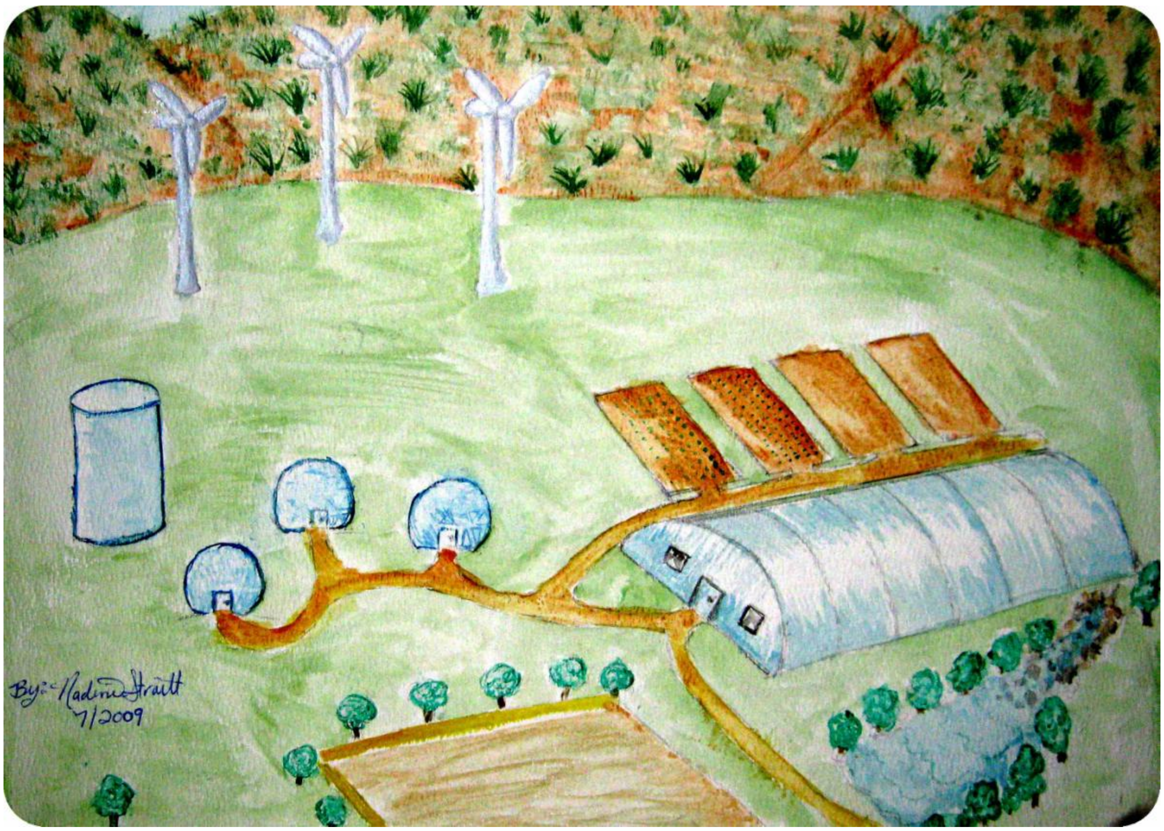
Project Overview

Year Round Pepper Growth Operation

Aquiculture and Aquaponics Facility



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7/19/2009

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Year Round Pepper Growth Operation

And

Aquiculture and Aquaponics Facility

Prepared for

Tim Rist

and

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Introduction

Google "Green Farm" on the internet and you will find many web pages with the term used on them but no official definitions of what "Green Farming". Green farming is an illusive and abstract term that encompasses many attempts to naturally grow crops or raise livestock with as little apparent impact to the environment as possible. The most common misconception made by laypeople, who are only aware of the buzzword and not at all familiar with the techniques and technologies that encompass "green farming" is that it is an agricultural operation that does not use any petroleum-based fuels. Nothing could be further from the truth and the whole underlying concept of "Green Farming" is.

For the purposes of the this project plan we will define "Green Farming" as: Green Farming, is an operation producing plants for harvesting, livestock, fish, or some combination of these, in which the process used are designed to minimize the amount of unusable waste material that is discarded into the environment locally or at some other location, in a manner that creates an environmental hazard.

Based on the definition above what is important for an operation to be considered "green" is not what energy source powers it but what is the total negative impact on the earth's environment because of its creation and continued operations. For example, using electricity for heat from a nuclear or coal fired electrical plant 300 miles away may be contributing to more green house gases emissions then say burning a cord of fallen tree limbs locally. The reason is that the fallen tree limbs decay anyway and release the same total amount of greenhouse gas into the atmosphere, whether they oxidize on the ground, or in your efficient wood stove. The coal and nuclear plants are releasing greenhouse gases and/or water vapor (a green house gas) into the atmosphere that would not have been released by a natural decaying process.

The idea is that you cannot get something for nothing. Our very presence on the earth's surface is going to change it. What we need to focus on is the minimization of adverse impacts on the environment and the promotion of neutral or positive impacts. If we can counter every adverse impact with substantial neutral growth or even better positive improvements then we get as close to a zero sum situation as possible and preserve our environment for virtually an indefinite time.

The purpose of this project overview is to outline a combined aquiculture and agriculture operation that utilizes alternative energy where feasible, recycles natural resources on site in an environmentally friendly way, and minimizes the total amount of local or remote generated waste products. The overview presents a production process that is virtually clean and green, while still being economical and profitable to operate.

Fisheries, Aquaponics, and Organic Agriculture

Nature best knows how to care for itself, and in nature we find that the optimum environments are those in which circle of life includes agricultural like processes (plants and animals) aquatic like processes (fish and algae), and Aquaponics processes (water plants) in a totally integrated and somewhat closed loop system. We say somewhat closed loop because water is really the only variable, clean water enters the system and clean water exits. The ultimate in green farming can best be achieved then by trying to mimic this natural process as completely as possible.

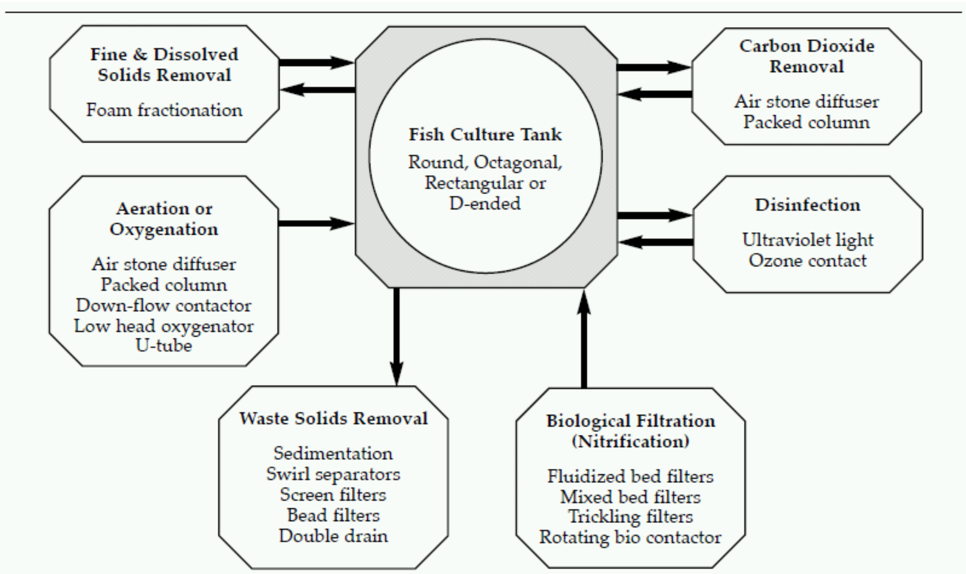
Many farmers are aware of the Organic Farming Movement. Although there is considerable pushback about it and in some case willful misapplication of the term, organic farming is really nothing more then reverting to the centuries old farming methods that have proven themselves most efficient, with the application of modern technology that makes the operation cost competitive. Across America, small profitable farms are making a resurgence as modern technology and yesterdays farming practices are combined. One area that has played a significant role in this resurgence is the practice of aquaculture or fish farming. Unlike the ole' trout stream or pond of your grandfathers era, these new aquaculture farms are clean, environmentally friendly, easy to run and most of all highly profitable. Although fish farming goes back for centuries, what is a new addition however is hypnotic gardening or the growing of plants in only water with out any soil. Combine these diverse growing methods together along with clean alternative energy as the primary energy source and one has a truly "Green Farm' by anyone's definition.

