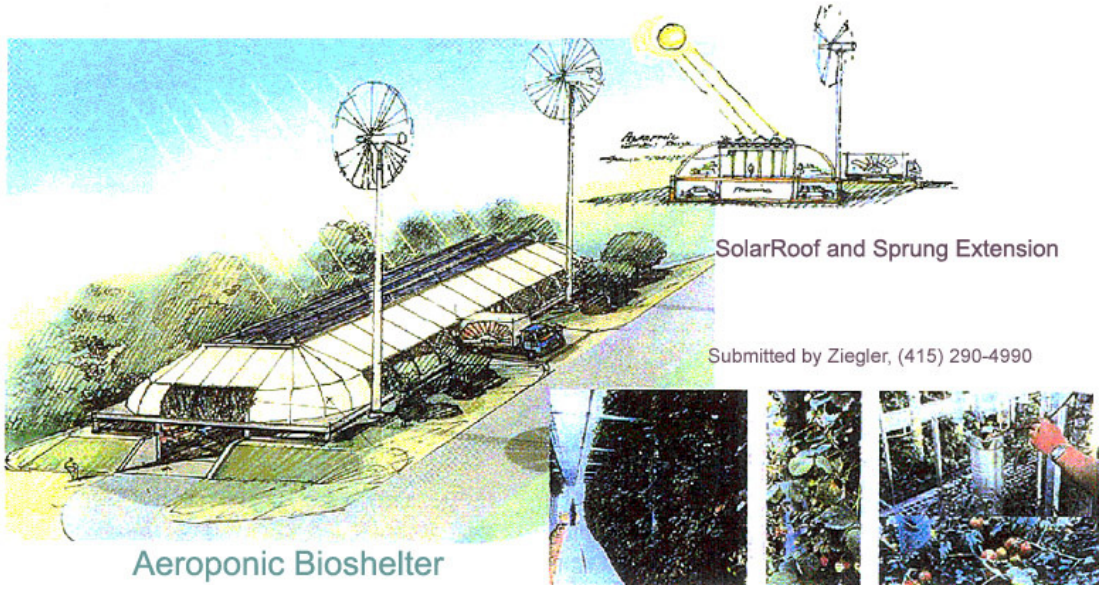
The Vertical Aeroponic Growing System



We are developers of a new agricultural growing system developed over the years in Italy, Hawaii and California. The system is a growing environment housed in an enclosure called a BIOSHELTER ®. Within this Bioshelter is a highly efficient growing system utilizing horizontal hydroponic growing beds and many vertical aeroponic growing tubes. Pumps powered by solar energy and monitored by a computer pumps nutrients to thousands of the growing tubes. These Bioshelters have 6 to 7 times the output of conventional greenhouses. Typical products include vegetables, sprouts, berries, flowers, and specialty plants such as pharmaceuticals

We are in the process of seeking sustainable development projects like the MASDAR Initiative to launch highly productive vertical farms, which not only function as climate buffers and sequesterers of carbon dioxide for the inhabitants, but they also produce oxygen and high value vegetable and nutraceutical crop which can be consumed within the future Eco-City.

This presentation is but an introduction to the designers and builders of any sustainable community. For further technical consultation and licensing contact:

Reinhold Ziegler, Laurie Rolfe
Synergy International Inc.
P.O. Box 3171
Sausalito, CA 94996
U.S.A.

Tel: (415) 290-4990
www.synergyii.com
synergyca@earthlink.net

The Aeroponic Growing System:

The principles of Aeroponics are based on the possibility of cultivating vegetables whose roots are not inserted in a substratum (the case with hydroponics) or soil, but in containers filled with biochar and flowing plant nutrition. In these containers roots can find the best condition regarding oxygenation and moisture. These conditions allow for better plant nutrition assimilation in a more balanced way, with consequential faster development of the cultivated plants.

Plant containers can be mounted on top of one another and because they are light and handy, they can be easily moved according to agricultural needs. Numerous plants are mounted in vertical columns within a greenhouse or shade house space. Nutrients are allowed to trickle down through the growth columns.

Most agricultural plants need a direct exposure to the sun during the first vegetative development. Afterwards this direct exposure is no longer relevant. Based on this observation, plant containers are periodically displaced. Young plants are placed at the highest level of the growth column. Afterwards they are progressively lowered using utilizing a rotational mechanical system. With the rotation periodically repeated, this permits constant production without any interruption. The Aeroponic system is agriculture with a non-stop production cycle.

Plant nutrition is supplied into a closed circuit. Consumption is consequently limited to only the quantities absorbed by the plants, allowing for substantial water savings. For example: to produce a kilogram of tomatoes using traditional land cultivation requires 200 to 400 liters of water, hydroponics requires about 70 liters, aeroponics utilizes only about 20 liters.

Because the aeroponic system is a continuous-cycle in an enclosed space it reduces the agricultural labor into a series of mechanical routine-operational tasks which are carried out daily and throughout the year. This enables workers to acquire considerable skill within a short period of time—a few months. In traditional agriculture activity commercial production is obtained only with skilled workers qualified by many years of experience.

The aeroponic equipment is sheltered within greenhouses, shade-houses or anti hail-storm coverings according to the latitude. Climate controls within the greenhouse ensure optimal growing conditions, assuring high yields.

The VAP System: Vertical Aeroponic Planting System

ON LAND WHERE NOTHING GROWS WE CAN WITH THE VAP SYSTEM GROW VEGETABLES, FRUITS, AND FLOWERS.

The basic local requirements to achieve this are:

a. Sunshine

b. A level area of land which is not shaded by mountains or high buildings. The area should be accessible by road.

c. Water of suitable quality for agricultural use. The quantity required is only 10% of that required for normal greenhouses.

d. A small amount of electric power. If necessary this can be provided by solar electric means.

If these requirements can be met a VAP System Bioshelter can be erected on the land, and within it cultivation of vegetables, fruits and flowers.

The VAP System Bioshelter will produce:

a. Annual crop yields of at least thirty times that of normal agriculture and six times that of a normal greenhouse.

b. Produce of quality and taste, equivalent to normal agriculture.

c. Produce which contains the minimum amount of nutrients or fertilizer.

d. Crops all year round. There are no growing seasons in a VAP System Bioshelter.

e. A substantial annual operating profit

Advantages of the Aeroponic Growing System:

In comparison with the traditional agriculture the most relevant advantages are the following:

1. Limited water consumption. This system has had commercial success in desert areas such as Saudi-Arabia and Israel.

2. Agricultural success independent of land and soil quality. Soil composition is not relevant because soil is never used in the process.

3. Intensive food production on a limited land surface area. The 3-dimensional growing system has the highest output per square foot of land per year of any system known.

4. The growing system can be constructed near consumers. The greenhouse can be constructed near urban centers and markets, with consequent reduction of freight costs and offering consumers freshly-cropped products.

