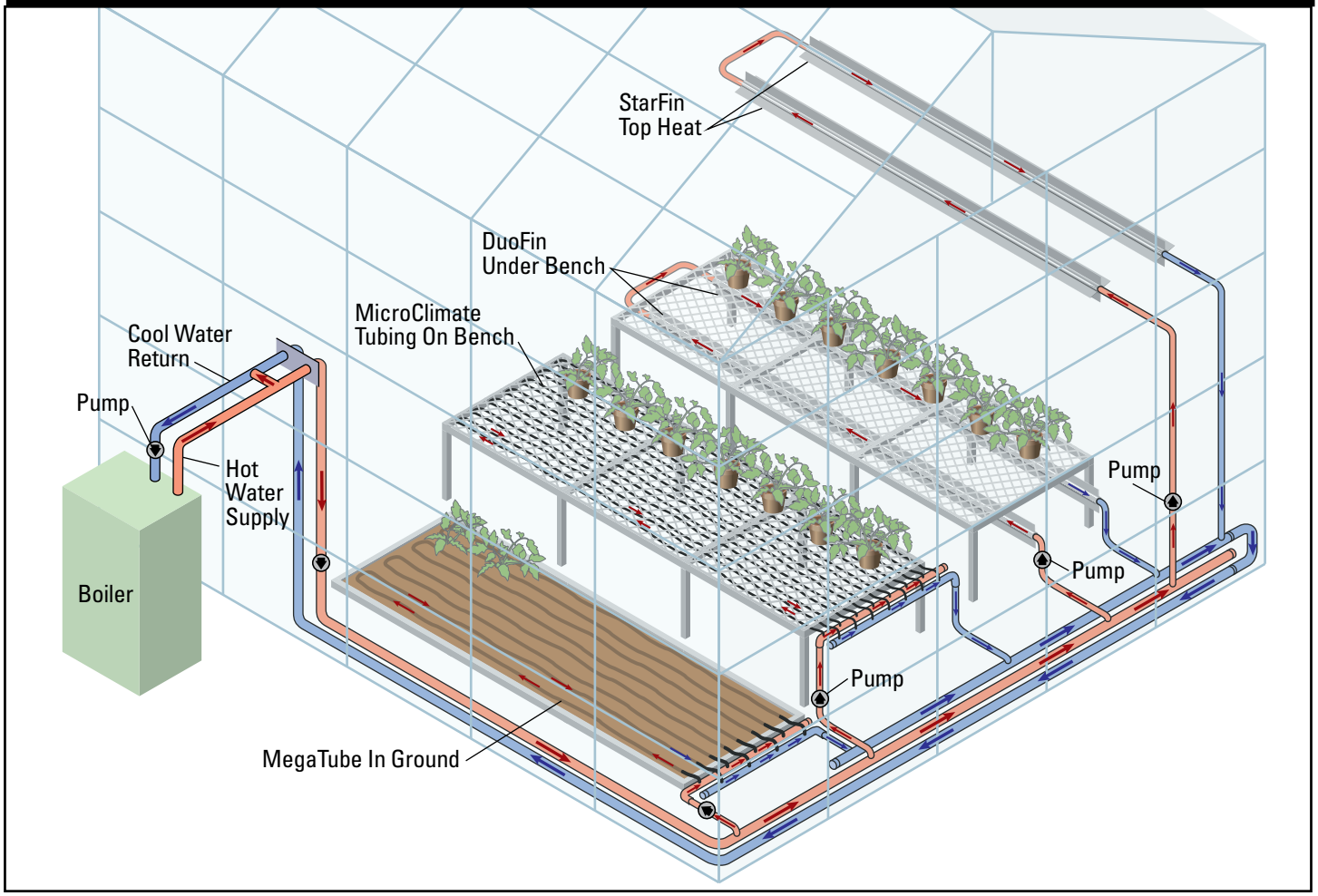
Jim, co-founder of BioTherm, poses with DuoFin, which distributes convective and radiant heat.

Roll-n-Grow 1.0. BioTherm's Roll-n-Grow 2.0 will be available for purchase in 2019! Great for any grower- commercial or recreational.

BioTherm HDX (high density extrusion) in-ground system provides an evenly heated surface for pots and flats.

BioTherm®

COMMON GREENHOUSE HEATING APPLICATIONS



BioTherm delivers high quality products with excellent sales and service which over the long term saves time and money.

BioTherm grows with you so you can plan for the future. With a cascading boiler system, Raypak condensing boilers may be added as you expand.

Our innovative energy-saving technology is designed to meet the individual needs of even the most demanding projects.

BioTherm is more than heating. We deliver the highest quality products with unparalleled service, saving you time and money.

Each system includes comprehensive instructions for installation and operation and custom CAD drawings. All heating systems include two years of free on-going support.

CASE STUDY: Patrick Herzing
Michael's Greenhouse, Cheshire, CT
Improving Turns and Planning for the Future

The Challenge

Michael's Greenhouse won a contract to grow bedding plants and hanging baskets for several big box stores. To accommodate the new business, they needed a way to turn more crops over each spring and expand the capacity of their growing operations.

The BioTherm Solution

BioTherm provided Michael's with a **MicroClimate Floor Heating System** on top of his native soil. Sandwiched between two pieces of fabric, it provided an evenly heated surface across the floor space. No slab was needed for the warm floor. His flats sit directly on top of the gently heated surface. With a BioTherm MicroClimate floor heating system, Patrick was able to shorten his grow time by 4-5 weeks.

For his hanging baskets, BioTherm provided a **DuoFin Top Heating System** that gently radiates heat around the plants, maintaining a consistent and even temperature.

To plan for the future, Michael's opted to have BioTherm design the boiler system to be easily expandable so they wouldn't have to re-do any infrastructure.

As Michael's expanded, so did the heating system. The BioTherm system was not only designed with larger pumps and increased pipe sizes, but with stub outs that left room for the addition of future boilers.

Patrick Herzing, General Manager

How It Works

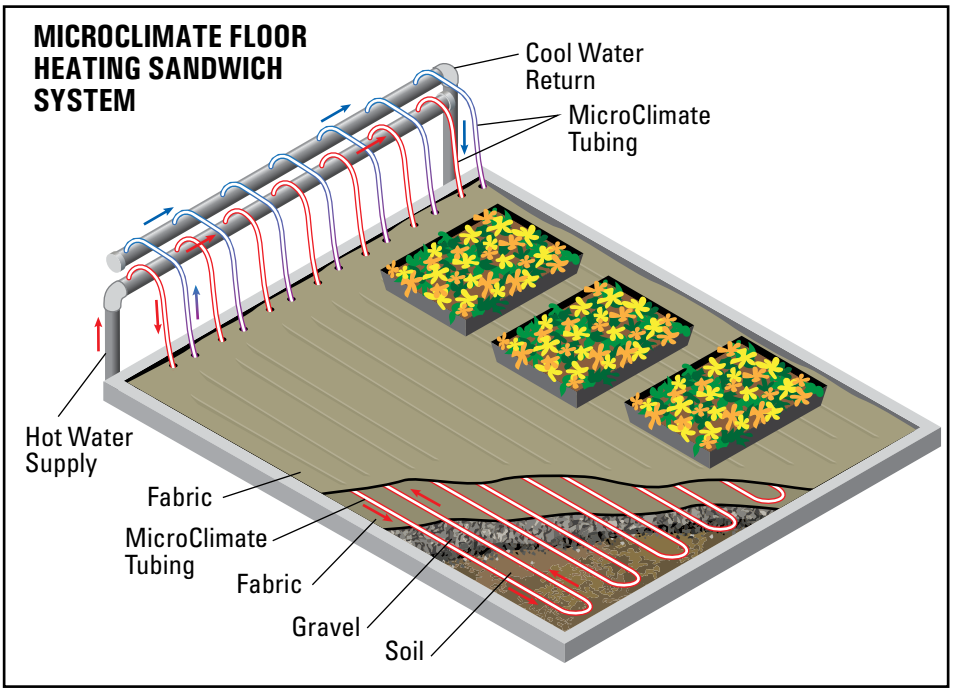
"With a completely heated floor surface, we were able to shorten our grow time by 4-5 weeks, increase production, and grow a more consistent and healthy crop," Patrick said.

Also, while maintaining a gentle and consistent heat for his hanging basket crop, the DuoFin Top Heat System did double duty as a snow melt system for his greenhouses.

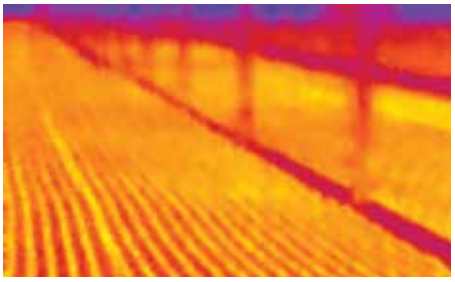
With the added benefit of high-efficiency boilers, Patrick was able to save money on fuel, adding to his bottom line. Because of the increase in energy savings, Michael's even qualified for a grant which helped pay for the boilers!

"BioTherm's DuoFin pipe provides more instant heat and reduces shade in the greenhouse. And with the BioTherm floor heat system my grow time has been cut 4-5 weeks."

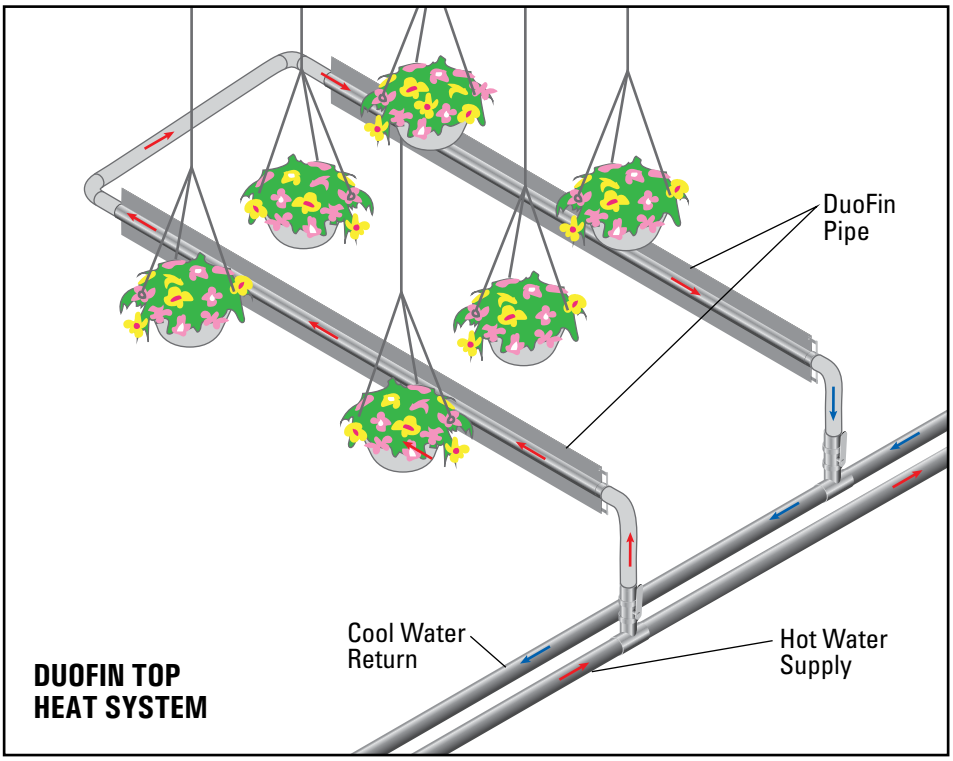
—Patrick Herzing, Michael's Greenhouse

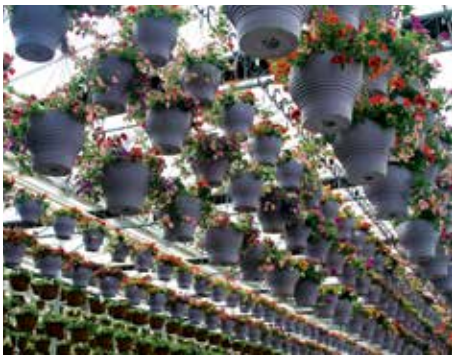


Michael's BioTherm MicroClimate heated floor during installation



Infrared image of Michael's heated floor.