Hydroponics: Hydroponics is the growing of plants in a soilless medium. Two systems are generally used. The more passive Nutrient Film Technique (NFT) involves growing seedlings on floating rafts in non-circulating water, such as, a trough of nutrient rich water. A more active system is based on circulating nutrient rich water past plants started in holes in pipes with their root system fully immersed in the water, or liquid hydroponics. Although fertigation (use of soluble commercial fertilizer, calcium nitrate for example) is a popular way of growing plants in a commercial enterprise, there is a green approach. The use of natural nutrients from Fish effluent can be the food stock for a variety of easy to grow and highly profitable organic foods. Fish effluent (manure) has been found to contain enough ammonia, nitrate, nitrite, phosphorus, potassium, and other secondary and micronutrients to feed a variety of hydroponics plants. This type of hydroponics is called Aquaponics. Plants that are readily adaptable to aquaponics gardening include peppers, tomatoes, leafy vegetables like lettuce and spinach, and of course herbs. In a liquid system or hybrid system as propose herein, it is best to have the flow of nutrients first feed those plants yielding fruit (tomatoes, bell peppers, and cucumbers) , which have a higher nutritional demand. Next, lettuce, herbs, and specialty greens (spinach, chives, basil, and watercress), which have low to medium nutritional requirements, should be planted. Finally, plants like melons, pumpkins, and wetland plants (used for wetland reclamation projects) are planted in soil-based filter beds that remove the solids from the water before it is oxygenated and returned to the fish tanks.

Fish Species: There are a number of species of fish that are well adapted to recirculating aquaculture systems, including both warm-water and cold-water species. Tilapia (right), trout, perch, Arctic char, and bass are the most common. Catfish are found in many fisheries and can be used but the market is well supplied by exiting sources and not as profitable for aquiculture setups. Tilapia a warm-water fish does well in a recirculating tank environment and is does not require as stable water conditions as some other species. Water quality parameters include dissolved oxygen, carbon dioxide, ammonia, nitrate, nitrite, pH, and chlorine.

Tilapia (Diver, 2006)

Biofiltration and Suspended Solids: Aquaculture effluent contains nutrients, dissolved solids, and waste byproducts that must be removed by the aquaponics system. Although commercial filters and cartridges to collect suspended solids in fish effluent are available, natural methods can produce amazing results. This project will utilize a four-stage approach. In the first stage, water will be passed though pipes beneath pepper grow beds, where the flow rate will be maintained to partially flood the lower section of the



Required unit processes and some typical components used in recirculating aquaculture production systems.

(Losordo, Masser, & Rakocy, 1998)

soil so that the pepper roots can take nutrients and water as required. Next, the water will flow into tanks where NFT hydroponics plants are being grown to begin the solid settling process, while allowing controlled release of solids to stage three. These solids can be periodically flushed from the tank. The third stage evolves the use of soil based filtering/grow beds where the water is allowed filter though different layers of soils removing most of the solids. Finally, stage four is an oxygenation process in which the water is passed over rock falls and manmade rapids to oxygenate it, held in a natural air pond, and returned to the fish tanks after passing through a reusable filter to remove any floating organics from the pond (grass, bugs, etc).

System Overview

The project can be categorized by the five primary elements of the concept.

1. Fisheries – The main fish facility is a design of three 8 – 10 foot diameter round plastic fish growth tanks protected by geodesic dome roofs made of recycled materials where possible. The water is supplied by a shallow drilled well on the property and the water is pumped to a 3,000 to 5,0000 gallon, water storage tank, which should be insulated to maintain desired temperature, before being circulated into the fish tanks. Insulation of the tank allowed for virtually energy free temperature control of the water supply to the tanks.

A simplified combination Aquaponics and Aquiculture System

This concept eliminated the need for continuous pumping of water from the well and/or the need to refrigerate or heat the water depending on ambient environmental conditions to maintain optimum water temperature for fish production.

2. **Green Houses** – Several designs for green houses were explored and previously experimented with, including rigid panel, before a final green house design was selected. The design ultimately proven to be the most durable, functional, cost-effective, and environmentally green/friendly was that of an inverted half round metallic frame covered with two layers of 6 and/or 8 mil UV-stabilized poly film sheeting. Small box fans similar to what is found in a standard desktop computer is used to pressurize the space between the layers, in order to lift the outer layer and provide 4 to 6 inches of insulating air. A sun-blocking layer will need to be added to the outside to maintain a manageable amount of solar radiation entering the greenhouse... Additionally a solar powered fan could be used to inflate the layers. The insulation value, ease of operations, and maintenance of this structure was found to be superior to the double-layered UV-stabilized polycarbonate panels, for this application. The cost of construction was considerably lower then other alternatives as a complete 28 by 95 foot greenhouse kit, including frame, coverings, vent fans, 200,000 BTU heater, and all necessary hardware currently costs only about $10,701.00.

System E2895 - 28' x 95'

- Complete 28' x 95' frame** with 1-5/8" bows and 5 ft. bow spacing. 2660 sq. ft. (4ft bow spacing available at additional cost)
- Double layer, inflated, 4 yr 6mil poly film cover
- Kwic-Klip poly attachment system
- One heavy-duty storm door
- One 42" 2-speed, 3/4 HP exhaust fan
- One 42" 1-speed, 3/4 HP exhaust fan
- One 33" motorized gable shutter
- Two 57" motorized intake shutter
- 200,000 BTUH heater with vent pipe and heater hanger
- Four 20" Uni-Flo HAF fans
- All necessary thermostats

Item	Price	Sale Price
System E2895 Package	$11,474.00	$10,701.00
Options	**Price**	
Metal Endwall* for polyethylene ends	$665.00	
Metal Endwall* for polycarbonate ends	$825.00	
Upgrade Carolina Cooler & Versa Vent for E2895	$2,508.00	$2,452.00
Northern Upgrade to E2896 (4' bow spacing)	$2,490.00	$1,205.00
Optional twinwall polycarbonate endwalls	$1,650.00	

*Metal endwalls are made of 1-1/2" square tubing. Metal ends are field-cut to fit required equipment and are attached with exclusive endwall connectors.

**Customer must provide treated lumber for endwall framing and base boards. Treated lumber should be used for best results. Optional

3. **Green House Hydroponics and Raised Bed Gardening** – The green house is to be used to support a

commercial Pepper Growing/canning operation. Secondary plants will organically grown tomatoes, lettuce, herbs, and other vegetable for the Las Vegas restaurant markets. Raised beds will be constructed out of split 15-inch plastic corrugated pipes framed by 2x8 pressure treated lumber for stability and extra soil depth.

4. **Grow beds** - will be filled with organic compost and local soil mix. Plant seedlings were started and then transferred to the raised beds and hydroponics growth area as necessary. High nutrient water supplied by the fisheries was gravity fed into the green house to irrigate the raised beds and provide high nutrient water for the hydroponics operations. About 600 feet of raised soil beds will be available for peppers. Each bed section can support two rows of pepper, providing about 1200 linear feet of pepper rows. Upon leaving the raised beds water will flow into Nutrient Film Technique or NFT growth tanks where plants such as lettuce can be grown and initial solid separation is performed. The water can then be pumped to overhead hydroponics growth pipes where plants such as tomatoes, squash, and zucchinis, can be grown in an overhead lattice network. Finally, the water will flow into filter/growth beds where it will be allowed to filter through soil and the remaining solid matter will be removed. After this third stage, the water will be pumped to a manmade waterfall with rapids located in a manmade pond that will allow for oxygenation of the water. Water will then be returned to the fisheries for reuse.