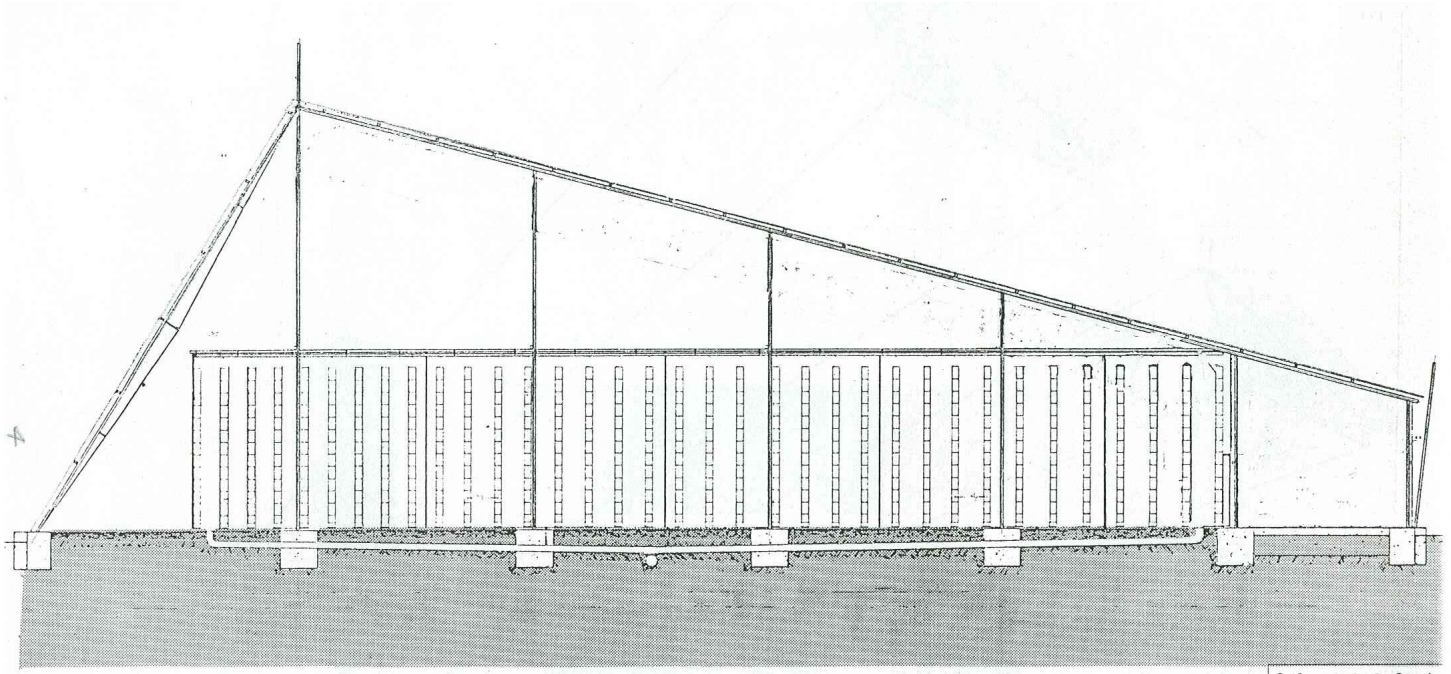
5. Yields are independent from any seasonal adversity. This includes cold, hot windy, or dry weather, etc.

6. Non-stop production cycle ensures a constant market supply with more price stability.

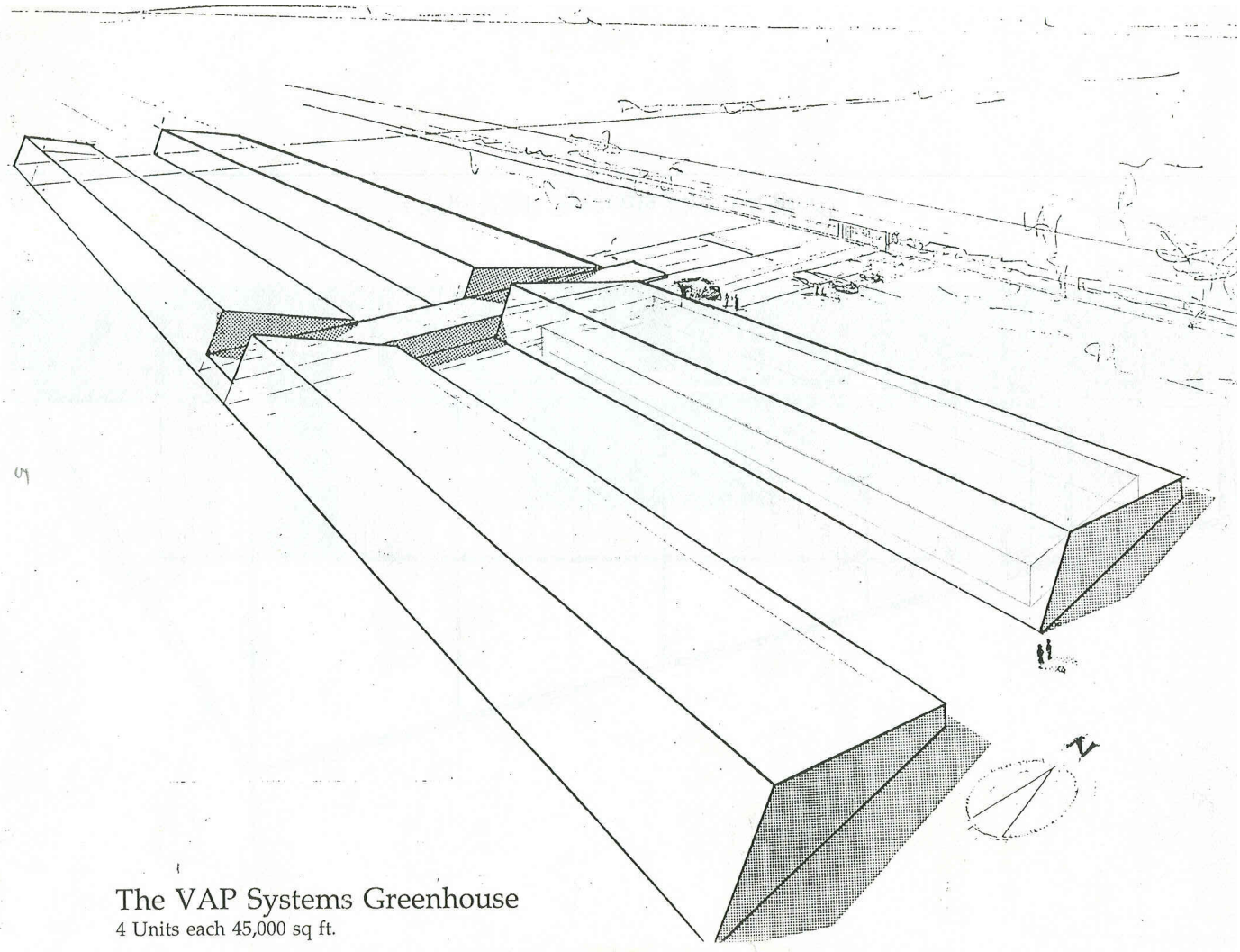
7. Automation of most agricultural operations with a limited necessity of farm-labor and farm equipment investments. The simplicity and reliability of the mechanical system permits the employment of unskilled labor and the partially handicapped. It therefore possible to produce on a commercial basis in areas that have no agricultural tradition.