Michael's hanging baskets.

CASE STUDY: Beth Tinsdale
Beth's Ornamentals, Tacoma, WA
Controlling Costs and Improving Consistency


Beth Tinsdale, Manager

The Challenge

Beth was tired of the changing cost of plugs she purchased for her 5,000 sq.ft. ornamental perennials operation. Further, she couldn't control the consistency of the product. She wanted to do her own plug propagation.

The BioTherm Solution

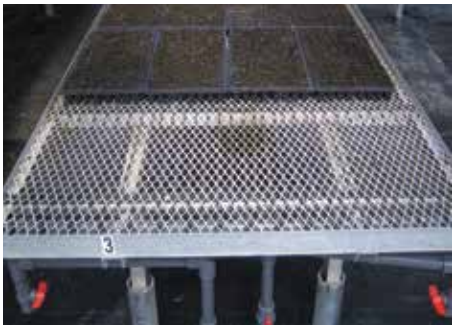
BioTherm provided Beth with an easy-to-install **Bench Warmer** kit that provides gentle and consistent heat for 950 sq.ft. of her metal-topped benches. The durable **MicroClimate Tubing** fit perfectly into the framing, underneath the metal tops, providing a smooth and accessible heated surface. The system is small enough that a traditional tanked hot water heater is a sufficient heat source. Beth is now able to propagate her own perennial starts and control the costs and consistency of her products.

How It Works

The innovative BioTherm **Bench Warmer** heating system delivers the perfect amount of heat energy right at the benchtop, where the plants grow. The tubing is evenly spaced to ensure even heating with no chance of striping, which is especially important for propagation.

"Since I began growing with BioTherm's Bench Warmer Kit, I now have consistent quality plug stock."

—Beth Tinsdale, Beth's Ornamentals



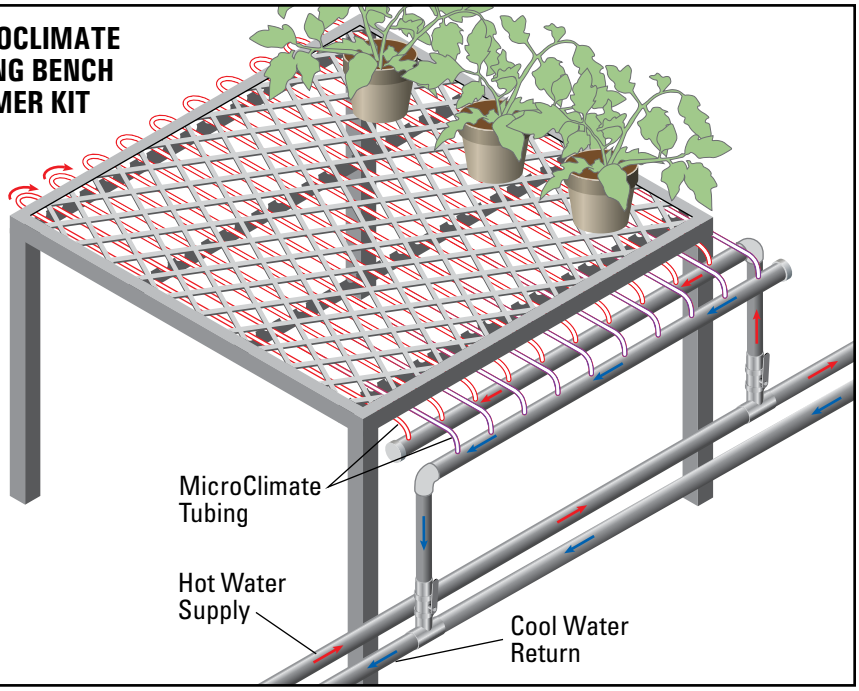
MicroClimate tubing fits perfectly under the expanded metal bench top.

MicroClimate tubing provides even and consistent heat for Beth's ornamental plugs.

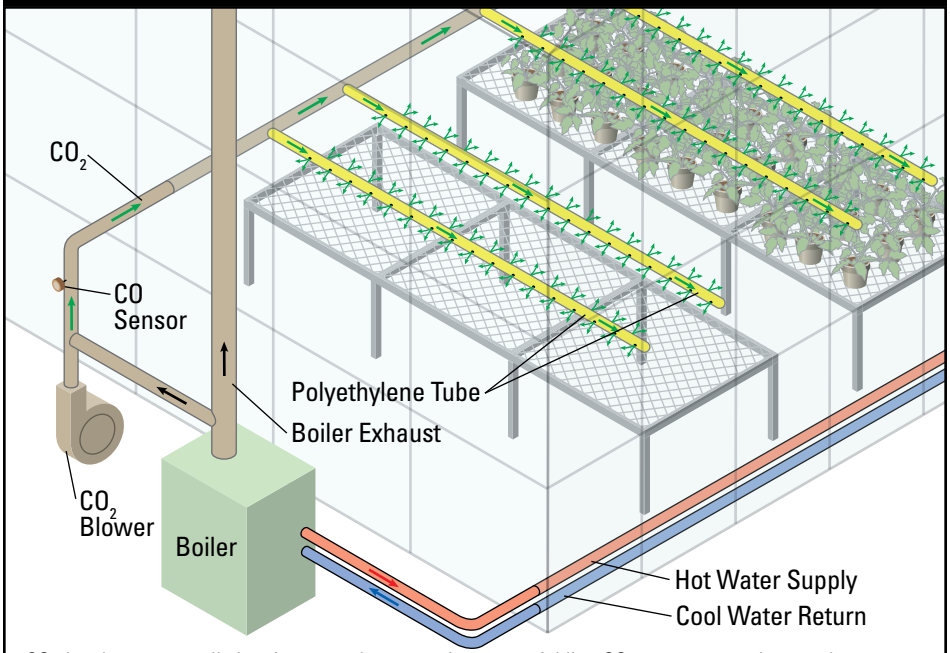
The MegaMicro Family of connectors make it easy to install tubing under a bench.

BioTherm CO2 system used for CO2 production in Fukashima, Japan

MICROCLIMATE TUBING BENCH WARMER KIT



BIOTHERM CO2 SYSTEM



CO_2 levels are naturally low in a greenhouse environment. Adding CO_2 encourages plants to better photosynthesize and promotes growth and health. With the right boiler system in place, a BioTherm CO_2 System can be easily added. CO_2 is pulled directly from the boilers exhaust gases and disbursed into the greenhouse, while ensuring other harmful gases are at a safe level.

CASE STUDY: Tiffany Allen
Best Taste Tomatoes, Windsor, CA
Improving Heating Costs and Plant Health

Tiffany Allen, Chief Horticulturist

The Challenge

Unit heaters were beating up Tiffany's crop and wasting fuel. They dried out leaves, caused uneven production, and reduced harvest—all with high fuel costs. She had read that a hot water system could deliver consistent and optimum media and canopy temperatures, saving fuel and producing more tomatoes.

The BioTherm Solution

BioTherm recommended a vertical **DuoFin Heating System** that could warm the media and provide gentle heat to the canopy. The DuoFin heat pipes were strategically located in and around the vines and the fruit, with vertical loops to bring steady gentle heat to the plant.

In addition, MegaTube was deployed around the root level to maintain consistently warm root and media temperature to encourage robust growth.

How It Works

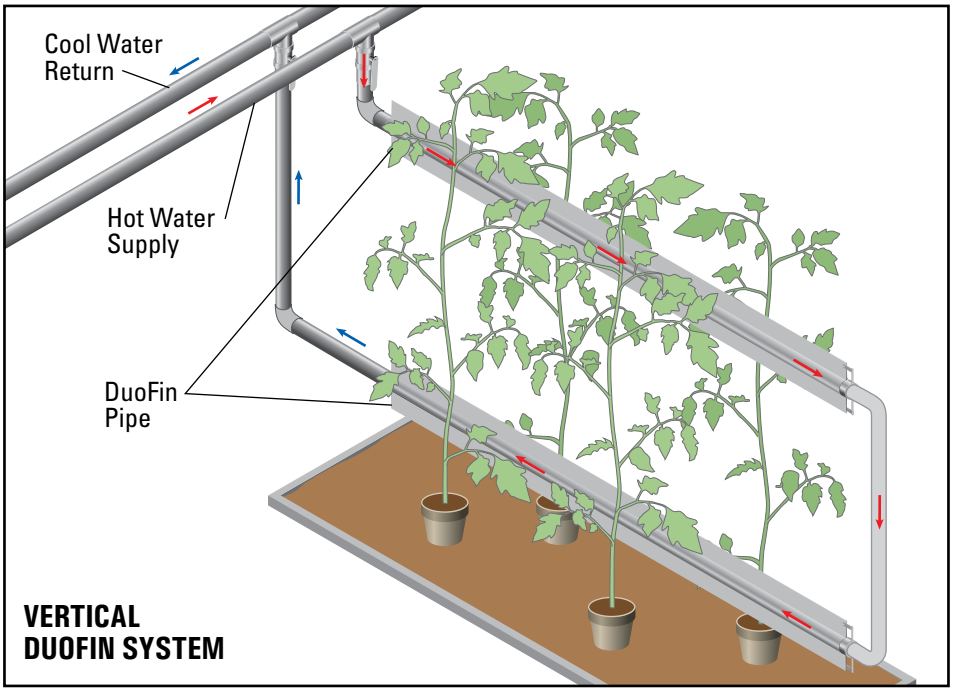
Consistent heat at the canopy and at the root media causes more branching, healthier foliage and less disease pressure. By warming the roots directly, the plant increases nutrient uptake, resulting in greater harvest and healthier fruit.

"BioTherm has helped me increase my harvest and produce healthier fruit."