5. **Wet Lands Restoration Vegetation** – Obviously the transplanting of wetland plant life from one wetland area to another compounds the wetland decimation problem. Thus, the restoration of damaged wetlands with plants species native to the damaged area is dependent on an abundant supply of cultivated wetland plant species. Nutrient rich water from a commercial fisheries operation can significantly damage an ecosystem if it is dumped directly into the environment, such as allowing it to flow directly into a surface water stream. The residue from a fishery must be handled safely as well. By creating multiple artificial wetland growing areas some of the waste water coming from the fisheries, can be diverted from being used or used after being used in the greenhouses, to these growth areas were it can be used to grow wetland plant species.

The plants can then be harvested on demand to fill the needs of wetland reclamation projects around the country. In addition, plant species could be custom grown as needed to meet any reclamation project's requirements; a controlled environment can also be obtained by placing a green house over designated growth beds.

Alternative Energy:

Energy for the operation will be supplied by a 10kW wind turbine with grid connection and backup 10kw generator. For this application a Liten LT8.0 - 10kW Turbine manufactured and sold by Liten Windpower is recommended. Based on average wind speed recorded over the last several years at Caliente the LT8.0 provides the best installation cost per production power and production cost ratios of the 6 wind turbines included in this review. Peak demand of the operation is enough below 10kW that surplus power should be available to net-meter back into the grind through out the year. A power storage system was not included at this time and could be a future enhancement. Because of the value added in net metering surplus power back to the grid, it is advisable from a cost standpoint to utilize grid power when the wind turbine is not producing enough energy. A backup 10kW generator is included in the system in the event of terminal failure of the primary power and the grid to prevent loss of water for the fisheries. A Generac Guardian Series™ 10 kW Emergency Power System LP/Natural Gas model

was selected as it can run off the LP tank for the green house heater. A future enhancement or design option for the operation could be a diesel generator and oil fired furnace for the green house. Both of these devises could then be fueled with bio-diesel produced in the local area.

Production and Potential Revenues:

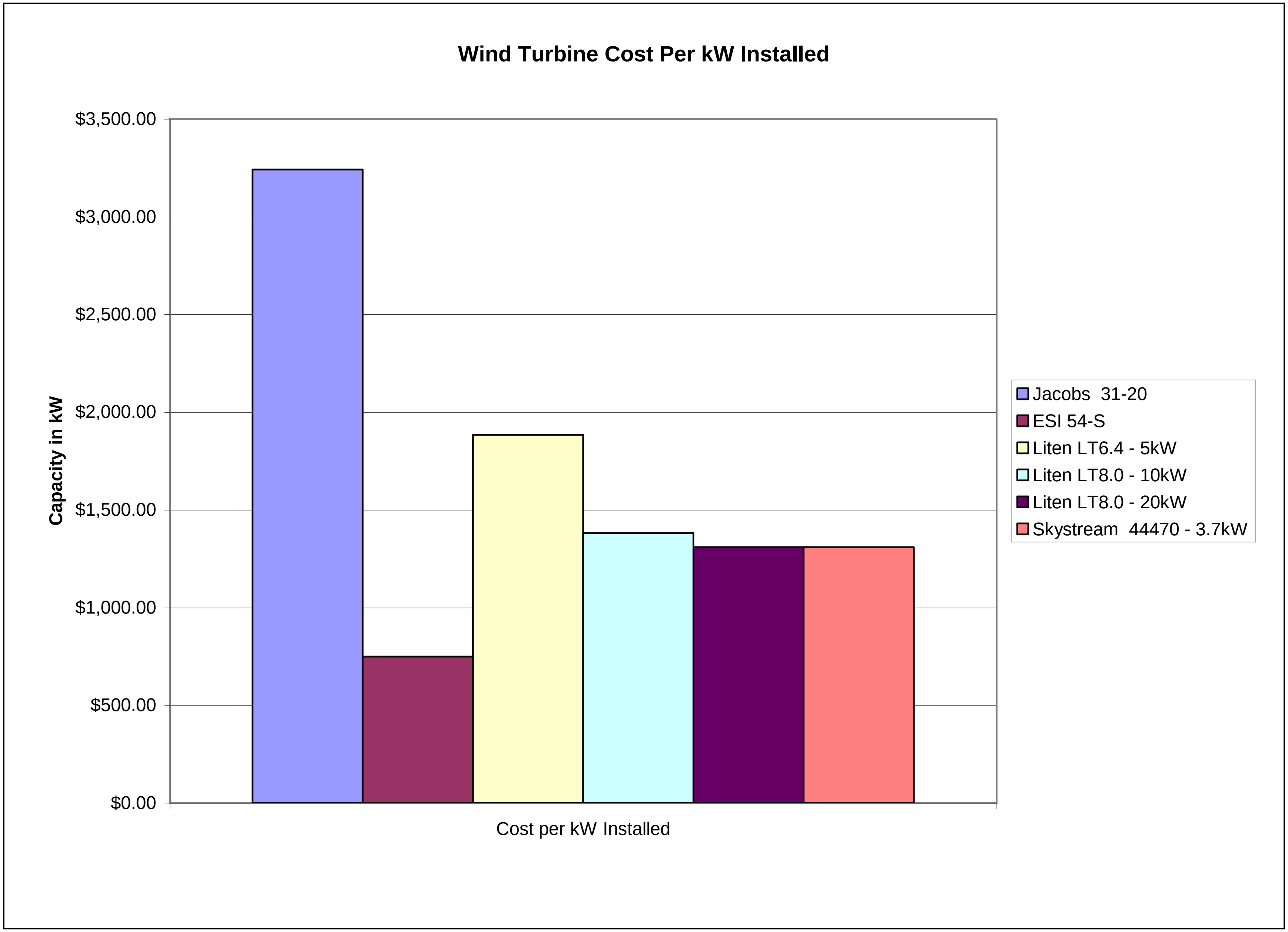
Sample Potential Yearly Opertional Revenues