8. Higher organic qualities of the products. Examination of “plateau” states of growing stock has shown a higher salt percentage of up to 30 %.

9. Social reevaluation of agricultural work which in the aeroponic system is planned. This agricultural scheme follows an industrial model: daily fixed working-hours, no more unsuitable back-breaking work in the environment but sheltered from the weather, no more seasonal or occasional work but uninterrupted activity during the whole year.



The VAP Systems Greenhouse



The VAP Systems Greenhouse

4 Units each 45,000 sq ft.

More Advantages of the Aeroponic Growing System:

The VAP System is a modern method of cultivation particularly suited to desert areas and island communities where land and fresh water is limited. Although the term "greenhouse" is used to describe the building in which the VAP System operates, by no means does the efficiency of a normal greenhouse compare with that of VAP System Bioshelter. The main advantages of a VAP System Bioshelter over a normal greenhouse are as follows:

- The annual yield per square foot of a VAP System Bioshelter is six times that of a normal greenhouse. Therefore; a VAP System Bioshelter of 5,000 sq. ft. is equivalent to a normal greenhouse of 30,000 sq. ft

- The VAP System Bioshelter is really independent of the seasons and will produce on a year-round basis. The environment of the interior is as near to a natural state as possible. In a normal greenhouse year-round production can only be achieved with full air-conditioning which, in fact produces a completely artificial environment. The necessary investment and operating costs make this a totally uneconomical proposition.

- The water consumption of a VAP System Bioshelter is only 10 % of that required for a normal greenhouse. With the VAP System there is no water wastage as the supply is contained within a closed circuit which permits recycling. The only water used is that taken by the plants.

- In a VAP System Bioshelter, the necessary nutrients for cultivation are contained in solution in the closed circuit water supply system referred to above. The composition of the nutrients is controlled automatically. The roots of the plants absorb only as much of the nutrients as they require. The resulting produce, therefore, contains the minimum of fertilizer and is consequently of the highest quality.

- In a VAP System Bioshelter fertile soil is not required. The nutrient solution is made of "compost tea" Any normal greenhouse requires large quantities of fertile soil.

- The personnel requirements of a VAP System Bioshelter are very low. For example a production bioshelter of 45,000 sq. ft. requires only 2 technicians and 6 unskilled workers. An equivalent size normal greenhouse of 270,000 sq.ft. would require at least 30 workers.

The VAP System is designed on a module of 12 ft x 6 ft x 10 ft. and can be supplied in multiples of this module. The minimum practical size, commercially viable, would be 10,000 sq. ft.

The VAP System: Vertical Aeroponic Planting System: Crop Yield:
(Without grow lights.)

The crop yield varies for each type of plant and is a function of the cultivation cycle of the particular plant in the Planting Tubes. For example;

Production - Tomatoes
Density of planting Tubes is one every square yard of covered surface.
Each Tube has 7 cultivation levels - each with 5 plants.
The cultivation cycle is 90 days and in one cycle the average production is 3.3 lbs/ plant.
Therefore the crop yield is:

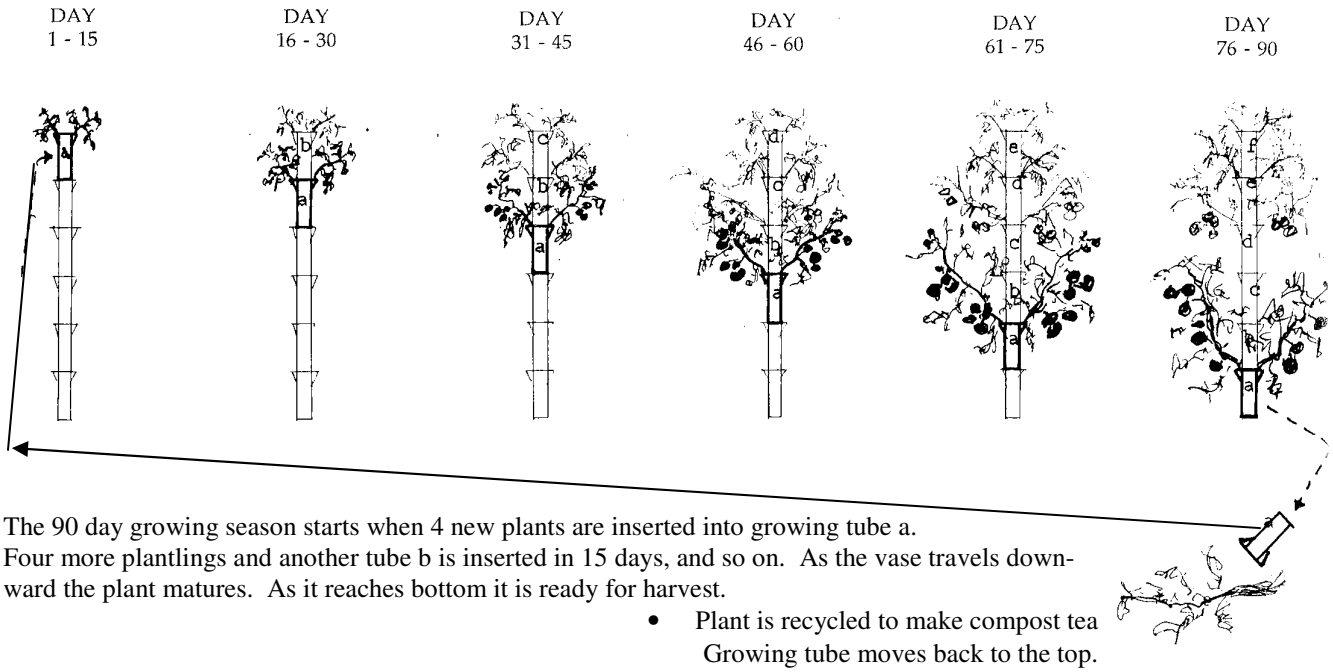
3.3 lbs x 5 plants = 16.5 lbs/level x 7 levels = 115.5lbs/tube/cycle x 4 cycles/year
= 462 lbs/year/square yard
= 51.3 lbs/year/square foot/year

Examples of other plants with different cultivation cycles are:

Egg Plants *	77.4 lbs/sq.yd./year
	8.6 lbs/sq.ft/year
Cucumbers *	430.1 lbs/sq.yd./year
	47.9 lbs/sq.ft/year
Peppers *	152.5 lbs/sq.yd./year
	16.9 lbs/sq.ft./year
Strawberries *	77.4 lbs/sq.yd./year.
	8.6 lbs/sq.ft./year

* Note: These production figures are based on the European and Hawaiian experience.