—Tiffany Allen, Best Taste Tomatoes

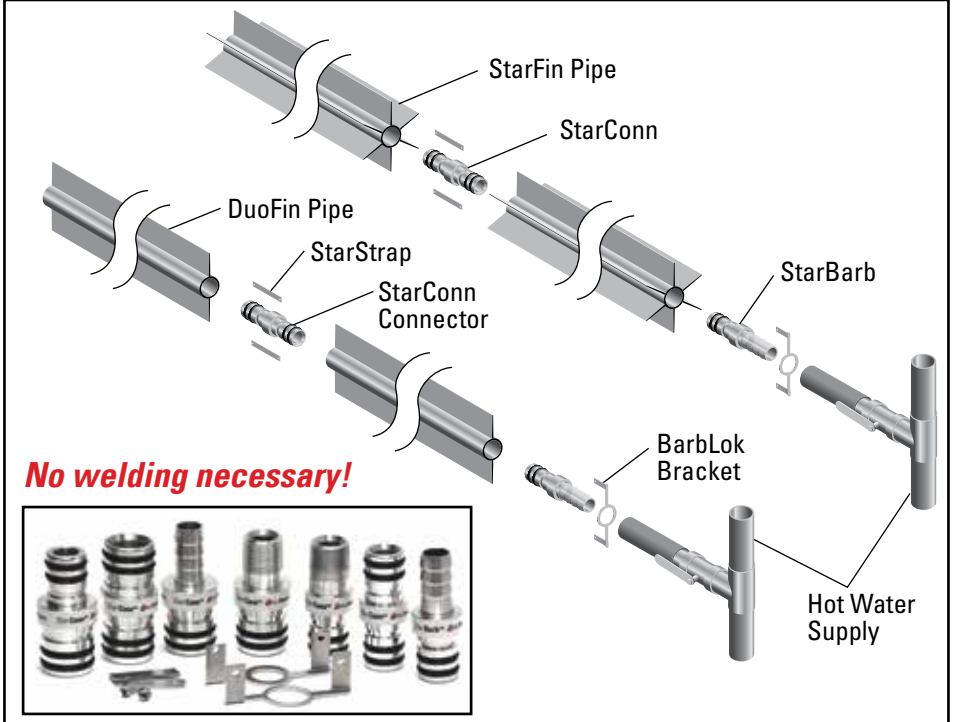
DuoFin heat pipe is strategically placed near the roots and in the canopy to provide gentle and stable heat.

MegaTube around the containers provide direct and consistent heat to the root zone.



VERTICAL DUOFIN SYSTEM

BIOTHERM STARFIN AND DUOFIN SYSTEM DETAIL



No welding necessary!

DuoFin and StarFin have a variety of easy to use, push-on connectors to meet every need.

CASE STUDY: Randy Strode
AgriStarts, Apopka, FL
Investing in the Future

Randy Strode, Owner

The Challenge

Business was almost going too well for Randy Strode and his son Ty of AgriStarts in Apopka, Florida. Product was in high demand and they knew they were going to need more plant volume while maintaining the already incredible quality and uniformity their customers had come to expect. Expansion was the answer. They choose BioTherm to design and install the heating system.

Agri-Starts may be a tissue culture-to-plug production business, but their needs are not much different from any demanding growing facility. If anything separates this type of production from that of a finishing greenhouse, it's that heat is even more important when used as a growing tool (and not just as cold weather protection). Taking the tissue culture from the lab, sticking it in soil media, and getting it to root without disease, and on time, requires precision heat.

The BioTherm Solution

BioTherm's finned heat pipe and low water volume not only mean high efficiency, but also quick responses to changes in soil temperatures, helping to maintain that all -important "flat line" result.

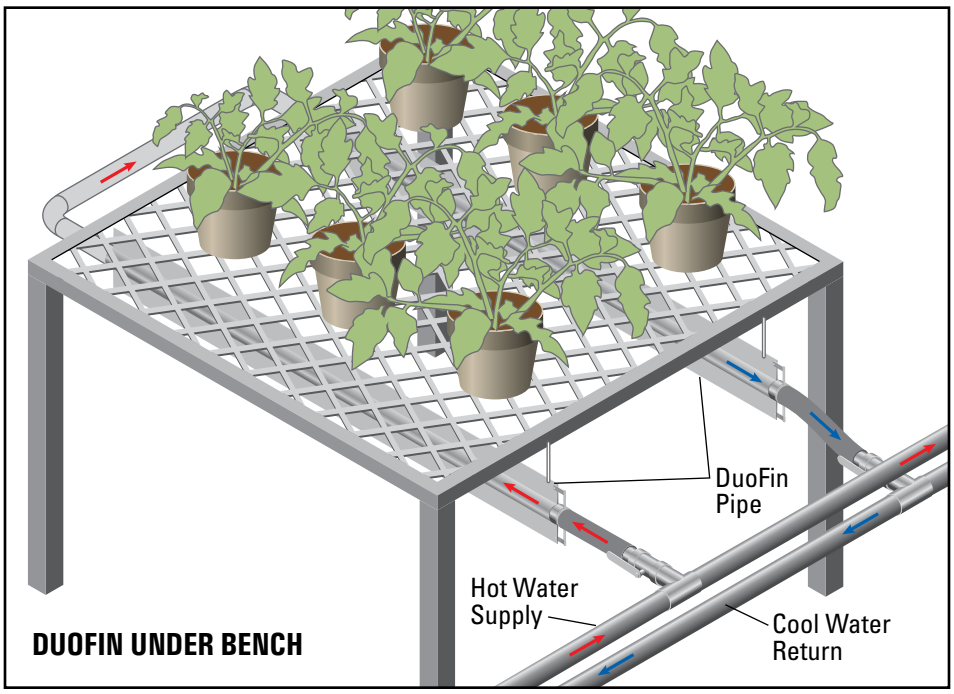
How It Works

BioTherm designed AgriStarts' boiler room with two fan-assisted, low mass boilers and the ability to expand the system to five total boilers when the next 50,000 square feet of greenhouse is built.

Good roots are king. The **DuoFin Under Bench** system that BioTherm installed pulls the roots of the baby plug down, strengthening them and creating the required turgidity—and most importantly doing all this when the grower wants it to happen.

"Quality, consistency and complete uniformity...these are not wants or wishes, but do-or-dies for our business."

—Randy Strode, AgriStarts



BioTherm DuoFin heat pipe provides an even and uniform heat, perfect for mobile benches.

THE BIOTHERM BOILER SYSTEM – EXCLUSIVE PROVIDER OF RAYPAK PRODUCTS TO THE CEA INDUSTRY

The **BioTherm Boiler Systems** run the gamut from tiny to large. All offer huge efficiency advantages and expandability. What's more, BioTherm designs each system individually tailored for you - the commercial greenhouse operator.

We consider these important questions every time we work on a design:

- Is this a retrofit or a new construction?
- What is the current heat load?
- What is the possibility of expansion in the future?
- Do other loads need to be considered? Irrigation pre-heating? Germination chambers? Floor heating for your head house?

Raypak® A Rheem® Company

CASE STUDY: Bill Noak
Nor'Eastern Farms, Lowell, MA
Upgrading for Success


Bill Noak, Manager

The Challenge

Nor'Eastern Farms had an old oil fired steam boiler connected to leaky and rusted steel pipes under the mobile benches they used to heat their potted plant crop. They struggled to keep temperature and maintain the equipment, and constantly worried the system would shut down, leaving their plants in the cold—all while paying high fuel bills. Bill, the facilities manager, was fed up and knew they needed an upgrade. He had heard about BioTherm from another greenhouse owner and told his boss to call **1-800-GET-HEAT.**

The BioTherm Solution

Keeping in mind time and budget, BioTherm provided Nor'Eastern with a plan to retrofit their greenhouse with a **StarFin Under Bench System** and a **SunFin Snowmelt System** around the perimeter and gutters.

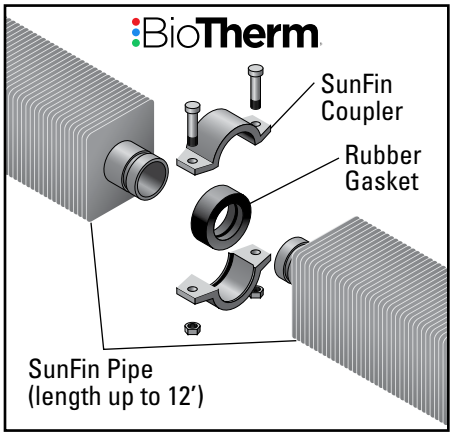
Nor'Eastern also recently got natural gas in the area, so BioTherm provided them with multiple quiet and highly efficient condensing Raypak boilers to replace their inefficient and clunky steam boilers.

How It Works

The **StarFin** aluminum finned pipe uses push connections that make it easy to replace the old rusty steel pipes. It also puts out twice the heat per linear foot, so less pipe was needed. The system provides precise gentle heating to the crop's root zone.

The high heat output of **SunFin** under the gutters made for a perfect snow melt system that is quick and responsive during a snow event.

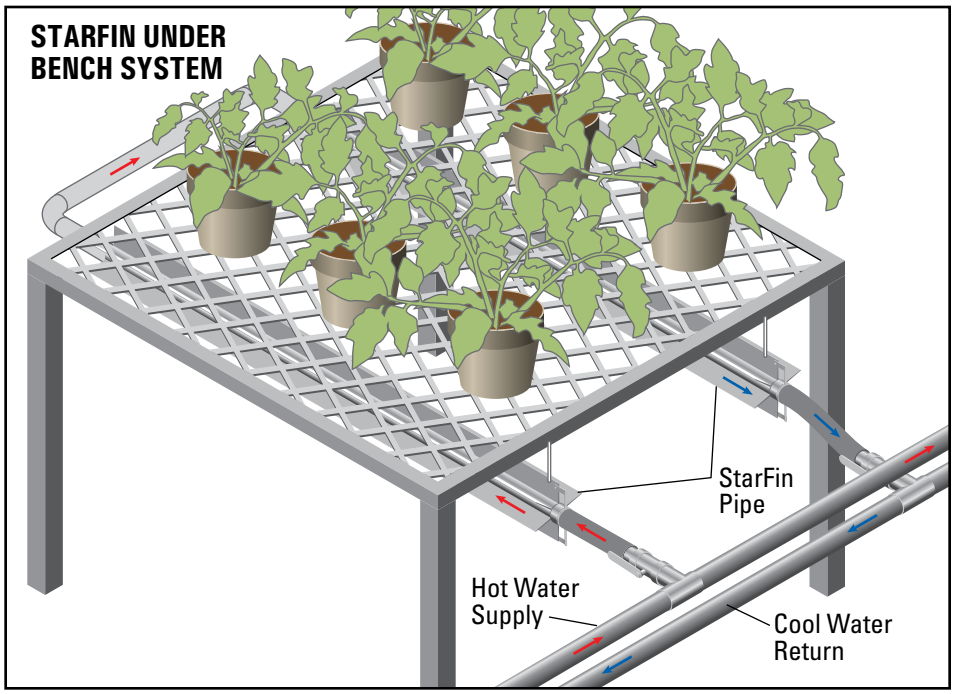
The multiple condensing boiler system is designed to use latent heat from the flue gases, greatly increasing the efficiency of the system while providing redundancy. It allows Nor'Eastern a worry-free heating system without outrageous heating costs.