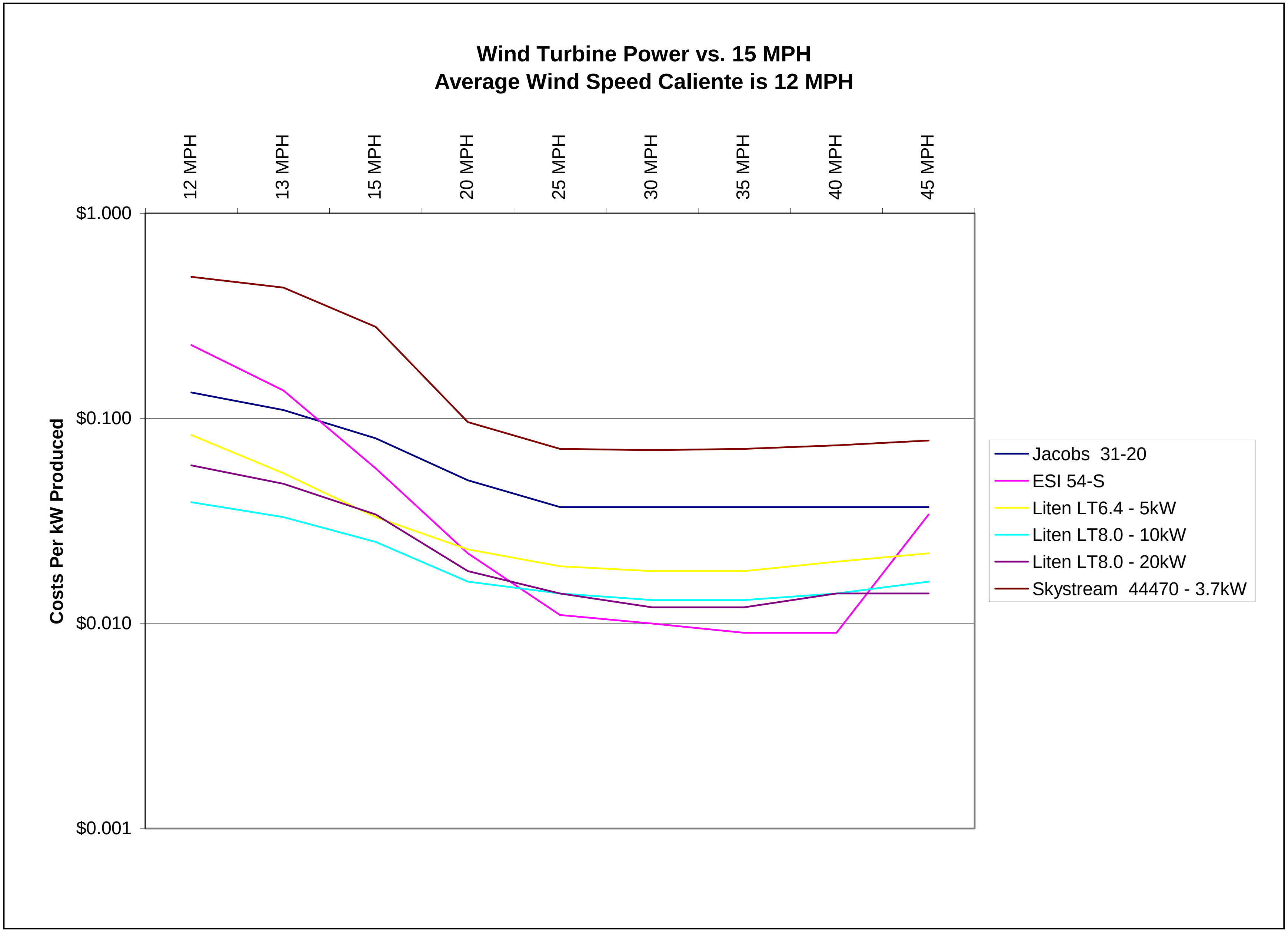
Pepper Production 6" Planting / 2 rows per bed	1200 Lineal Feet = 2400 plants	2 Quart per plant per 3 month period	19200 Quarts per year @ $10/qt	$	192,000.00
Fish Salmon	300 Pounds per month	$10/pound	$45,00/month	$	54,000.00
100 Organic Tomatoes Plants	10 pounds per week = 100 pounds	$3/pound	$300/week	$	15,600.00
Organic Lettuce butter head	200 plants per 1.5 months	$3/plant	$800/month	$	9,600.00
Organic Squash	30 Plants @ 15 lbs/plant per week	$2/pound	$900/week	$	46,800.00
Organic Zucchini	30 Plants @ 15 lbs/plant per week	$2/pound	$900/week	$	46,800.00
Wetland Reclamation Grasses*	144000 plugs per 20x50 outside grow plot	2 harvests/year	$1/plug	$	288,000.00
Wetland Reclamation Ferns**	6000 plants per 20x50 outside grow plot	2 harvests/year	$6.50/plant	$	78,000.00
Wetland Reclamation Schrubs**	1500 plants per 20x50 outside grow plot- 2 plots	2 harvests/year	$10.00/plant	$	60,000.00
			Total	**$**	**790,800.00**

*http://www.vermontwetlandplants.com/plants_restoration.html
**http://www.newp.com/ferns.htm

Major Parts List

Item #	Item Name	Model Number	Source	Units	Unit Cost	Extended Cost	URL
1	Freestanding Greenhouse complete package w vents and heater 28' x 95' 2660 sq ft.	System E2895 Package - 28' x 95'	Gothic Arch Greenhouses	1	$10,701.00	$10,701.00	http://www.gothicarchgreenhouses.com/economyfreestandingpackages.html
1a	Optional twin wall polycarbonate end walls			1	$1,650.00	$1,650.00	http://www.gothicarchgreenhouses.com/economyfreestandingpackages.html
1b	Metal End wall* for polycarbonate ends			1	$825.00	$825.00	http://www.gothicarchgreenhouses.com/economyfreestandingpackages.html
2	Myers Sub. Well Pump 50 GPM 2 HP 230V with Control Box	FEM-ASY-SJF2021L-SS2050	King Pumps	1	$1,091.00	$1,091.00	http://store.waterpumpsupply.com/myersubwelpu.html
3	920 Gallon Poly Livestock Trough 106" Dia. x 29"H	ARM-10135	Plastic-Mart.com	3	$319.99	$959.97	http://www.plastic-mart.com/class.php?item=3416
4	2500 Gallon Plastic Water Storage Tanks 96" dia. x 92"H	GRN2500-96RMD	Plastic-Mart.com	1	$699.99	$699.99	http://www.plastic-mart.com/class.php?item=87
5	18' x 20' PVC Pond Liner Outside Pond Liner	PVC1820	Pondliner.com	2	$180.00	$360.00	http://www.pondliner.com/product/18_x_20_pvc_pond_liner/fish_grade_pvc_pond_liners
6	Generic EPDM 3" Seam Tape	EPDMSMTP-100	Pondliner.com	1	$75.00	$75.00	http://www.pondliner.com/product/3_inch_epdm_seam_tape/epdm_splicing_supplies
7	Inside Grow bed liner for water filtering 15' x 40' Firestone 45 mil EPDM Pond Liner	E15040	Pondliner.com	1	$264.00	$264.00	http://www.pondliner.com/product/15_x_40_firestone_45_mil_epdm_pond_liner/Firestone_EPDM_Pond_Liners_15
8	Geodesic Dome Connector Kit for 2 x 4	GD2-X1	GardenDome.com	3	$396.00	$1,188.00	http://www.gardendome.com/gd2x1_plan.html
8a	Boards, Main Dome struts, 33, 2 x 4 x 10 ft			99	$4.75	$470.25	http://www.gardendome.com/gd2x1_plan.html
8b	Boards, X1 Subdivision struts, 25, 2 x 4 x 8 ft			75	$2.75	$206.25	http://www.gardendome.com/gd2x1_plan.html
8c	Wood preservative sealant for struts, 2 gallons/dome			6	$15.00	$90.00	http://www.gardendome.com/gd2x1_plan.html
8d	Roof panels made from 4 x 8 ft sheets: Qty 20 7/16" OSB/dome			60	10	$600.00	http://www.gardendome.com/gd2x1_plan.html
8e	Nails/screws for OSB installation, 4 lbs/dome			12	5	$60.00	
9	Pepper Beds 15" Corrugated Pipe Split in half	N-12 PROLINK ULTRA 33701 PC 15850020IB	Agri Supply Company	15	149.95	$2,249.25	http://www.agrisupply.com/store/3200005.htm
10	Pressure Treated 8' 2x8s for framing Pepper Beds and legs			125	$6.00	$750.00	
11	Perforated Pipe, 3" x 100' for raised pepper bed feeders	639079	Auborchon Hardware	6	$49.99	$299.94	http://plumbing.hardwarestore.com/52-297-corrugated-drain/perforated-pipe-639079.aspx
12	Perforated Pipe, 3" x 100' for filter beds	639079	Auborchon Hardware	2	$49.90	$99.80	http://plumbing.hardwarestore.com/52-297-corrugated-drain/perforated-pipe-639079.aspx
13	Corrugated Pipe, 3" x 100' for filter beds	639403	Auborchon Hardware	3	$49.90	$149.70	http://plumbing.hardwarestore.com/52-297-corrugated-drain/solid-pipe-639403.aspx
12	Liten 10 kW Wind Turbine	LT8.0-10000W	Liten Windpower Corp	1	$13,820.00	$13,820.00	http://www.wind-turbine.cn
13	Generac Guardian Series™ 10 kW Emergency Power System LP/Natural Gas	Model 5502	Electric Generators Direct	1	$2,739.00	$2,739.00	http://www.electricgeneratorsdirect.com/Generac-Guardian-5502/p1820.html
13	Mis Parts and Supplies			1	$5,000.00	$5,000.00	
			Total Pepper/Aquafarm Costs			$44,348.15	


Wind Turbine Cost Per kW Installed
$3,500.00
$3,000.00
$2,500.00
$2,000.00
$1,500.00
$1,000.00
$500.00
$0.00
Capacity in kW
Cost per kW Installed
Jacobs 31-20
ESI 54-S
Liten LT6.4 - 5kW
Liten LT8.0 - 10kW
Liten LT8.0 - 20kW
Skystream 44470 - 3.7kW