Vertical Aeroponic Planting System (VAP)
Showing the cultivation of vegetables in a continuous cycle.
(Only skylights no night lighting)



The 90 day growing season starts when 4 new plants are inserted into growing tube a.
Four more plantlings and another tube b is inserted in 15 days, and so on. As the vase travels downward the plant matures. As it reaches bottom it is ready for harvest.

- Plant is recycled to make compost tea
  Growing tube moves back to the top.

VAI: The Vertical Aeroponic Planting System

Technical Description:

1.1 Bioshelter Structure.

Typical Covered Area - 10,000 sq. ft modules

A Membrane Tent Structure: (Other buildings can be substituted.

With 80% translucent ceiling membrane and netting side panels for cross ventilation.

Internal precast concrete pathways or full slab

1.2 VAP System Equipment

Ceramic plant holding pots forming planting tubes 96" high and fitted with vertical rotation equipment.

Grid-Beam Support Structure 12 rows, with 12 different vegetables, herbs, etc.

Number of planting tubes - 4,032

1.3 Nutrient Solution Distribution System.

Underground storage tank, capacity - 500 gallon

Electric peristaltic pump, delivery and recovery piping.

Flexible nutrient distributors and collectors fitted to each planting tube.

1.4 Environmental Control.

Fixed ventilation extractor fans - 4 typical.

Natural cross ventilation by means of netted walls.

Optional Shading nets can provide 50% shade over roof area.

1.5 Electrical System.

Central control panel with command and control equipment, visual and acoustic alarm signals.

Internal wiring and cabling.

Photovoltaic power system available for remote power application.

Electrical energy required for pumps, 10 Kw/ 10,000 sq ft Bioshelter.

1.6 Ancillary Areas.

Hydroponic seedling tables for seed propagation

Storage and distribution of phyto medicines.

Storage of fertilizer, tools, spare parts, etc.

Offices, toilets, changing rooms, etc.

Packing and shipping area.

1.7 Exterior.

Access road within site boundaries

Loading Bay

Parking area

Security Provisions

1.8 Construction Cost

Bioshelter Tent structure or Post and Beam (10,000 sq. ft.)	$250,000.
Foundations, Pathways, Slabs, Drainage	$ 10,000
VAP System Equipment Nutrient Solution Distribution System	$150,000.
Environmental Control Equipment	$ 30,000.
and Solar Electric Power	$ 20,000.
	$460,000

1.9 Annual Production Costs.

1 Technician x 12 months x $4,000	$ 48,000
2 Workers x 12 months x $3,000	$ 72,000
Fertilizer & Nutrients	$ 4,000
Nursery Stock	$ 8,000
Electrical Power	$ -0-
Water	$ 2,000
Tools and Maintenance	$ 2,000
Sales Costs:	$ 4,000
Packing	$ 2,000
Transport	$ 5,000
Promotion	$ 6,000
General Miscellaneous	$153,000

2.0 Site Requirements.

The following are general requirements for the installation of a VAP System Bioshelter of 10,000 sq. ft.

- Area of land — 15,000 sq. ft.
- Flat and level site, not shaded by mountains or high buildings, and not subject to air pollution.
- Soil conditions are not important except the soil should be uncontaminated and salt free.
  Clean desert sand or lava basalt is ideal.

The Vertical Aeroponic Planting System:

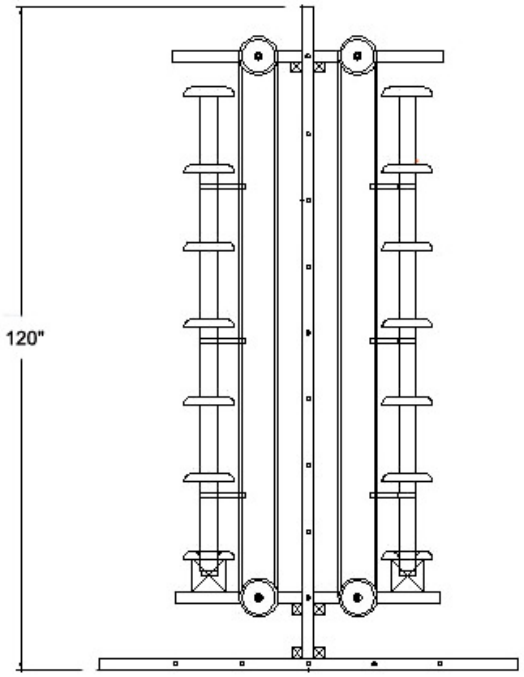
Production Income:

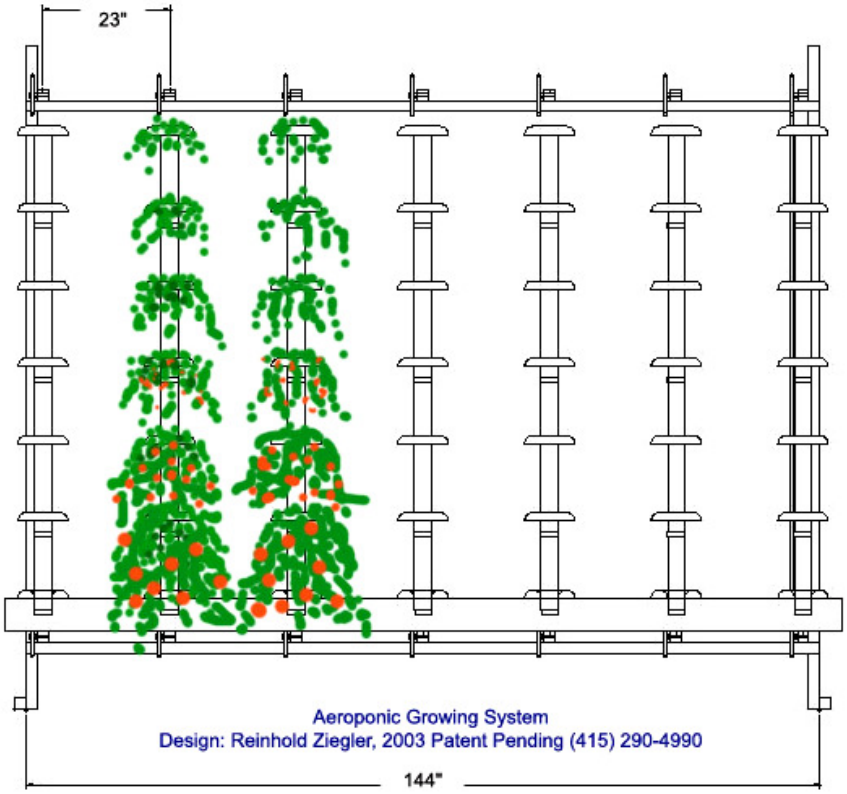
The income is directly related to the type of produce that is grown.