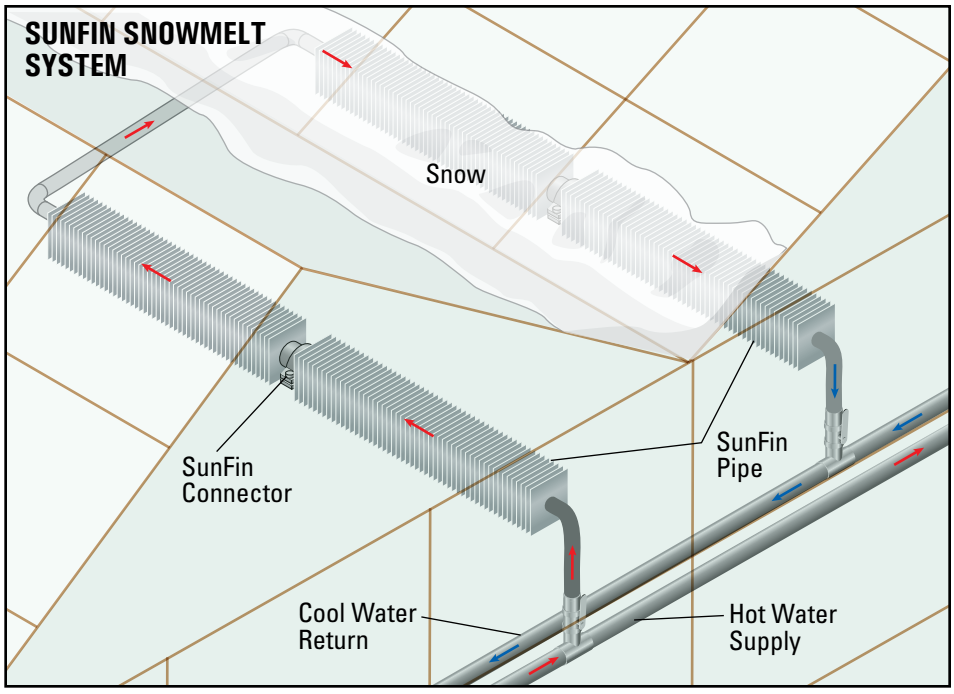


SunFin Pipe sections securely connect to each other with a rubber gasket and clamp.

"With the use of Raypak condensing boilers and BioTherm's high heat output finned pipe, I can maintain steady soil temperatures for my potted plants and protect the greenhouse from heavy snow dams. All while cutting my fuels bills in half!"

—Bill Noak, Nor'Eastern Farms





StarFin Pipe sections are easily connected to each other with a push-on StarConn Connector. (See page 10 for details).

SunFin snow melt system.

SunFin perimeter system in protective cover.

StarFin under-bench system.

High-efficiency Raypak boilers (up to 95%).

CASE STUDY: Manfred Orozco
Manfred and Son's Greenhouse, Annapolis, MD
Improving Health and Yields

BioTherm MicroClimate Tubing
In-Bench System

The Challenge

Looking over his mounting fuel bills, Manfred Orozco was frustrated year after year by all the heat trapped at the top of his greenhouse while his plants were on rolling benches near the floor. He had problems with stunted roots, uneven growth, and cold spots.

The BioTherm Solution

Manfred called 1-800-GET-HEAT and his BioTherm consultant recommended a BioTherm 2.0 in-bench heating system. The BioTherm rep explained how BioTherm 2.0 could be run between the frame and the surface of his rolling benches, to maximize his fuel dollars and even out his heat.

How It Works

By placing heat exactly where it is needed, at the root zone, Manfred's greenhouse uses a 1/3 less of the fuel, saving them over 30% on their bill. They can now use this money on other projects in the greenhouse. Because he was able to set an optimum root zone temperature, his plants are robust and healthy, have less disease, all with quicker turns and better profits. The greenhouse no longer has cold spots, and Manfred has a healthier and more consistent cannabis crop.

The BioTherm 2.0 Heating System is a network of high performance and durable tubing, evenly spaced, and installed within the rolling benchtop. This system is designed to be affordable, tough, and proven to last years with minimal maintenance.

The tubes are connected to special manifolds that balance the flow of warm water produced by a Raypak highly efficient condensing boiler system.

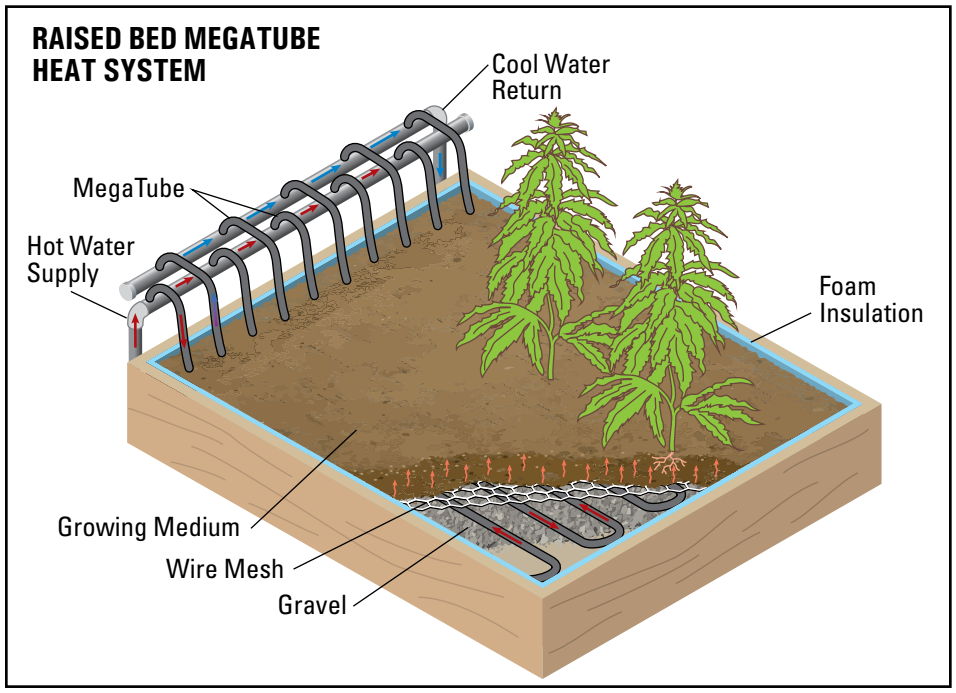
BioTherm shipped all technical components pre-assembled for easy installation. Because BioTherm supplied clear instructions and technical drawings, Manfred's crew had no problems installing the BioTherm 2.0 heating system. He also felt comfortable because an experienced technician was just a phone call away.

"With my BioTherm Bed Heating System, I have grown my most consistent and highest quality crop."

—Manfred Orozco, Manfred and Son's Greenhouse

BioTherm Raised Bed MegaTube Heat System results in rapid growth, healthy plants...

...and bigger profits.

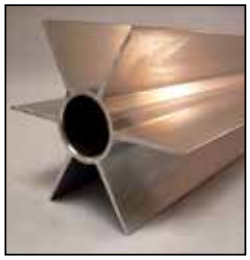


MegaTube loops and supply pipes exposed near the surface of a raised bed.

BioTherm

Signature Products

BioTherm products are designed to provide efficient heating.



StarFin™

BioTherm StarFin heating systems use minimal water to emit maximum heat. Six tapered fins extend from a central pipe, creating a large surface area that radiates heat evenly.

DuoFin™ and DuoFin LT™

BioTherm DuoFin heating systems involve pipes with two fins, which distribute convective and radiant heat. This system is often installed under benches with the fins aligned vertically, so debris does not collect on the pipes.

SunFin™

SunFin is BioTherm's heat output finned pipe, designed with maximum surface area to deliver heat from the boiler into your growing environment.

HDX™

BioTherm HDX (High Density Extrusion) systems involve durable polyethylene tubing made of ultra-high molecular weight resin. These rugged tubes meet stringent ASTM standards.

MegaTube Systems™

BioTherm MegaTube systems use flexible EPDM rubber tubing that provides heat directly to the root zone in all types of installations.

MicroClimate Systems™

BioTherm MicroClimate systems use flexible EPDM rubber tubing (slightly smaller than MegaTube), which allows for tighter spacing, more loops, and uniform conductive heat.

BioTherm Hydro Sciences

BioTherm Hydro Sciences has one simple focus... To enhance your irrigation system and boost plant growth using cutting edge technologies with efficiency in mind. Our products are proven to increase yields, improve plant vigor, and increase resistance to diseases and pests.

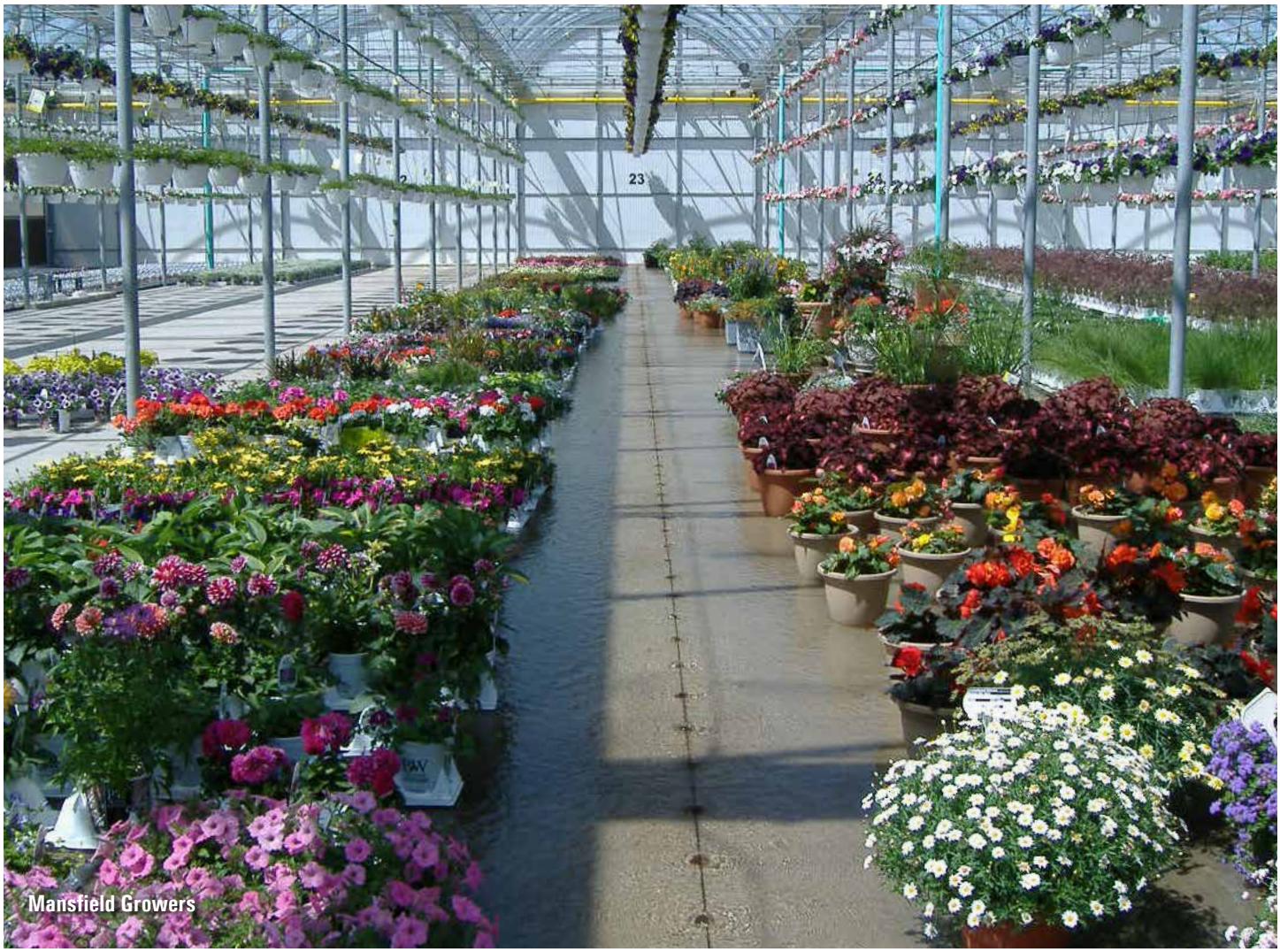
BioTherm Flood Floor irrigation systems are a great way to save water, conserve energy, and reduce fertilizer waste and eliminate labor costs by up to 95%.