Wind Turbine Power vs. 15 MPH
Average Wind Speed Caliente is 12 MPH
12 MPH
13 MPH
15 MPH
20 MPH
25 MPH
30 MPH
35 MPH
40 MPH
45 MPH
Costs Per kW Produced
$1.000
$0.100
$0.010
$0.001
Jacobs 31-20
ESI 54-S
Liten LT6.4 - 5kW
Liten LT8.0 - 10kW
Liten LT8.0 - 20kW
Skystream 44470 - 3.7kW

Revenue and Break-Even Point at 15 MPH Average Wind Speed

		Turbine Now at Caliente		Recommended Turbine		
	Turbine 1	**Turbine 2**	**Turbine 3**	**Turbine 4**	**Turbine 5**	**Turbine 6**
Turbine	Jacobs	ESI	Liten	Liten	Liten	Skystream
Model	31-20	54-S	LT6.4 - 5kW	LT8.0 - 10kW	LT8.0 - 20kW	44470 - 3.7kW
Manufacturer/Supplier	Wind Turbine Industries	TJA,LLC	Liten Windpower	Liten Windpower	Liten Windpower	Skystream
Unit Rated kW	20	80	5	10	20	3.7
URL	http://www.windturbine.net/products.htm		http://www.wind-turbine.cn	http://www.wind-turbine.cn	http://www.wind-turbine.cn	http://www.skystreamenergy.com/
Number of units	1	1	2	1	1	1
Cost Per Unit	$54,850.00	$30,000.00	$6,420.00	$8,820.00	$16,200.00	$11,299.98
Installation of Turbine	$10,000.00	$5,000.00	$3,000.00	$5,000.00	$10,000.00	$3,000.00
Total Cost	$64,850.00	$35,000.00	$18,840.00	$13,820.00	$26,200.00	$14,299.98
Installed System kW	20	80	10	10	20	3.7
Wind Speed	15 MPH / 6.71 M/Sec	15 MPH / 6.71 M/Sec	15 MPH / 6.71 M/Sec	15 MPH / 6.71 M/Sec	15 MPH / 6.71 M/Sec	15 MPH / 6.71 M/Sec
kW at Listed Speed (per unit)	9.19	12.00	3.25	6.40	8.90	0.60
Production Availability	100%	100%	100%	100%	100%	100%
Total kWh Produced Daily (all)	221	288	156	154	214	14
Total kWh Produced Annually	80665	105120	56940	56210	78110	5110
Revenue Per kWH	$0.030	$0.030	$0.030	$0.030	$0.030	$0.030
Average Monthly Electric Bill	$213.000	$213.000	$213.000	$213.000	$213.000	$213.000
Yearly Electric Bill	$2,556.000	$2,556.000	$2,556.000	$2,556.000	$2,556.000	$2,556.000
Net Metering Profit/Loss						
Net-metered Daily Costs	($0.37)	$1.64	($2.32)	($2.38)	($0.58)	($6.58)
Net-metered Monthly Costs	($11.34)	$0.00	($70.65)	($72.47)	($17.72)	($200.22)
Net-metered Yearly Costs	($136.05)	$0.00	($847.80)	($869.70)	($212.70)	($2,402.70)
Years to Break Even	26.80	13.69	11.03	8.20	11.18	93.28
Power Purchase Agreement Profit/Loss						
PPA Daily Revenue	$6.63	$8.64	$4.68	$4.62	$6.42	$0.42
PPA Monthly Revenue	$201.66	$262.80	$142.35	$140.53	$195.28	$12.78
PPA Yearly Revenue	$2,419.95	$3,153.60	$1,708.20	$1,686.30	$2,343.30	$153.30
Cost per kW Produced (10yr)	$0.080	$0.033	$0.033	$0.025	$0.034	$0.280
Cost per kW Installed	$3,242.50	$437.50	$1,884.00	$1,382.00	$1,310.00	$3,864.86
Yearly System Costs (10 yr)	$6,485.00	$3,500.00	$1,884.00	$1,382.00	$2,620.00	$1,430.00
Yearly System Profit (10 yr)	($4,065.05)	($346.40)	($175.80)	$304.30	($276.70)	($1,276.70)
Years to Break Even	26.80	11.10	11.03	8.20	11.18	93.28

Revenue and Break-Even Point at 15 MPH Average Wind Speed

		Turbine Now at Caliente		Recommended Turbine		
	Turbine 1	**Turbine 2**	**Turbine 3**	**Turbine 4**	**Turbine 5**	**Turbine 6**
Turbine	Jacobs	ESI	Liten	Liten	Liten	Skystream
Model	31-20	54-S	LT6.4 - 5kW	LT8.0 - 10kW	LT8.0 - 20kW	44470 - 3.7kW
Manufacturer/Supplier	Wind Turbine Industries	TJA,LLC	Liten Windpower	Liten Windpower	Liten Windpower	Skystream
Unit Rated kW	20	80	5	10	20	3.7
URL	http://www.windturbine.net/products.htm		http://www.wind-turbine.cn	http://www.wind-turbine.cn	http://www.wind-turbine.cn	http://www.skystreamenergy.com/
Number of units	1	1	2	1	1	1
Cost Per Unit	$54,850.00	$30,000.00	$6,420.00	$8,820.00	$16,200.00	$11,299.98
Installation of Turbine	$10,000.00	$5,000.00	$3,000.00	$5,000.00	$10,000.00	$3,000.00
Total Cost	$64,850.00	$35,000.00	$18,840.00	$13,820.00	$26,200.00	$14,299.98
Installed System kW	20	80	10	10	20	3.7
Wind Speed	15 MPH / 6.71 M/Sec	15 MPH / 6.71 M/Sec	15 MPH / 6.71 M/Sec	15 MPH / 6.71 M/Sec	15 MPH / 6.71 M/Sec	15 MPH / 6.71 M/Sec
kW at Listed Speed (per unit)	9.19	12.00	3.25	6.40	8.90	0.60
Production Availability	100%	100%	100%	100%	100%	100%
Total kWh Produced Daily (all)	221	288	156	154	214	14
Total kWh Produced Annually	80665	105120	56940	56210	78110	5110
Revenue Per kWH	$0.030	$0.030	$0.030	$0.030	$0.030	$0.030
Average Monthly Electric Bill	$213.000	$213.000	$213.000	$213.000	$213.000	$213.000
Yearly Electric Bill	$2,556.000	$2,556.000	$2,556.000	$2,556.000	$2,556.000	$2,556.000

