Living Energy Farm has pioneered a new way of handling energy. Our system is unique, breaking the chains of destructive energy use habits while providing a high level of comfort. We call it Long-term Integrated Village Energy, or LIVE for short.

LIVE is based on the following design principles:
1) **Durable batteries.** Given the intermittent nature of wind and sun energy, much research has been done on finding effective batteries to compensate for the variability of renewable energy sources. The problem is that battery technology – like other technologies – evolves toward profit, not function. We use batteries that last for decades, meaning our annual equipment depreciation/ degradation costs are very small.
2) **Insulation and conservation** using community-oriented methods. It's always more economical to save energy than to generate energy.
3) **Integration of systems.** When one energy source can serve many needs, then systems become much more efficient. Community-scale systems can support each other in myriad ways.
4) **Lowest-cost energy storage.** Electrical storage is expensive, thermal storage is cheap. LIVE systems utilize the most cost-effective energy storage methods available.
5) **Leveraging.** That means using small amounts of high grade energy to capture very large amounts of lower grade energy.
6) Use of **daylight drive DC powered equipment** employing high and low-voltage industrial motors. Daylight drive is a simple, powerful, durable way to run equipment. Sun comes up, motors run. Sun goes down, motors quit. No electronics of any kind are needed. Daylight drive employs **leveraging and lowest-cost energy storage** instead of electrical storage, which makes our DC Microgrid cheaper and more durable than any other energy system.
7) **Context appropriate design.** That means looking at energy demands and resources in the context of where people live. "One size fits all" does not apply to renewable energy. Maximizing shared use, making sure the pieces fit together.

1) Durable batteries. The battery shown here works, and it's about 100 years old. It is a Nickel Iron (NiFe) battery. NiFes were produced by Thomas Edison in large numbers. They tolerate voltage swings and discharge depths that would destroy any other battery. Technology evolves toward profit, not function. NiFes were driven off the market because they are extremely durable, somewhat bulky batteries. Disposable batteries are more profitable.

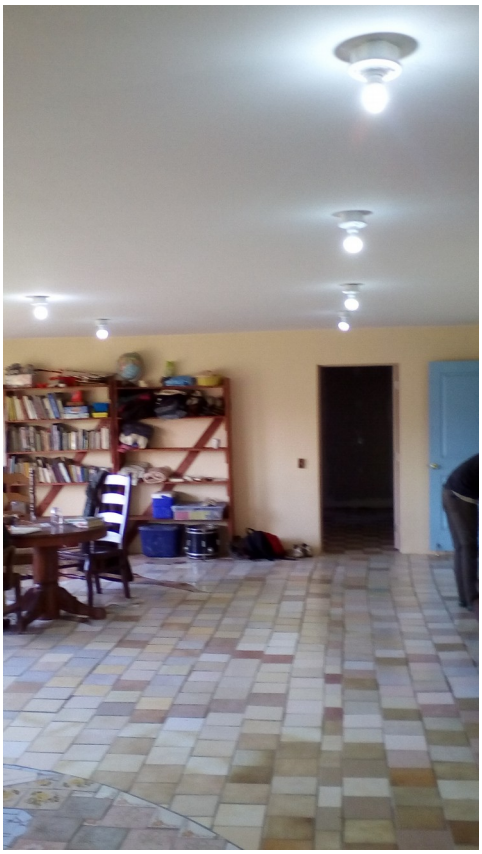
LIVE systems are multilinear. That means there is never any such thing a “power outage.” One line in our system is lighting, connected to NiFe batteries. In 8 years, our lights have never gone out. We use them as much as we want, surf the net as much as we want, and use NiFes for power tools as well.