Cascade Floors create a thin sheet of water that flows evenly down a slope, uniformly distributing moisture.

Russ Johnson at Red Oak with his BioTherm Flood Floor system.

BioTherm's newest product, the Toob, which promotes higher Dissolved Oxygen levels in irrigation water. Measure DO easily with the Hanna DO Meter.

CASE STUDY: Mansfield Growers
Mansfield, OH
Reducing Labor Costs and Water Conservation



Mansfield Growers

The Challenge

Davis won two new contracts to expand the reach of his regional greenhouse facility, but he knew he would have to expand his production as well. In order to control labor costs, while simultaneously increasing the square footage of his growing area without sacrificing quality, David decided to build a new **Flood Floor** equipped greenhouse.

The BioTherm Solution

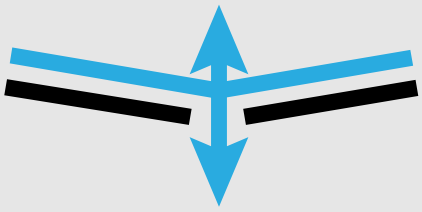
BioTherm installed a fill and drain system to work in tandem with an engineered concrete floor. The system is designed with precision in mind, providing greater control of nutrient uptake, watering time and preventing over-watering. With up to a 95% reduction in labor costs, a flood floor equipped greenhouse can be operated by just one technician spanning multiple acres.

How It Works

BioTherm uses a number of pumps in tandem with fill/drain valves to uniformly irrigate the shallow pan of the greenhouse flood-floor in five or six-minute cycles. Recycling the irrigation water prevents the waste of expensive nutrients and also conserves water.

Since 1998, BioTherm has been at the forefront of subirrigation systems.

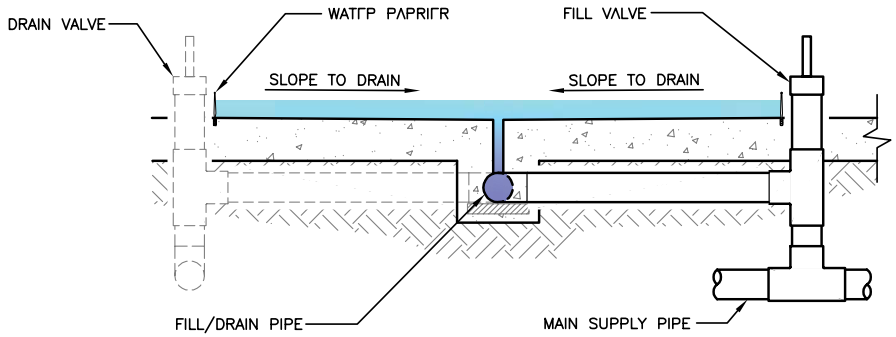
Flood Floor



Cross Section: "V" or "W" Pattern.
Flow Pattern: Common fill and drain pipe located along floor valleys.
Watering Cycle: Floor fills, floor drains then water is available for use in next zone.
Cycle Time: 6-10 minutes (min.)
Material: Precision installed structural concrete.
Containment: Flexible rubber barrier surrounding floor perimeter which allows for ample employee and cart access.


Flood Floor

FLOOD FLOOR CROSS SECTION



	Ebb-and-Flood vs.	Watering from Above
WATER APPLIED	To bottom of container	To top of potting media
WATER UP TAKE	By capillary action	By percolation
WATER MOVEMENT	Up only	Down first, up after watering
LEACHING	None, may lead to salt accumulation when over fertilizing	Excess water leaches. Wasteful, but can be used to manage salt content
DISEASE TRANSFER THROUGH WATERING	Possible, but rare	Through splash

CASE STUDY: Marvin Fessler
Fessler's Nursery, Woodburn, OR
Irrigation Efficiency and Reduced Labor

Fessler Nursery

The Challenge

Fessler's Nursery wanted to expand their production space to meet their ever-growing market demand. However, they also needed to provide the highest quality product, with the lowest labor cost, all the while maintaining their earth-friendly business practices.

The BioTherm Solution

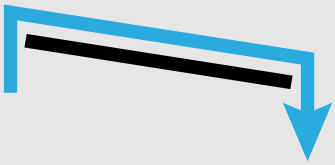
BioTherm **Cascade Floors** are the most efficient method of sub-irrigation. Water is pumped to individual irrigation zones, where a thin skim of water evenly irrigates every plant as it flows from the fill side to the drain side of the zone.

How It Works

Cascade Floors use a unidirectional slope which allows gravity to drain the system. Because the system fills and drains simultaneously, water is available for same cycle use. These design features allow for a faster irrigation cycle with less energy expended for pumping. Reduced labor and water conservation are additional benefits of a BioTherm **Cascade Floor.**

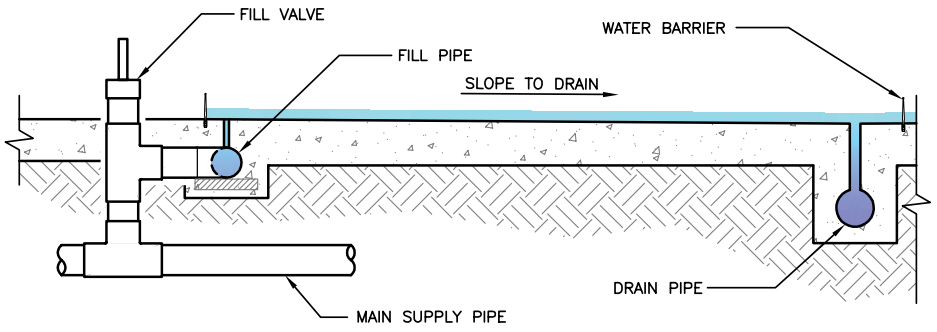
Since 1998, BioTherm has been at the forefront of subirrigation systems.

Cascade Floor



Cross Section: Unidirectional pattern.
Flow Pattern: Independent fill pipe flowing to common drain pipe.
Watering Cycle: Floor fills and drains simultaneously which makes water immediately available for same cycle use.
Cycle Time: Only what you need. (5-6 minutes typical).
Material: Precision installed structural concrete.
Containment: Flexible rubber barrier surrounding floor perimeter which allows for ample employee and cart access.

CASCADE FLOOR CROSS SECTION



CASE STUDY: Elizabeth Mitchell
Holy City Farms, Charleston, SC
Increased Yield and Healthier Plants


Holy City Farms

The Challenge

Elizabeth struggled with summer crop failures two years in a row, and thought that excess heat was the cause. However, after making adjustments to keep her houses cooler, she discovered that something was wrong besides just the heat. She discovered that their irrigation water was too hot to hold an essential element... oxygen. Due to a lack of dissolved oxygen (DO) in their irrigation water. The roots of the plants were being smothered every time they watered causing the plants to suffocate and die from a condition known as Root Zone Hypoxia.

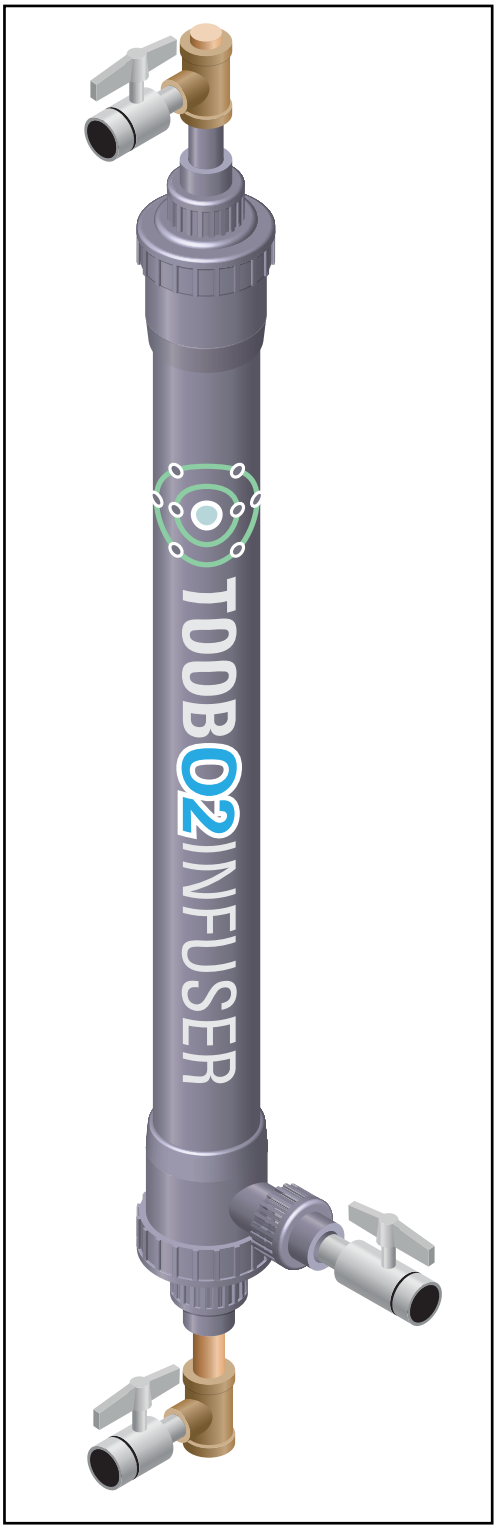
The BioTherm Solution

BioTherm provided Holy City with a complete **BioTherm Oxygen Infusion** package. This included a **Toob Infuser, Oxygen Generator and DO Commander**. With this combination, she was able to infuse and manage the dissolved oxygen levels in her source water tank and maintain the infused levels direct to the rootzone of her plants. Given her remote location, the Oxygen Generator allowed her to have a dedicated oxygen supply and avoid tank refills. With the DO Commander, she was able to view DO levels at a glance on the touch screen.

How It Works

Using the Oxygen Generator, Elizabeth generates her own oxygen supply and never has to worry about oxygen tanks running empty. This consistent and inexpensive supply of oxygen is directed to her Toob Infuser where irrigation water is infused with oxygen under pressure. To integrate the entire system, she uses the DO Commander to control the oxygen flow into the Toob Infuser and to constantly monitor DO levels in real time. Before installing the BioTherm Oxygen Infusion system, DO levels in the Summer were under 4ppm. Now Elizabeth maintains 20ppm despite high temperature conditions and has plans to boost her DO levels even higher. Thanks to the BioTherm Oxygen Infusion system, low DO is no longer a stress on her crops or her family.

THE TOOB MOLECULAR OXYGEN INFUSION



THE TOOB - MOLECULAR OXYGEN INFUSION

The TOOB is a groundbreaking new way to economically boost dissolved oxygen (DO) levels in your irrigation system to enhance plant health and production.

Why Choose the TOOB?
Dissolving oxygen into water is normally considered to be an energy-intensive process. Until now, inefficient air blowers or bubble diffusers have been used and the results are usually only minor increases in the oxygen levels. There is no known method as efficient and economical as the TOOB.

Why choose the TOOB as your Enhanced Irrigation Solution?
- Simple and efficient
- Easy to install
- Connects to locally-sourced oxygen tank or an optional oxygen concentrator
- Economical with immediate ROI
- Long product life -- No parts replacement
- Scalable for your irrigation needs

BioTherm's O2 Gen, The TOOB, and HANNA DO Meter working in tandem together.