Net Metering Profit/Loss

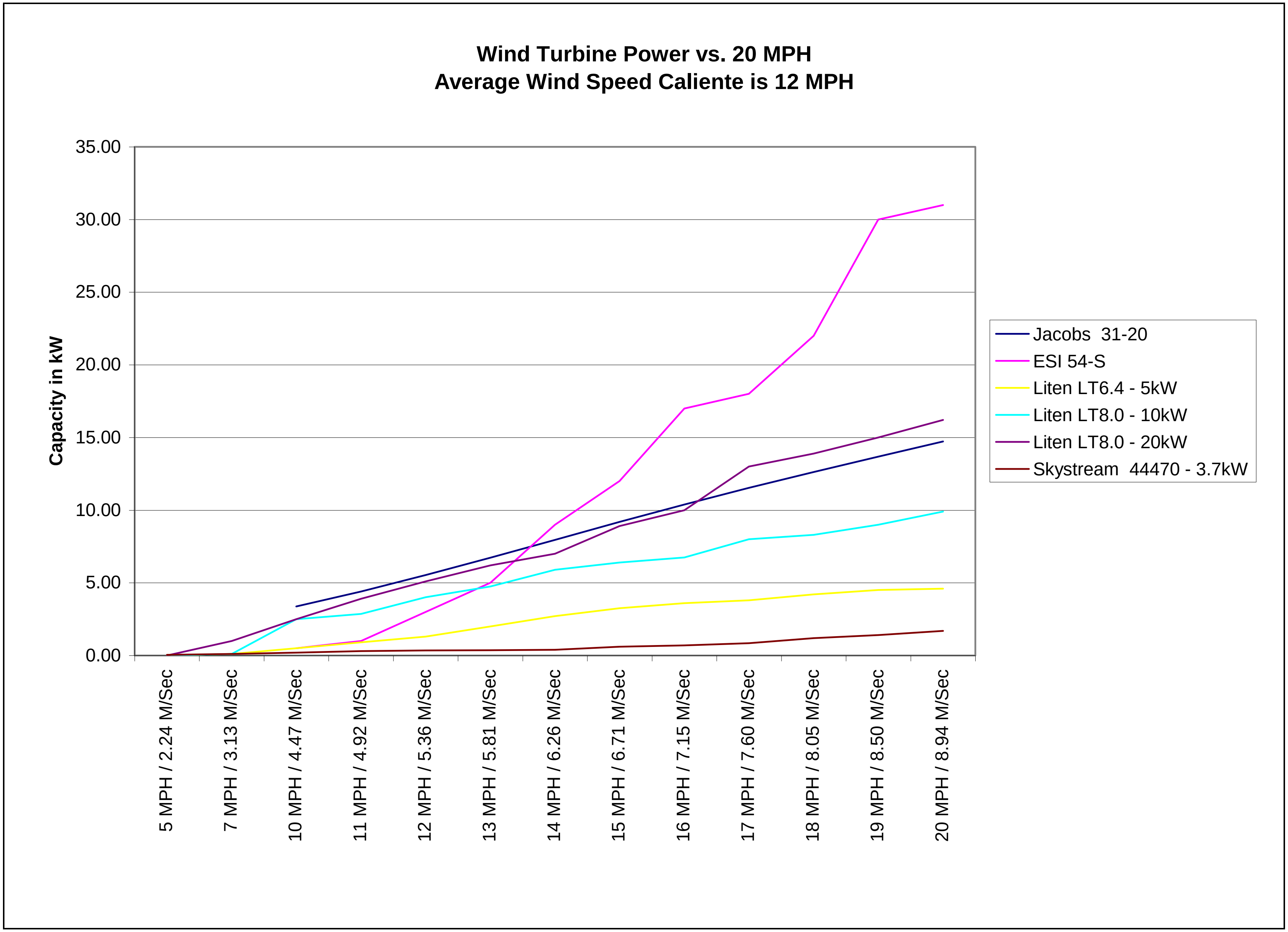
Net-metered Daily Costs	($0.37)	$1.64	($2.32)	($2.38)	($0.58)	($6.58)
Net-metered Monthly Costs	($11.34)	$0.00	($70.65)	($72.47)	($17.72)	($200.22)
Net-metered Yearly Costs	($136.05)	$0.00	($847.80)	($869.70)	($212.70)	($2,402.70)
Years to Break Even	26.80	13.69	11.03	8.20	11.18	93.28

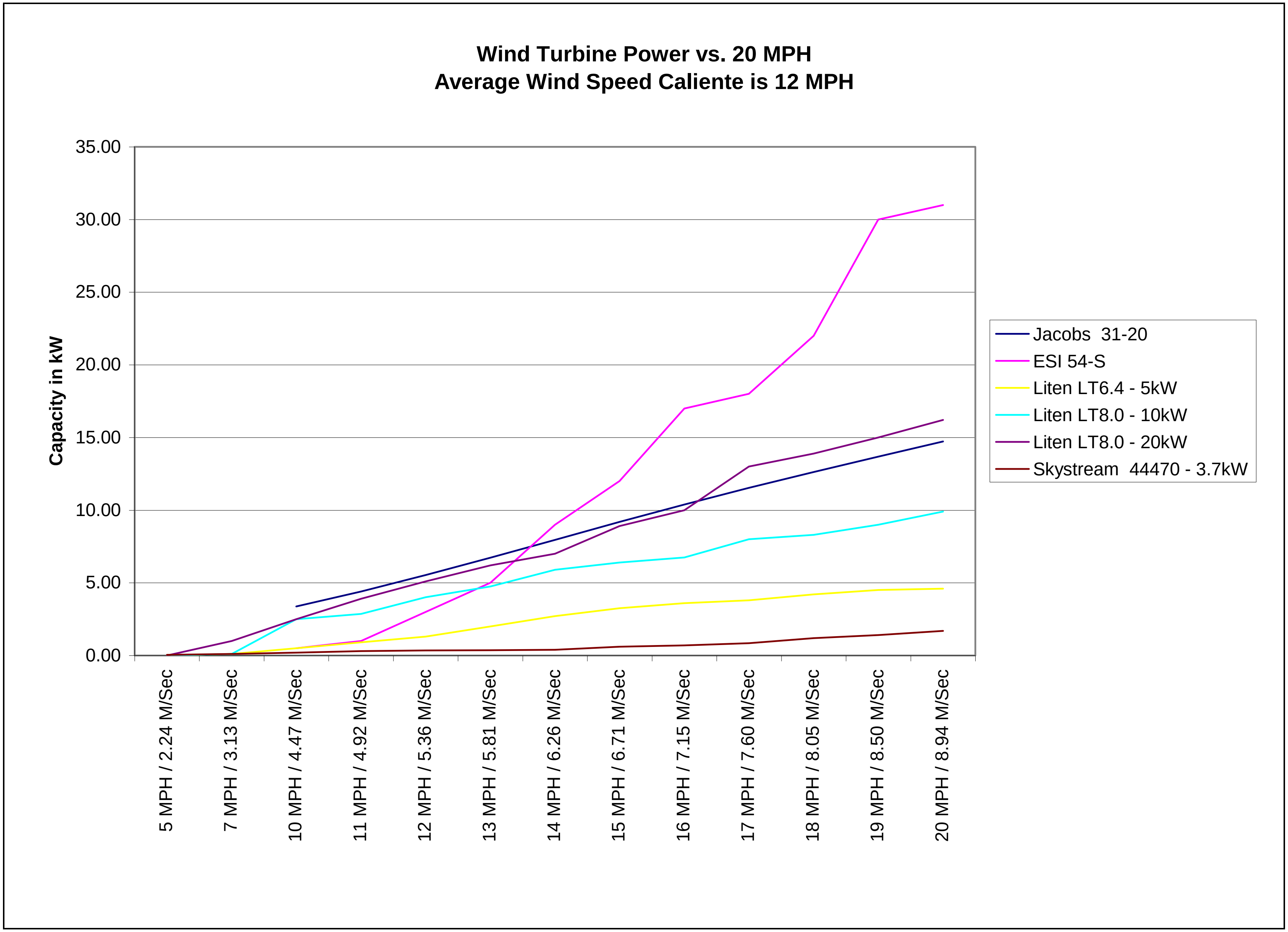
Power Purchase Agreement Profit/Loss

PPA Daily Revenue	$6.63	$8.64	$4.68	$4.62	$6.42	$0.42
PPA Monthly Revenue	$201.66	$262.80	$142.35	$140.53	$195.28	$12.78
PPA Yearly Revenue	$2,419.95	$3,153.60	$1,708.20	$1,686.30	$2,343.30	$153.30
Cost per kW Produced (10yr)	$0.080	$0.033	$0.033	$0.025	$0.034	$0.280
Cost per kW Installed	$3,242.50	$437.50	$1,884.00	$1,382.00	$1,310.00	$3,864.86
Yearly System Costs (10 yr)	$6,485.00	$3,500.00	$1,884.00	$1,382.00	$2,620.00	$1,430.00
Yearly System Profit (10 yr)	($4,065.05)	($346.40)	($175.80)	$304.30	($276.70)	($1,276.70)
Years to Break Even	26.80	11.10	11.03	8.20	11.18	93.28