This business projection utilizes a 10,000 sq. ft. Bioshelter.
The dollar value is for 10,000 sq. ft of tomatoes, egg plant etc. respectively.
Note: these values are based on day lighting only with no artificial lights which can double output.

	Yields lbs/sq.ft/year:	**Wholesale** S/lb	**$ Value** 10.000 sq. ft.
Tomatoes	61	$ .90	$ 377,821
Egg Plant	12.6	$2.00	$ 173,462
Cucumbers	65.5	$ .60	$ 270,463
Japanese	70.0	$ .85	$ 409,479
Peppers	35.4	$1.20	$ 292,347
Strawberries	20.6	$ .95	$ 134,680

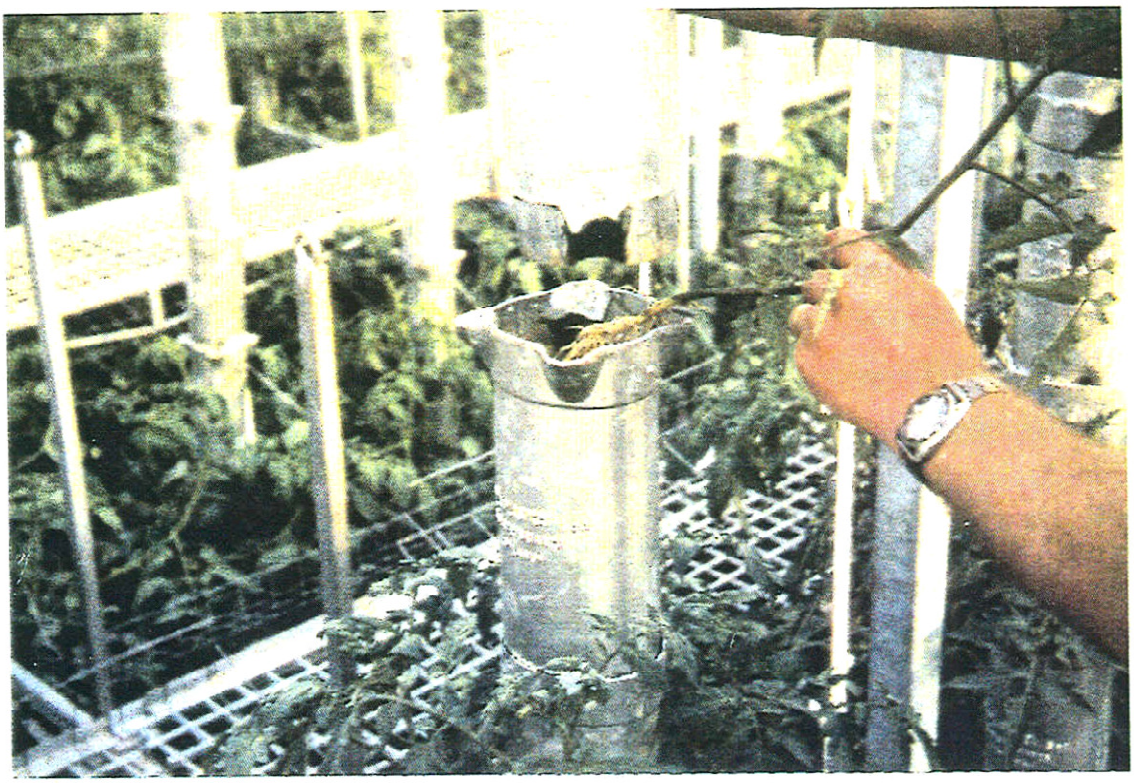
Note:
Vegetables will be mature for picking and distribution 90 days after beginning and continuously thereafter. All produce is organic, vine ripened, and ready for immediate consumption.





Strawberries: Production in a continuous cycle

Romain Lettuce:



Cultivation of Tomatoes: Day One in the production cycle
Note the 4 lips in the growing vase.

Cultivation of Tomatoes: Day 90 in the production cycle.
Wire supports carry the extensive harvest.

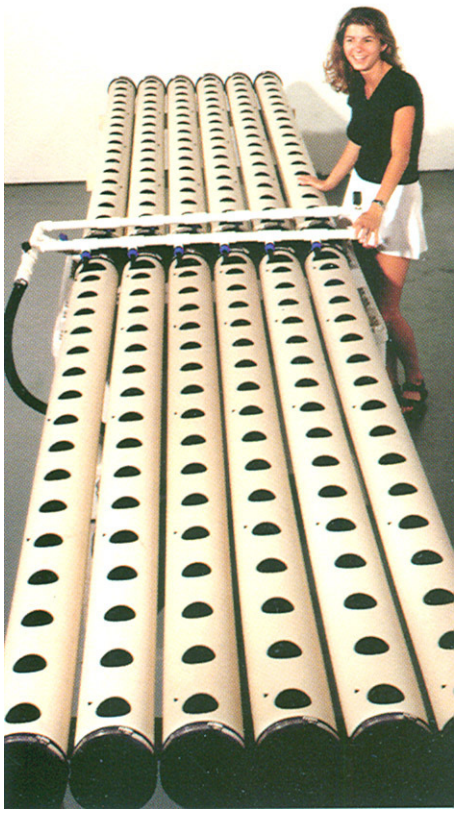
AEROFLO²® 60

Our largest AeroFlo²® unit, the AF²60, features sixty plant sites. Growers who wish to expand this system can enjoy a total of one hundred and twenty plant sites with the addition of our AeroFlo²® 60 Extension Unit. Users can choose either to configure the grow chambers on the same side or to stagger them in order to cover a larger area or to grow larger plants. The AF²60 and Extension Unit feature the generous 40 gallon Panda™ reservoir.