THE TOOB O_2 MOLECULAR OXYGEN INFUSION

BioTherm's O2 Generator. Can be ordered with your Toob Dissolved Oxygen System.

O2 GENERATOR SYSTEM

For customers with larger oxygen needs or those less than interested in swapping out oxygen tanks, we have the solution. The O2GEN (Oxygen Generator) was built to fill the specific need of our Oxygen Infusion customers. Many greenhouses or grow operations are too remote for delivery of oxygen tanks or require amounts of oxygen that are cost prohibitive.

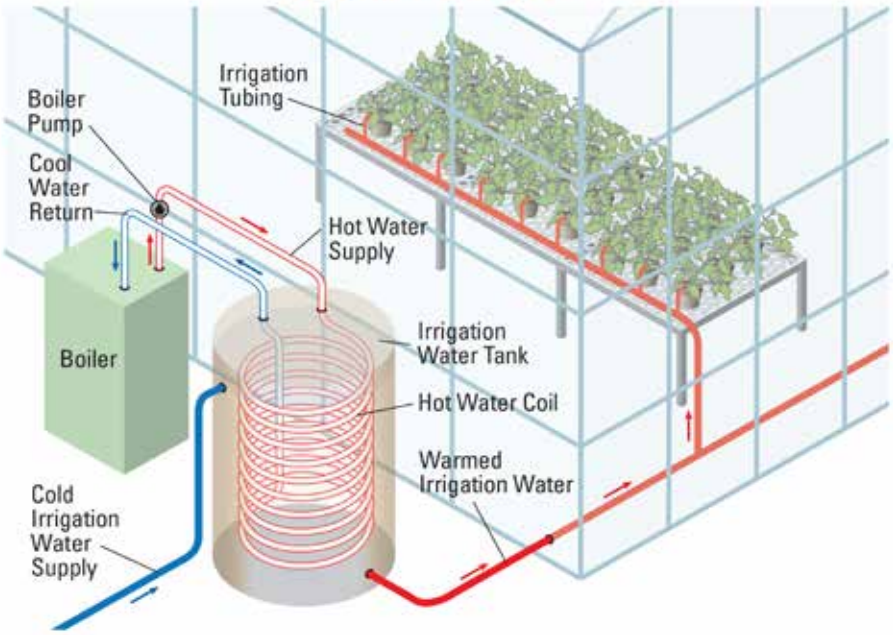
Our generator is unique in that it provides 93%+ pure oxygen at pressures high enough for infusion, but flow rates low enough for precision control. Other generator or concentrator solutions on the marker are unable to achieve this balance. Built on a strong, but lightweight aluminum frame and field-proven, the O2GEN unit is a must-have for growers serious about automating their DO (Dissolved Oxygen) experience.

Don't forget about our companion product, the DO commander. With the full infusion package, it will become one of the most automated and beneficial processes in your grow operation.

Specifications	O2GEN v1.0
Voltage	120 VAC, 60 Hz
Amperage	10.9 A
Oxygen Purity	93% +-3%
Noise	56.2 dB
Operating temperature	41°F to 104°F (5°C - 40°C)
Storage temperature	0°F to 140°F
Humidity	0 to 95% RH
Barometric Pressure Range	8 to 31 inches of Hg
Dimensions	18"x18"x51"
O2 Tank Storage Capacity	8 gallons
Max Tank Storage Pressure	116 psi (.8 Mpa)
Weight	178lbs.
Steady State O2 Gen. Rate	7 LPM (liters per minute)

Hydro Sciences
Irrigation Pre-Heat & Irrigation Pre-Cool

IRRIGATION PRE-HEAT AND PRE-COOL



BioTherm

Signature Products

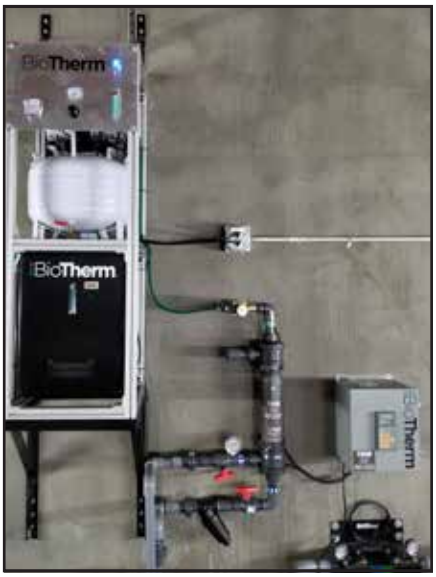
BioTherm products are designed to enhance your irrigation system.

Flood Floor

BioTherm Flood Floor irrigation systems save water, conserve energy, reduce fertilizer waste, and eliminate labor costs by up to 95%.

Cascade Floor

BioTherm Cascade Floor irrigation systems create a thin sheet of water that flows evenly down an imperceptible slope from ridge to drain, uniformly distributing moisture for a homogeneous crop.



The Toob Oxygen Infuser

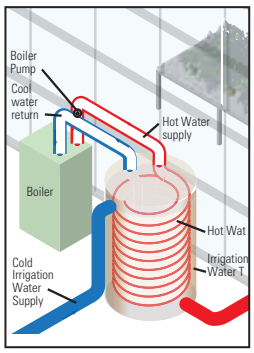
BioTherm's Toob Oxygen Infusion systems integrate with fertigation and other irrigation components to promote faster and more robust plant growth by increasing the molecular oxygen available at the root zone.

O2 Oxygen Generator

Our O2 Generator provides 93%+ pure oxygen at pressures high enough for infusion, but flow rates low enough for precision control. The O2 Gen works in tandem with the Toob, and is a must-have for growers serious about automating their DO experience.

HANNA DO Meter

The DO Commander maintains dissolved oxygen levels in your irrigation line or tank, according to your desired set-point. This integrated system includes a Hanna DO meter, DO sensor, oxygen valve, and related components.



Irrigation Pre-Heat and Pre-Cool

Irrigation water should be kept that the ideal temperature for each species. BioTherm irrigation heating/cooling systems can be integrated or stand-alone, depending on the situation.

BioTherm

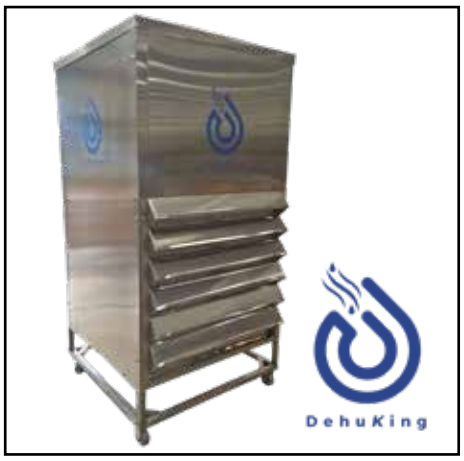
BioTherm Optimized Air

The atmosphere of the growing environment directly affects the health and productivity of the crop. BioTherm offers heating, cooling, dehumidification, and CO2 enrichment to optimize the air in your greenhouse.

BioTherm's StarFin™ System lines the perimeter of this greenhouse.

BioTherm's highly efficient Co2 Enrichment system in use.

Balanced CO2 distribution with BioTherm's DuoFin™ under-bench system.



BioTherm has partnered with ChillKing to bring the DehuKing - a greenhouse dehumidification system.

CASE STUDY: WB Greenhouses
Washtenaw County, MI
BioTherm Dehumidification System

The Challenge

Fresh funding allowed Bill Wayans to scale up his cannabis growing operation. The new facility required industrial-sized hardware to manage the many botanical challenges that Bill was already familiar with. In the past, he used small, overhead dehumidifiers to prevent white powdery mildew, but he seized this opportunity to benefit from the economies of scale.

The BioTherm Solution

Bill described the irrigation schedule and target humidity for his crops, and BioTherm provided the appropriate **DehuKing** dehumidification system. With more standard features than its competitors, and the best operating efficiency on the market, Bill scaled up his business while bringing down unit costs.

How It Works

BioTherm is the exclusive distributor of DehuKing, made in America by ChillKing. The eight models of DehuKing range from 272 pints per day to 6912 pints per day. The DehuKing's stainless-steel hardware is built for exposure to harsh growing conditions, and every unit includes ultraviolet treatment in the dehumidification process, to destroy mold spores and microorganisms.

CASE STUDY: Sierra Gold Nursery
Sutter County, CA
BioTherm Cooling and Heating System

Raypak Boiler System

ChillKing Cooler

SunFin™

StarFin™

The Challenge

When Sierra Gold Nursery decided to pursue a plant tissue culture project, they needed special rooms that could be precisely calibrated for humidity, temperature, and light. Delicate samples are expensive to cultivate, and the failure rate is unpredictably high. To control costs by controlling mortality, Sierra Gold needed to perfectly control the environment. BioTherm was already installing the heating solution in another project, so they asked, "Do you do cooling, too?"

The BioTherm Solution

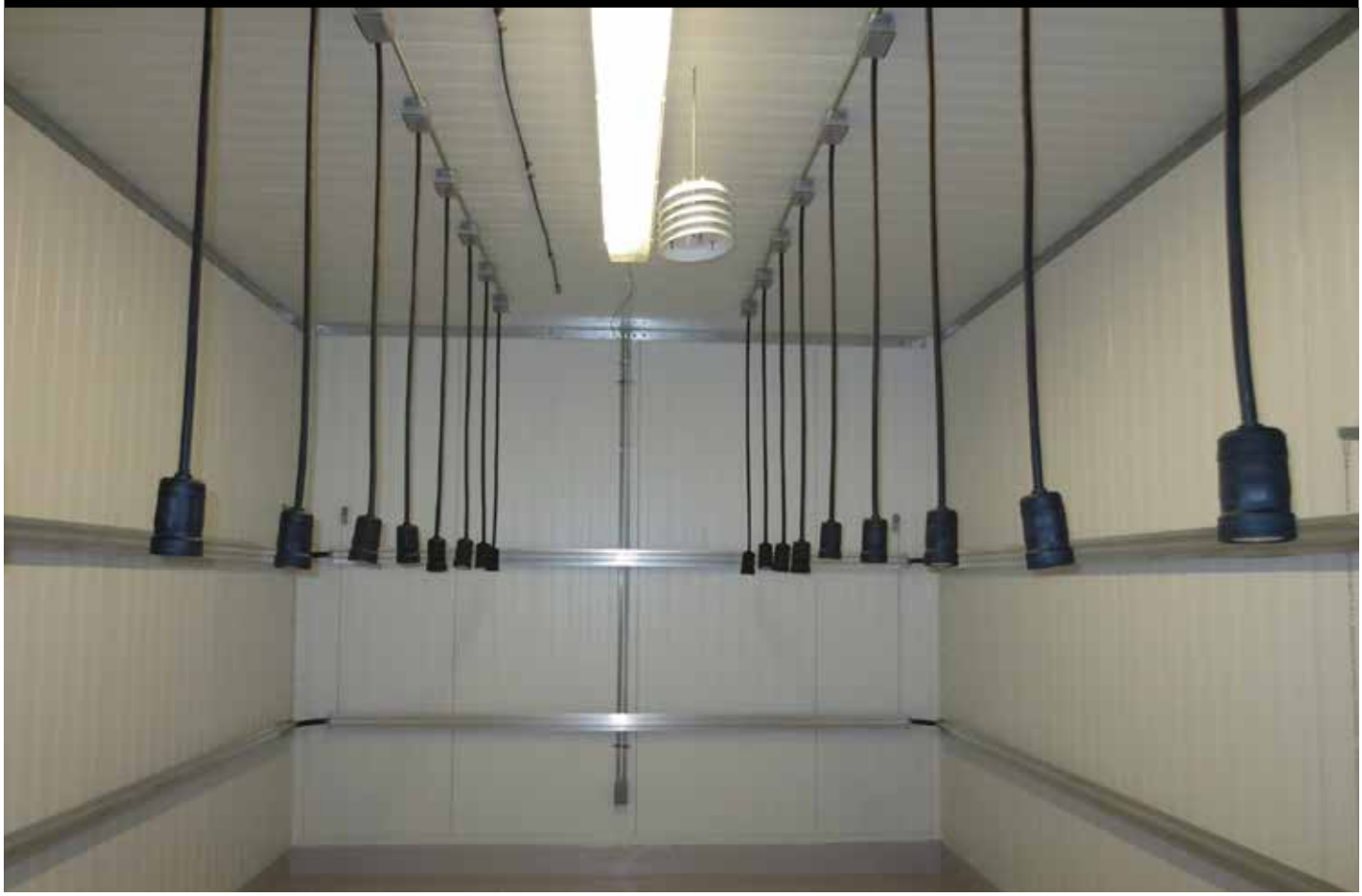
BioTherm used high thermal-transfer **StarFin™** to surround Sierra Gold's acclimation chambers. During hot weather and when lights are running, cold water circulates within the **StarFin™**, keeping the environment cool. When the seeds need more warmth, hot water flows through the same pipes.