Revenue and Break-Even Point at 20 MPH Average Wind Speed

		Turbine Now at Caliente		Recommended Turbine		
	Turbine 1	**Turbine 2**	**Turbine 3**	**Turbine 4**	**Turbine 5**	**Turbine 6**
Turbine	Jacobs	ESI	Liten	Liten	Liten	Skystream
Model	31-20	54-S	LT6.4 - 5kW	LT8.0 - 10kW	LT8.0 - 20kW	44470 - 3.7kW
Manufacturer/Supplier	Wind Turbine Industries	TJA,LLC	Liten Windpower	Liten Windpower	Liten Windpower	Skystream
Unit Rated kW	20	80	5	10	20	3.7
URL	http://www.windturbine.net/products.htm		http://www.wind-turbine.cn	http://www.wind-turbine.cn	http://www.wind-turbine.cn	http://www.skystreamenergy.com/
Number of units	1	1	2	1	1	1
Cost Per Unit	$54,850.00	$30,000.00	$6,420.00	$8,820.00	$16,200.00	$11,299.98
Installation of Turbine	$10,000.00	$5,000.00	$3,000.00	$5,000.00	$10,000.00	$3,000.00
Total Cost	$64,850.00	$35,000.00	$18,840.00	$13,820.00	$26,200.00	$14,299.98
Installed System kW	20	80	10	10	20	3.7
Wind Speed	20 MPH / 8.94 M/Sec	20 MPH / 8.94 M/Sec	20 MPH / 8.94 M/Sec	20 MPH / 8.94 M/Sec	20 MPH / 8.94 M/Sec	20 MPH / 8.94 M/Sec
kW at Listed Speed (per unit)	14.73	31.00	4.60	9.91	16.20	1.70
Production Availability	100%	100%	100%	100%	100%	100%
Total kWh Produced Daily (all)	354	744	221	238	389	41
Total kWh Produced Annually	129210	271560	80665	86870	141985	14965
Revenue Per kWH	$0.030	$0.030	$0.030	$0.030	$0.030	$0.030
Average Monthly Electric Bill	$213.000	$213.000	$213.000	$213.000	$213.000	$213.000
Yearly Electric Bill	$2,556.000	$2,556.000	$2,556.000	$2,556.000	$2,556.000	$2,556.000
Net Metering Profit/Loss						
Net-metered Daily Costs	$3.62	$15.32	($0.37)	$0.14	$4.67	($5.77)
Net-metered Monthly Costs	$0.00	$0.00	($11.34)	$0.00	$0.00	($175.59)
Net-metered Yearly Costs	$0.00	$0.00	($136.05)	$0.00	$0.00	($2,107.05)
Years to Break Even	25.37	13.69	7.79	5.41	10.25	31.85
Power Purchase Agreement Profit/Loss						
PPA Daily Revenue	$10.62	$22.32	$6.63	$7.14	$11.67	$1.23
PPA Monthly Revenue	$323.03	$678.90	$201.66	$217.18	$354.96	$37.41
PPA Yearly Revenue	$3,876.30	$8,146.80	$2,419.95	$2,606.10	$4,259.55	$448.95
Cost per kW Produced (10yr)	$0.050	$0.013	$0.023	$0.016	$0.018	$0.096
Cost per kW Installed	$3,242.50	$437.50	$1,884.00	$1,382.00	$1,310.00	$3,864.86
Yearly System Costs (10 yr)	$6,485.00	$3,500.00	$1,884.00	$1,382.00	$2,620.00	$1,430.00
Yearly System Profit (10 yr)	($2,608.70)	$4,646.80	$535.95	$1,224.10	$1,639.55	($981.05)
Years to Break Even	16.73	4.30	7.79	5.30	6.15	31.85


Wind Turbine Power vs. 20 MPH
Average Wind Speed Caliente is 12 MPH
Capacity in kW
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
5 MPH / 2.24 M/Sec
7 MPH / 3.13 M/Sec
10 MPH / 4.47 M/Sec
11 MPH / 4.92 M/Sec
12 MPH / 5.36 M/Sec
13 MPH / 5.81 M/Sec
14 MPH / 6.26 M/Sec
15 MPH / 6.71 M/Sec
16 MPH / 7.15 M/Sec
17 MPH / 7.60 M/Sec
18 MPH / 8.05 M/Sec
19 MPH / 8.50 M/Sec
20 MPH / 8.94 M/Sec
Jacobs 31-20
ESI 54-S
Liten LT6.4 - 5kW
Liten LT8.0 - 10kW
Liten LT8.0 - 20kW
Skystream 44470 - 3.7kW


Wind Turbine Power vs. 20 MPH
Average Wind Speed Caliente is 12 MPH
Capacity in kW
35.00
30.00
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15.00
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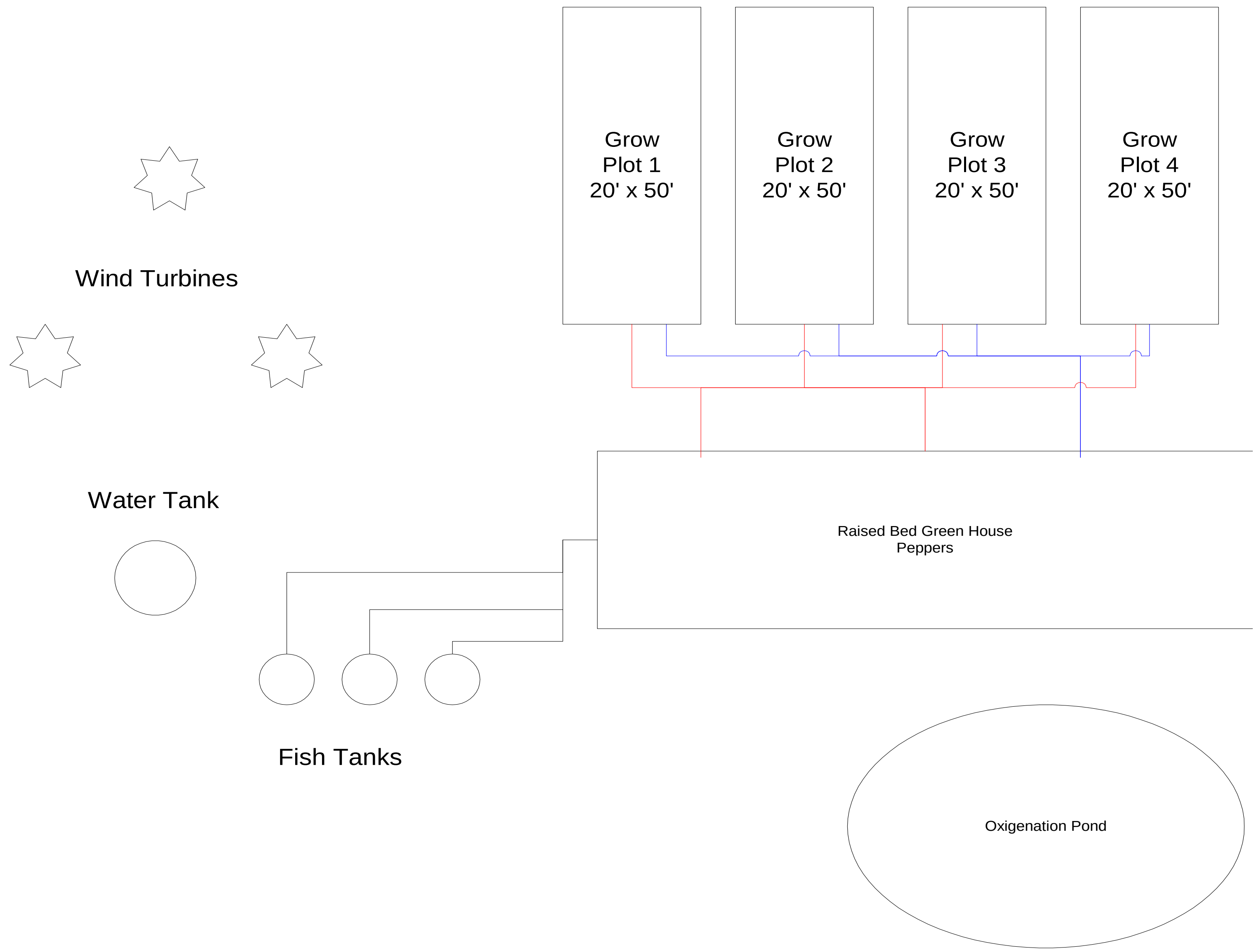
5.00
0.00
5 MPH / 2.24 M/Sec
7 MPH / 3.13 M/Sec
10 MPH / 4.47 M/Sec
11 MPH / 4.92 M/Sec
12 MPH / 5.36 M/Sec
13 MPH / 5.81 M/Sec
14 MPH / 6.26 M/Sec
15 MPH / 6.71 M/Sec
16 MPH / 7.15 M/Sec
17 MPH / 7.60 M/Sec
18 MPH / 8.05 M/Sec
19 MPH / 8.50 M/Sec
20 MPH / 8.94 M/Sec
Jacobs 31-20
ESI 54-S
Liten LT6.4 - 5kW
Liten LT8.0 - 10kW
Liten LT8.0 - 20kW
Skystream 44470 - 3.7kW