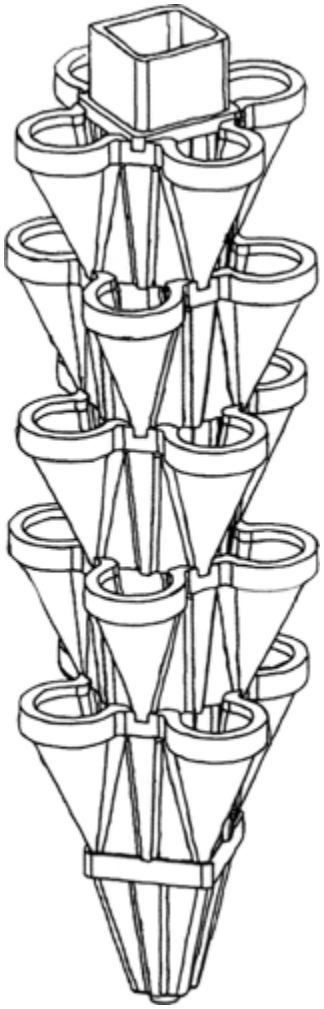
- AF²60 dimensions:
  standard configuration:
  5'1"L x 6'10"W x 2'T
  staggered configuration:
  5'1"L x 11'7"W x 2'T
  with Extension Unit:
  9'7"L x 6'10"W x 2'T

The AF²60 system includes:
- 40 gallon Panda™ reservoir
- Six 6 ft. grow chambers
- TNC 1268 gph pump
- Injection manifold
- SnapStand® support structure
- 3" Grow Cups
- Coco cups and Hydroton
- 3 part Flora Kit

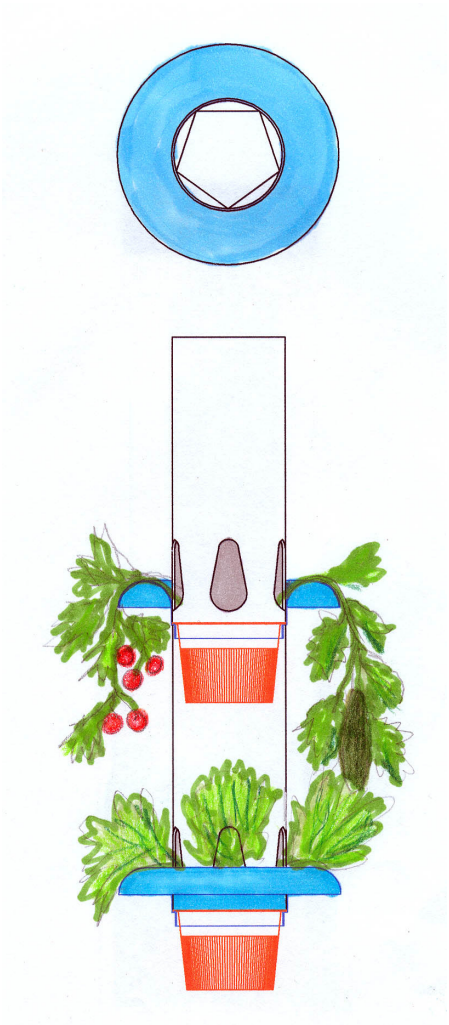
The AF²60 Extension includes:
- 40 gallon Panda™ reservoir
- Six 6 ft. grow chambers
- Injection manifold
- SnapStand® support structure
- PVC reservoir connection tube
- 3" Grow Cups
- Coco cups and Hydroton
- 3 part Flora Kit



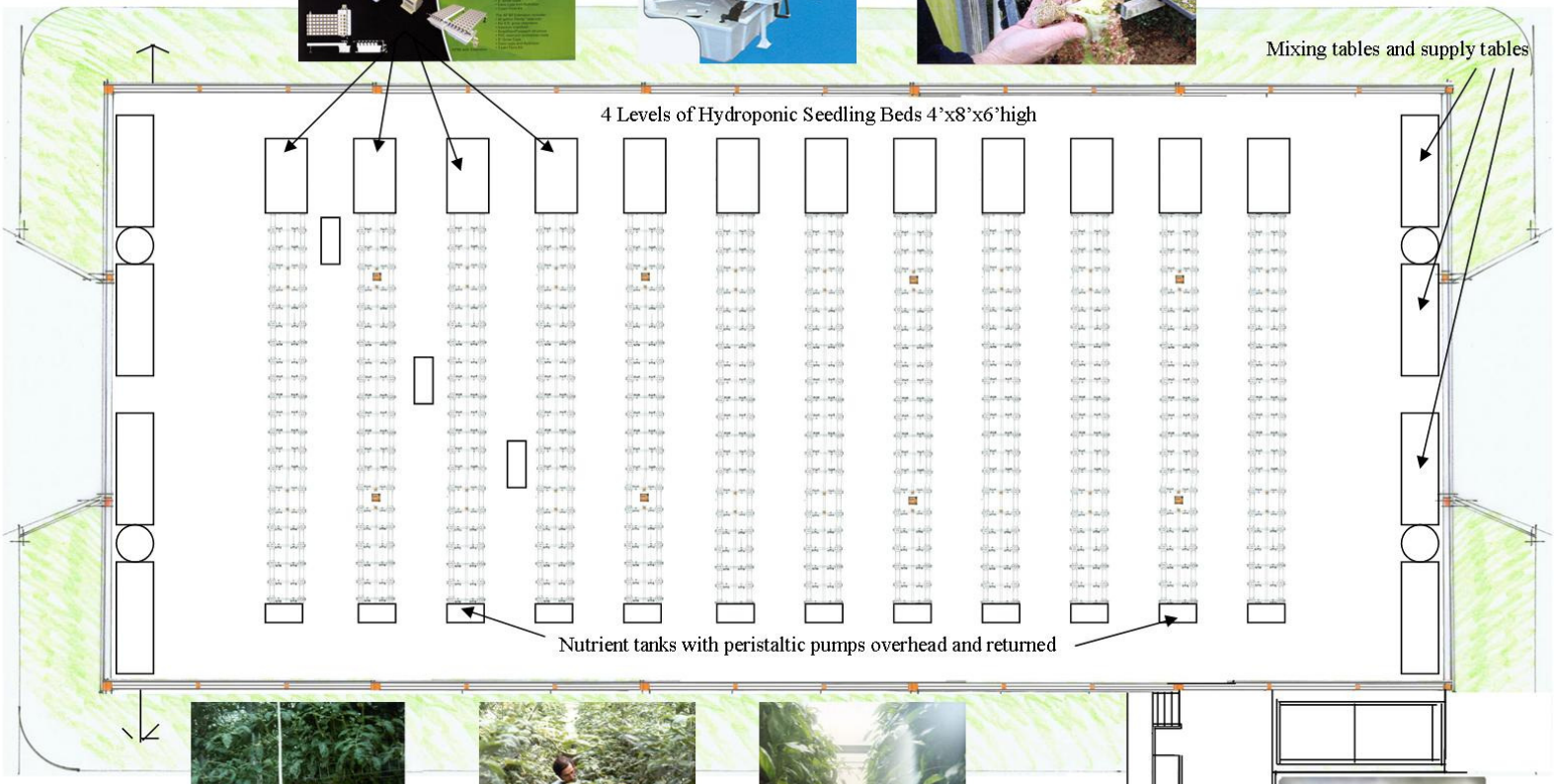
Hydroponic Seed Beds
Seedlings to be transplanted to Hydroponic & Aeroponic Growing tubes.