How It Works

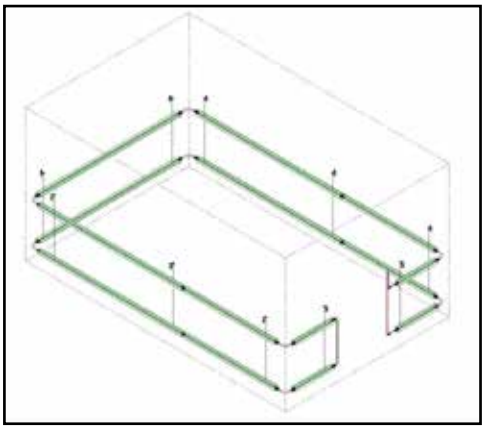
The boiler and chiller for all the acclimation chambers connect to valves above each chamber, connected to a control that monitors and controls temperature, humidity, and light.

BioTherm Cooling Systems

ACCLIMATION CHAMBER



Acclimation chambers with electrical supply for rolling racks, two rows of StarFin™ along perimeter walls.



BioTherm design for StarFin™ heating and cooling system.

ChillKing cooling unit for BioTherm optimized air solution.

CASE STUDY: Nancy Duvall
Sunnyside Farms, CA
Increased Yield and Faster Growth

The Challenge

Nancy knew that greenhouses are prone to suffer from reduced levels of CO2 and that increasing the CO2 concentration above ambient could help boost her crop yield. However, her experiences with CO2 burners had always been disappointing and she wasn't interested in a liquid CO2 system. One option that had always intrigued her was to use exhaust gas from a boiler system, but she had assumed the technology was either unsafe or simply too expensive to implement. BioTherm had already successfully provided rootzone heating and oxygen infusion technologies to help her grow bigger, healthier crops in less time. Since those investments had paid for themselves very quickly, she wanted to understand how a CO2 system would benefit her and requested a proposal for a centralized CO2 Enrichment system which could increase her yield even more.

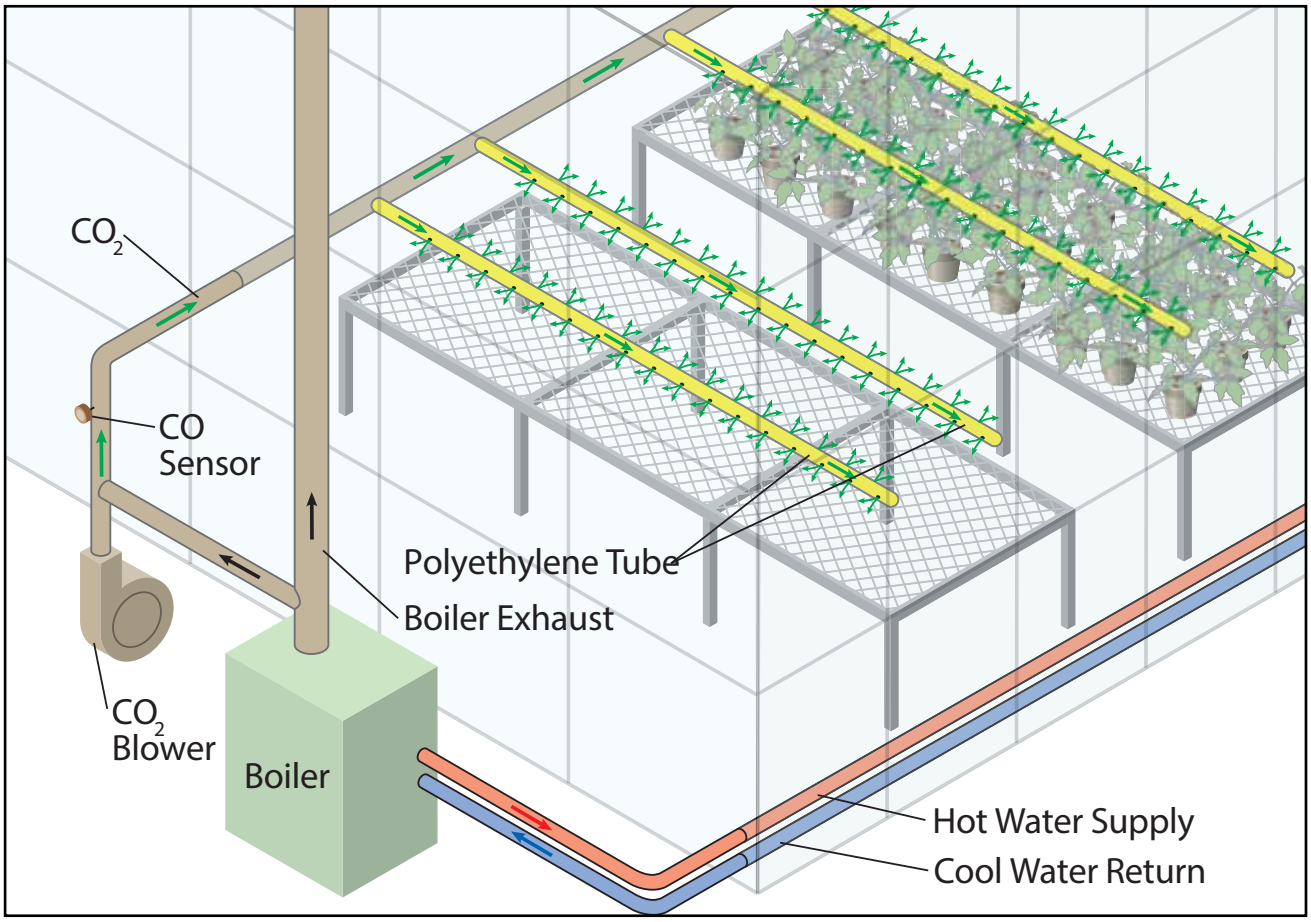
The BioTherm Solution

BioTherm CO2 Enrichment systems provide elevated and uniform CO2 levels using the same equipment that heats the greenhouse. A condensing boiler is the heart of the system, and as it burns fuel, it produces combustion gases rich in CO2. Through the use of a blower and control assembly, this flue gas is routed into the greenhouse zones evenly and without a lot of complicated equipment. CO2 is introduced at truss level, and as CO2 is heavier than air, gently drops onto the plant canopy, bathing Nancy's crops in Carbon Dioxide. Within weeks, she saw the difference. More leaves and flowers, faster growth, and higher yield. Within a few harvests, the investment bore fruit.

How It Works

BioTherm CO2 Enrichment systems distribute the exhaust CO2 from the boiler system out into the greenhouse zones. A stainless steel or fiberglass blower fan works in tandem with a custom built control panel to extract flue gas CO2 and direct it through PVC supply lines out into the greenhouse zones. After reaching the greenhouse zones, actuated zone valves open or close to release gas through correctly sized precision orifice polytubes where CO2 is emitted into the greenhouse environment. When CO2 concentration is too high at the blower assembly, fresh air can be mixed to produce the exact CO2 concentration desired. Carbon Monoxide (CO) produced from combustion is also continuously monitored with sensors both in the greenhouse and in the boiler room to ensure human and plant safety. BioTherm CO2 systems integrate with many common environmental control systems to ensure growers have the ability to maintain their desired CO2 levels at all times.

Efficient CO2 Enrichment Solutions



BIOTHERM CO2 ENRICHMENT

CO2 levels are naturally low in a greenhouse environment as plants use available CO2 as part of the photosynthetic process. Increasing CO2 levels above ambient conditions promotes increased plant growth and health.
With the right condensing boiler system in place, a **BioTherm CO2 Enrichment** system can be easily integrated to achieve elevated CO2 levels in the greenhouse environment.

BioTherm systems pull CO2 directly from the boiler's exhaust gases and distributes them uniformly into the greenhouse environment, while ensuring other harmful gases are kept at a safe level.

With a BioTherm CO2 system, there is no need for large bulk tanks, or individual CO2 burners. These systems can be used in both indoor and outdoor greenhouse operations.

BioTherm

Signature Products

DehuKing - Dehumidification Systems

BioTherm exclusive line of DehuKing dehumidification systems control the humidity while also filtering the air and eliminating 99.9% of microorganisms.

Hydronic Air Cooling Systems

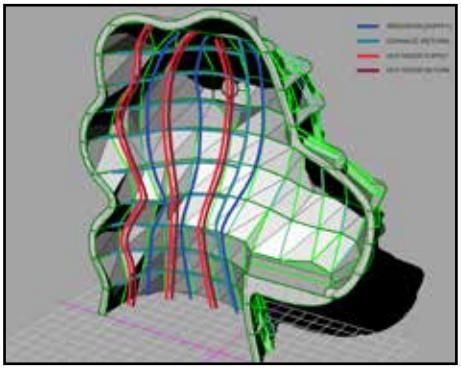
BioTherm cooling systems are custom designed for each project. A typical system includes: air handlers, compressors, condensers, and hydronic cooling.

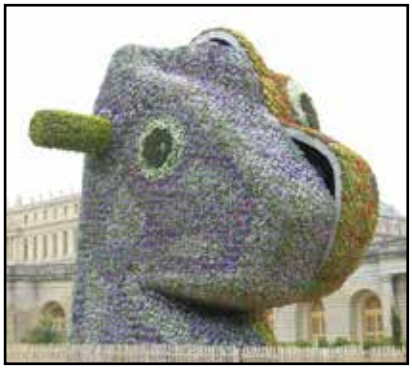
CO2 Enrichment

BioTherm CO2 Enrichment systems deliver filtered carbon dioxide directly into the canopy where it can stimulate plant growth. Clean CO2 is produced from the condensing boiler's flue gases.