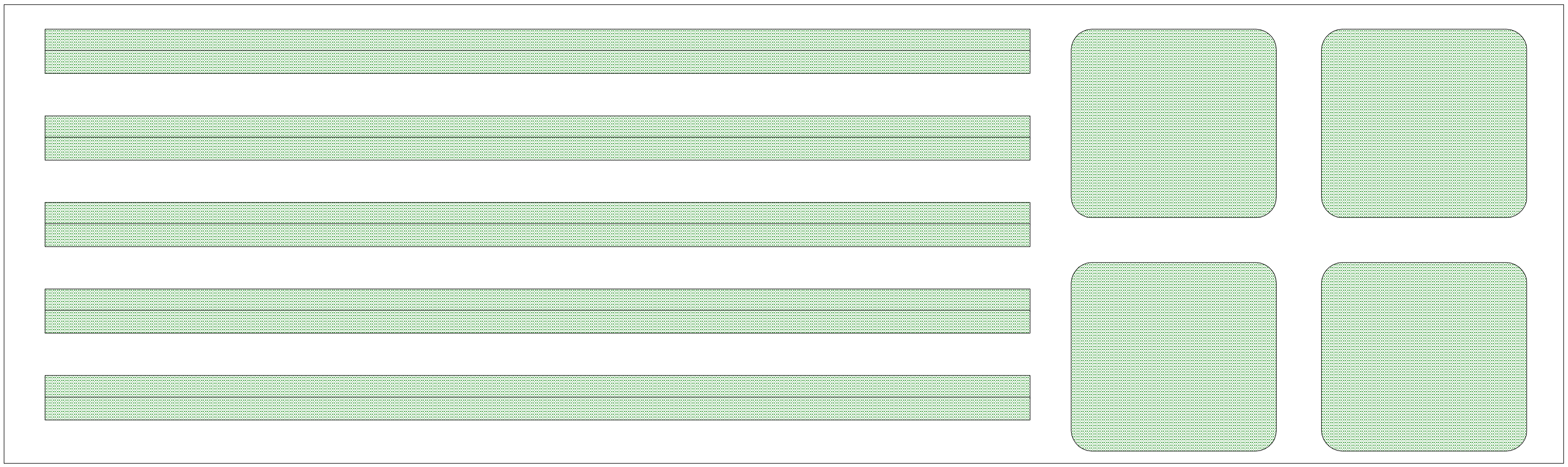
Sample Site Layout

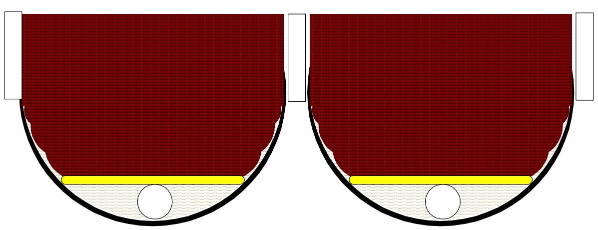


28' x 95' Greenhouse

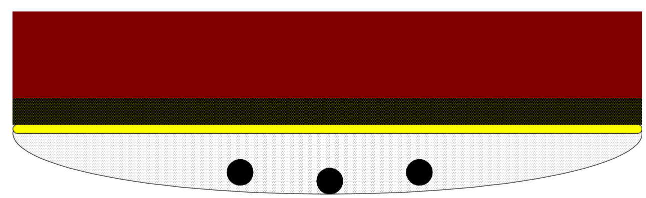
Raised Pepper Beds of 15' Split Corrigated Pipe Ganged in Pairs
36" x 60' each Bed Pair

Lined Filter/Grow Beds 12' x 12'





Cross Section of Raised Pepper Beds
15"W x 60'L x 13"D
3" Feed Pipe w/peastone and
silt-stop membraane



Cross Section of Filter/Grow Beds
12'W x 12'L x 30"D
18" Top Soil, 6" Filter Soil, Silt-stop membrane,
6" Pea-stone, 3"Drain Pipe, Pond Liner Lined

Some Successful Projects

1. Cabbage Hill Farm is a non-profit organization located about 30 miles north of New York City. The foundation is dedicated to the preservation of rare breeds of farm animals, sustainable agriculture and local food systems, and aquaponics greenhouse production. Cabbage Hill Farm designed and continues to operate a simple recirculating aquaponics system. Cabbage Hill Farm promotes education on aquaponics and hosts greenhouse interns. Tilapia fish and leaf lettuce are the main products of the Cabbage Hill Farm system, though basil and watercress are also grown in smaller quantities. In addition to hydroponics, water passes through a constructed reed bed outside the greenhouse for additional nutrient removal.

2. The Freshwater Institute, Shepherdstown, West Virginia A Cooperative Agreement funded by the U.S. Department of Agriculture, Agricultural Research Service. Meeting the

   2.1. The Challenge: U.S. consumers are increasingly demanding a cost-competitive, safe, reliable animal protein supply, which is appealing, nutritious, and raised with minimal environmental impacts. Controlled intensive aquaculture systems are intrinsically secure agriculture systems in which aquatic animals are produced in semi-closed environments with protected water supplies. Inputs to the systems can be controlled, so quality assurance is comparatively easier to achieve than in some other animal confinement systems. Controlled intensive aquacultural production systems are poised to expand to a larger role in the aquaculture production of the U.S. domestic edible seafood supply.

   2.2. The Solution: This project uses a multi-disciplinary approach to develop and evaluate solutions to major challenges that delay expansion of the aquaculture industry. The major objectives of this project are: A) To develop and evaluate solutions, which improve efficiencies of scale and reduce water quality constraints for sustainable production in controlled intensive aquaculture systems. B) To develop and evaluate sustainable waste management technologies which result in environmentally compatible controlled intensive aquaculture systems.

2.3. Outcome: This research will advance the capacity to produce a nutritious seafood product in an aquaculture system that is secure, reliable, and both economically and environmentally sustainable. Improvements in resource and capital efficiencies for controlled intensive aquaculture systems will result in better production systems, management practices, and expanded market and investment opportunities for domestic aquaculture production. The research will result in more sustainable and globally competitive aquaculture systems for U.S. farmers. This work is relevant to consumers demanding cost competitive, high quality fish raised in environmentally friendly production systems, fish farmers producing a variety of freshwater and marine species in tank-based systems, and scientists and consultants who design and evaluate sustainable land-based finfish production systems.

CABBAGE HILL FARM

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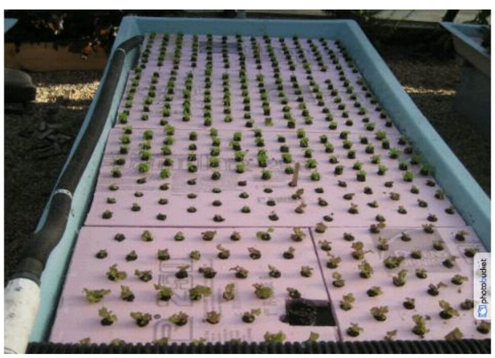
http://www.cabbagehillfarm.org/



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