Prototype: Stackable
Aeroponic Growing Tubes
(Non-rotational)



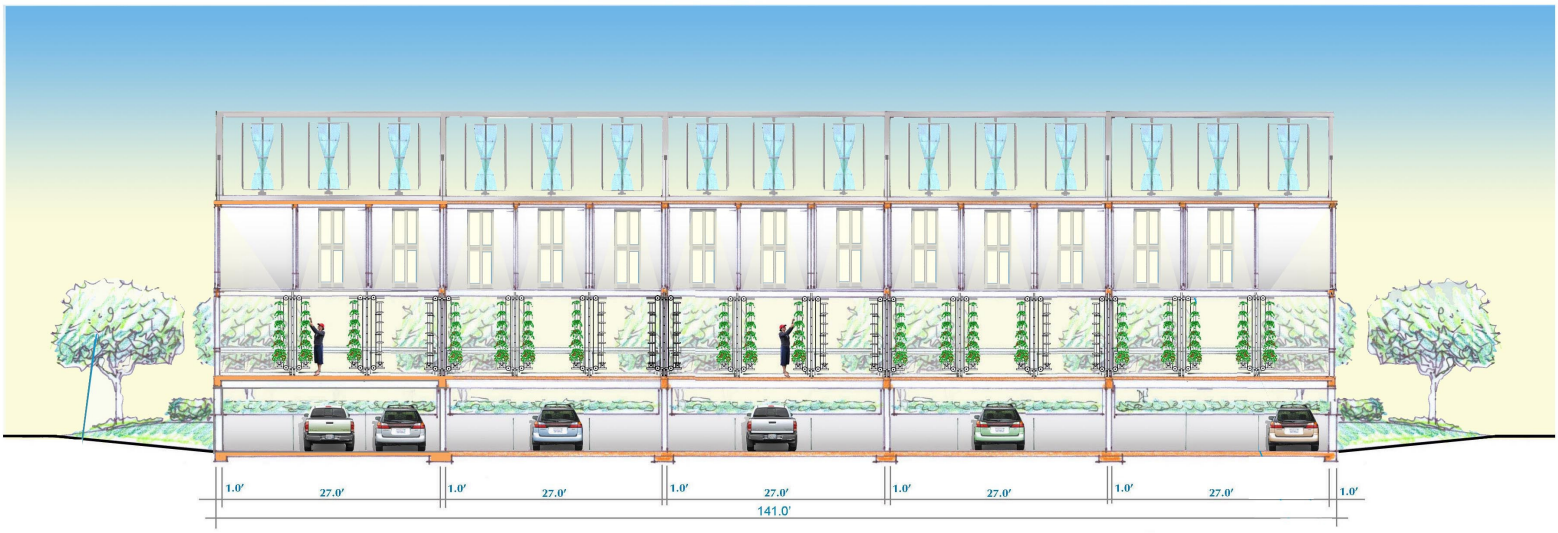
Production Prototype Vertical Growing of Produce
With baskets filled with Biochar.
(Rotational)



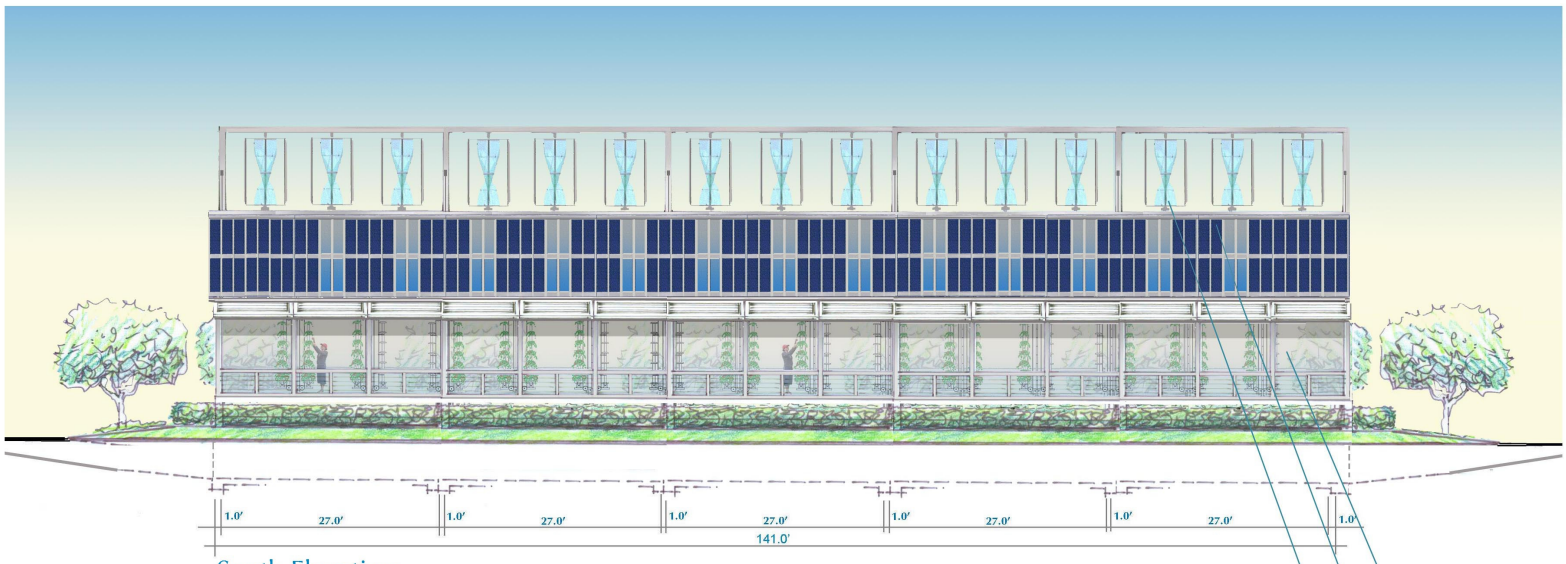
Tomato Production in Stationary tubes, Italy Anthurium Production, Italy

Inventory of Growing Tubes and Plants:

- 12 Rows of Growing Tubes (Hosting up to twelve different vegetables)
- Each Row has 42 columns with 8 growing tubes per column = 336 growing tubes
  @ 5 plants per growing tube = 1,680 plants/row
- 12 Rows x 1680 = 20,160 plants in the greenhouse.
- At any time 2,520 plants are ready for harvest. These are available for harvest every 15 days.
- Total growth cycle from seed to harvest (top to bottom = 120 days)



East / West Cross Section view to the South:



South Elevation

Solar / Wind Electrical Production from Greenhouse Roof will support - 21units -1,000 SF units @ 3,000kwh / year or 2.6 Ohana Eco Village 8-plexs on a 6 acre site.
Peliminary estimate -
4- Aeroponic Greenhouse & Solar / Wind Harvesting Platforms will support - 7 OEV 8-plexs , 1 Community Vision Center and ancillary facilities.