BioTherm's Institutional & Research Experience

San Francisco Conservatory of Flowers





Heating System Design for Split-Rocker by Jeff Koons

OSU Ohio Agricultural Research and Development Center

- BASF
- Bayer Crop Science
- Beta Seed
- Clarke University
- Clemson University
- Cornell University
- Donald Danforth Plant Science Center
- Forrest House
- Glenstone Foundation
- Longwood Garden
- Ohio State University
- Monsanto
- Pennsylvania State University
- Purdue University
- Rutgers University
- San Francisco Conservatory of Flowers
- Syngenta Seed
- United States Botanic Garden
- United States National Aboretum
- University of Alaska, Fairbanks
- University of Florida
- University of Wisconsin
- Welby Gardens

Grants and Incentives

Offset your new project or capital improvement costs through Grants, State Rebates and Incentives.

We can identify potential funding, grant and utility rebates. Through our Energy Savings Calculator, we can provide detailed calculations on the efficiency of different heating options that we propose.

Grower-centric technologies eligible for incentives are:

- Condensing Boilers
- Hot Water Distribution Systems
- Energy/Shade Curtains
- Condensing Unit Heaters
- Variable Speed Drives
- Environmental Control Systems
- LED Lighting
- Structure Re-glazing
- Natural Ventilation Structures

Once incentives have been identified, we can provide a reference to grant and incentive firm Sustainable Energy Financing to help you with the process of applying for these funds—regardless of technology. Our close working relationship provides a seamless interface to help you get the funding you deserve.

To learn more, please contact our grant and incentive specialist Dan Kuipers at (800) 438-4328.

Incentive Case Study - Artcan Group, Fitchburg, MA

The Challenge

Artcan Group and its affiliated companies are producers of cannabis flower and associated products located in Fitchburg, MA. To become a leader in an evolving and competitive marketplace, a new high efficiency greenhouse encompassing approximately 32,000 sq. ft. of production space is being planned.

Energy use and its associated cost will represent a sizeable portion of the facility's operational expenses. Artcan believes that energy efficient technologies offer the best long-term option to remain profitable and minimize the risk associated with rising energy costs. However, the increased cost difference between "baseline" standard technologies and high-efficiency equipment is cost prohibitive without utility or government support.

The BioTherm Solution

Many utility companies offer rebates and other incentives to motivate customers to purchase and operate high-efficiency equipment. BioTherm worked with Artcan to identify eligible energy-saving technologies and determine the amount of financial support that would be offered by their local utility.

How It Works

BioTherm modeled and calculated expected energy usage for several design scenarios with varying degrees of efficiency. These calculations were then submitted to the local utility and reviewed for accuracy. Upon completion of the review, the amount of energy saved in each scenario was translated into a guaranteed dollar amount that would be offered to Artcan as an incentive to purchase more efficient (and more expensive) equipment. Through this process, Artcan saved $150,000 through rebates and incentives.

PROPOSAL QUESTIONNAIRE

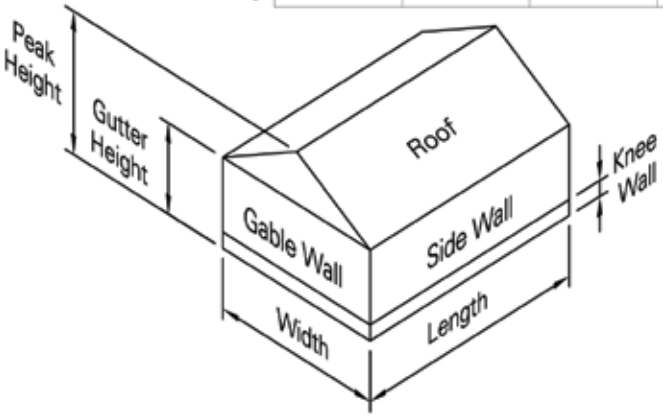
BioTherm

Fill out this page if additional heat is required (see supplemental heat section on page 1).

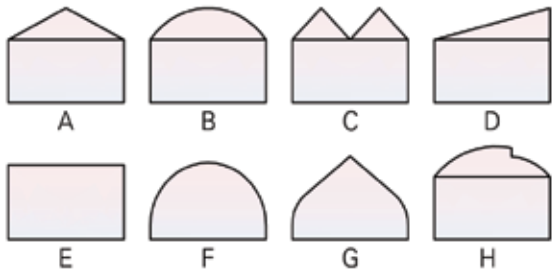
STRUCTURES

Indicate your greenhouse characteristics in the table below.

Structure Label	1	2	3	4	5	6	7	8
# of Ranges:								
# of Bays per Range:								
Gutter Height (ft.):								
Knee Wall Height (ft.):								
Bay Width (ft.):								
Bay Length (ft.):								
Peak Height (ft.):								
Structure Type*:								
New/Existing:								



*Structure types:



GLAZINGS & COVERINGS

Using the list below, indicate glazings/coverings in the following table.

Structure Label	1	2	3	4	5	6	7	8
Side Wall A:								
Side Wall B:								
Gable Wall A:								
Gable Wall B:								
Roof:								
Knee Wall:								

Glazing/Covering List:

1. Polyethylene Film, Single
2. Polyethylene Film, Double
3. Acrylic Film, Double
4. Polycarbonate Sheet, 16mm
5. Polycarbonate Sheet, 8mm
6. Polycarbonate Sheet, 6mm
7. Polycarbonate Sheet, Triple Wall
8. Polycarbonate Sheet, Corrugated
9. Fiberglass
10. Glass, Sealed
11. Glass, Lap
12. Concrete, 4"
13. Concrete, 8"
14. Concrete, Block
15. Wood
16. Metal
17. Insulated (R-Value _____)
18. Other: _____

FEATURES

Curtains:

- ☐ Shade
- ☐ Blackout
- ☐ Heat Retention

Other:

- ☐ Below Grade Insulation (R-Value _____)
- ☐ Retractable Roof
- ☐ Other: _____
- ☐ Roll-up Sidewalls
- ☐ Pad/Fan System
- ☐ Unit Heaters (Size: _____ BTU/h)

Heating System Proposal Questionnaire

Hydronic heat systems use water as the medium to transmit heat which is more efficient and flexible than using air. This questionnaire is meant to capture information needed to design a cost effective and efficient hydronic heating system. If you have difficulty completing this form or have any questions, please let us know and we will be happy to guide you through the process.

Project Name:

CONTACT
Company: _____
Name: _____
Phone: _____
email: _____

PROJECT SITE
Address 1: _____
Address 2: _____
City: _____
State: _____ Zip: _____

DEALER
Company: _____
Name: _____
Phone: _____
email: _____

PRODUCT INTEREST
☐ Roll-n-Grow ☐ CO2 Generation
☐ Cooling ☐ Oxygen Infusion
☐ _____ ☐ Flood Floor

CROPS
Crop(s): _____
Container: ☐ Bags ☐ Beds ☐ Pots ☐ Trays

PROJET START DATE
☐ Now
☐ 3 Months
☐ 6 Months
☐ 1 Year

PROBLEMS
☐ Uneven Heat
☐ Crop Shrink
☐ Humidity
☐ Utility Costs
☐ Production Time
☐ Potency
☐ Labor Cost
☐ Disease
☐ Cold Spots
☐ Can't Maintain Setpoint
☐ _____

ZONES
☐ Minimal
☐ Qty. _____

GROWING SURFACES
Benches:
☐ Stationary
☐ Rolling
☐ Mobile Tray
☐ Trough/NFT

Bench Surface:
☐ Tray
☐ Expanded Metal
☐ Wood
☐ _____

Floor/Ground:
☐ Concrete
☐ Soil/Raised Bed
☐ Gravel/Sand

Other:
☐ Vine/Row
☐ Hanging Basket
☐ Rafts
☐ _____

TEMPERATURE
Indicate what temperature (°F) you wish to maintain.
Soil _____
Air _____
☐ Temperature varies
Please explain: _____

FUEL
☐ NG ☐ Electric
☐ LP ☐ Biomass _____
☐ Fuel Oil ☐ _____

POWER
_____ VA(
_____ Ph
_____ Hz

CONTROLS
How will you control your heating system?
☐ Please provide BioTherm stand-alone controls.
☐ I will use another control system. _____

HEAT LOCATION
Benches:
☐ In
☐ On
☐ Under

Rail Systems:
☐ Irrigation Booms
☐ Hanging Basket
☐ Cart

Floor/Ground:
☐ In
☐ On

Space:
☐ Overhead
☐ Perimeter

HEAT SOURCE
☐ Provide new boiler system, ☐ with redundancy
☐ Reuse my boiler if possible
Heat Output: _____
Make: _____
Model: _____

SUPPLEMENTAL HEAT
Heating your growing surface may not provide adequat heat to maintain your desired structure temperature. If this is the case, in order to fulfill the structure heat loac
☐ Propose the best solution.
☐ I prefer unit heater
☐ I will provide supplemental heat.
☐ I prefer additional hydronic heat.

Structure information on page 3 is required to determine supplemental heat requirements.

IRRIGATION PREHEAT
Min. Water Temp. (°F): _____
Desired Temp. (°F): _____
Desired Flow (gpm): _____
Usage (min/hr): _____

Cooling/Dehu System Proposal Questionnaire

This questionnaire is meant to capture information needed to design a cost effective and efficient cooling/dehumidification system. If you have difficulty completing this form or have any questions, please let us know and we will be happy to guide you through the process.

Project Name:

PRODUCT INTEREST ☐ Dehumidification ☐ Cooling

CONTACT
Company: _____
Name: _____
Phone: _____
email: _____

PROJECT SITE
Address 1: _____
Address 2: _____
City: _____
State: _____ Zip: _____

DEALER
Company: _____
Name: _____
Phone: _____
email: _____

PROJECT START DATE
☐ Now
☐ 3 Months
☐ 6 Months
☐ 1 Year

FUEL
☐ Natural Gas
☐ Liquid Propane

POWER
_____ VAC
_____ Ph
_____ Hz

CONTROLS
How will you control your heating system?
☐ Please provide BioTherm stand-alone controls.
☐ I will use another control system. _____

CROPS
Crop(s): _____
Container: ☐ Bags ☐ Beds ☐ Pots ☐ Trays

ZONES
☐ Minimal
☐ Qty. _____

GROWING SURFACES
Benches:
☐ Stationary
☐ Rolling
☐ Mobile Tray
☐ Trough/NFT

Bench Surface:
☐ Tray
☐ Expanded Metal
☐ Wood
☐ _____

Floor/Ground:
☐ Concrete
☐ Soil/Raised Bed
☐ Gravel/Sand

Other:
☐ Vine/Row
☐ Hanging Basket
☐ Rafts
☐ _____

TEMPERATURE
Indicate what temperature (°F) you wish to maintain.
Soil _____ ☐ Temperature varies
Air _____ Please explain: _____
Desired Humidity Level: (%) _____

COOLING LOCATION
Benches:
☐ In
☐ On
☐ Under

Rail Systems:
☐ Irrigation Booms
☐ Hanging Basket
☐ Cart

Floor/Ground:
☐ In
☐ On

Space:
☐ Overhead
☐ Perimeter

IRRIGATION
☐ Booms ☐ Drip ☐ Hand
☐ Other _____

AIR MOVEMENT
Circulation Fans:
☐ HAF ☐ VAF ☐ Basket
Air Exchanges per Hour _____
Intake SCFM _____

BioTherm®

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Cotati, CA 94931

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www.BioThermSolutions.com
@BioThermSolutions