64,250 kwh / year / 3,000kwh / year = 21units

AEROTECTURE International Inc. - 15 - 6' x 10' Helical Wind Turbines
Bil Becker - Aerotecture
@ 10 mph average annual wind speed 1 Turbine produces
2,000 kwh / year x 15 = 30,000 kwh / year

UNI-SOLAR - photovoltaic roof - PVL- 136 w 18'x1.3' roll flex panel
Solar Roof area 36' X145.6'=
138 - 18' - 136 w panels = 18,768w x 5hrs = 93.84 kwh / day
93.84 kwh / day x 365 days = 34,250 kwh / year

Projected Total Annual Electric Power from Wind and Solar: 64,250 kwh / year

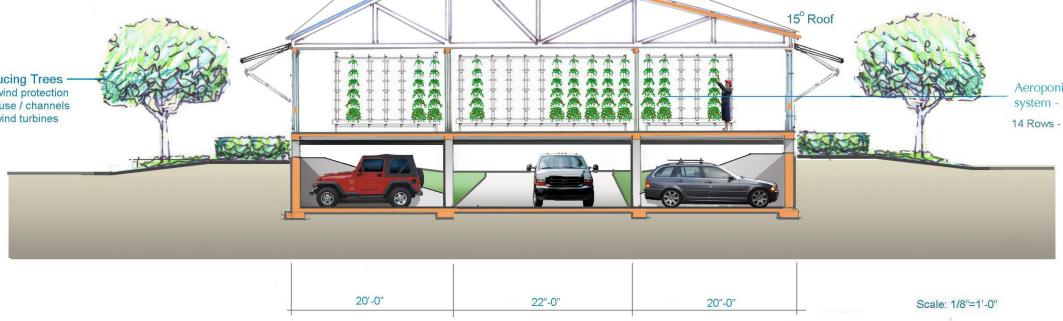
27.0'

North Translucent Roof

15° Roof

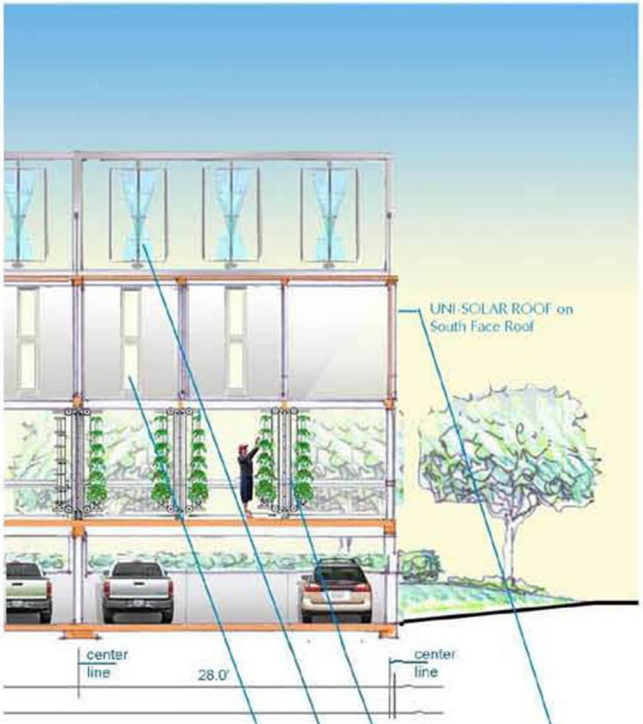
Fruit Producing Trees
shade and wind protection for Greenhouse / channels wind up to wind turbines

Aeroponic growing racks and conveyor system - Reinhold Ziegler - Synergy California L.P.
14 Rows - 10' High x 50'



Scale: 1/8"=1'-0"

Aeroponic Greenhouse & Solar / Wind Energy Harvesting Platform - Design Earth Synergy Inc.



Translucent Roof Panel Sky lights between Aeroponic Growing Racks

AEROTECTURE International Inc. - 15 - 6' x 10' Helical Wind Turbines
Bil Becker - Aerotecture
@ 12 mph average annual wind speed 1 Turbine produces
3,000 kwh / year x 15 = 45,000 kwh / year

Solar / Wind Electrical Production from Greenhouse Roof
will support - 21units -1,000 SF units @ 3,000kwh / year
or 3.75 Ohana Eco Village 8-plexs on a 6 acre site.
$\frac{90,000 \text{ kwh / year}}{3,000 \text{kwh / year}} = 30$ units
Peliminary estimate -
3 - Aeroponic Greenhouse & Solar / Wind Harvesting Platforms
will support - 7 OEV 8-plexs , 1 Community Vision Center and
ancillary facilities.

UNI-SOLAR - photovoltaic roof - PVL- 136 w 18'x1.3' roll flex panel

180 - 18' - 136 w panels = 24,480w x 5hrs = 122.4 kwh / day
122.4 kwh / day x 365 days = 44,676 kwh / year

Wind Turbines - 45,000 kwh / year
+ Photo-voltaics - 44,676 kwh / year
Projected Total Annual Electric Power from Wind and Solar: 89,676 kwh / year
90,000 kwh/year

27.0'
Clear story air vent
North Translucent Roof
perlins
15° Roof

Fruit Producing Trees
shade and wind protection
for Greenhouse / channels
wind up to wind turbines

Slope
Slab to
Drain
1"in 12'

Aeroponic growing racks and conveyor
system - Reinhold Ziegler - Synergy California L.P.
14 Rows - 10' High x 50'

synergyca@earthlink.net
www.synergyii.com
(415) 290 4990

20'-0" 22'-0" 20'-0"

Scale: 1/8"=1'-0"

Aeroponic Greenhouse & Solar / Wind Energy Harvesting Platform - Design Earth Synergy Inc.

PROFORMA
Estimated Income Stream from the system:

Tent Greenhouse: 10,000 sq ft.
Cost to build $500,000
Yearly Revenue from Plants: Up to $400,000/ year

Cost to operate: $153,000/yr

OHANA Energy Platform: 10,000 sq ft with grow lights.
Cost to build $1,000,000
Yearly Revenue from Plants: ~ $700,000
Yearly Revenue from Electricity produced:

- Solar: 45,000 kW/year at $.30/kWhr = $ 13,500
- Wind: $ 25,000

Salad Bar Retail sales: @ $5/bowl x 100 per day x 275 = $ 137,500
Structured water sales: @$1/gallon x 500 gallons/day x 275days = $ 74,250
"Solarchinos" coffee or tea:

Cost to operate: $175,000/yr