The DC electricity from this ***one*** PV panel goes to

this charge controller, to

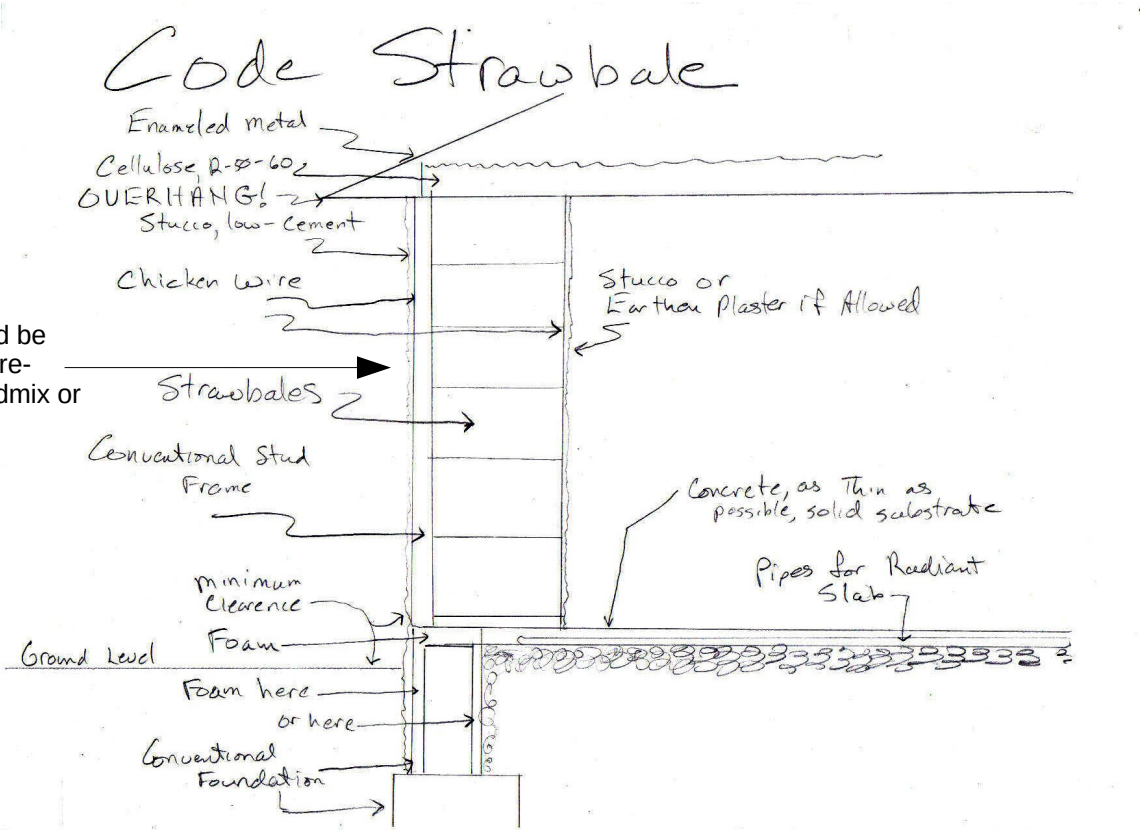
this set of very, very durable nickel-iron batteries, then to

keeping the lights on. NiFe batteries are much more effective than lead-acid or lithium technologies for stationary use. We have no trouble keeping the lights on, even in cloudy spells in the winter.



We take cordless tools, pull out the batteries, and run a cord back to the nickel-iron batteries. 18 volt tools run fine at 12 or 24 volt, the miracle of DC.

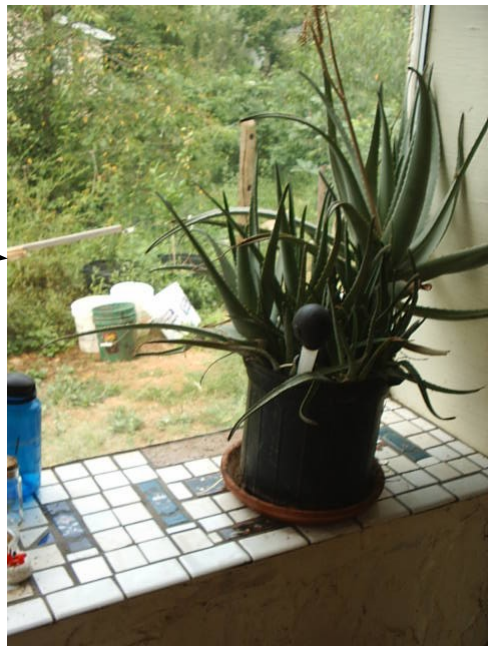
2) Insulation and conservation. LEF's main house stays warm through an entire winter with almost no firewood.



Note, stucco should be treated with moisture-proofing sealant, admix or painted on.

This is what super-insulation looks like. Our deep window-sills look great and function as mini-greenhouses.

Super-insulated walls cost no more than ordinary walls, they are just thick. This photo is from a retro-fit where straw bales were wrapped around an old house. This is not normal because it mimics the historical building style of the poor, whereas construction techniques in the U.S. are dominated by mimicry of the wealthy.

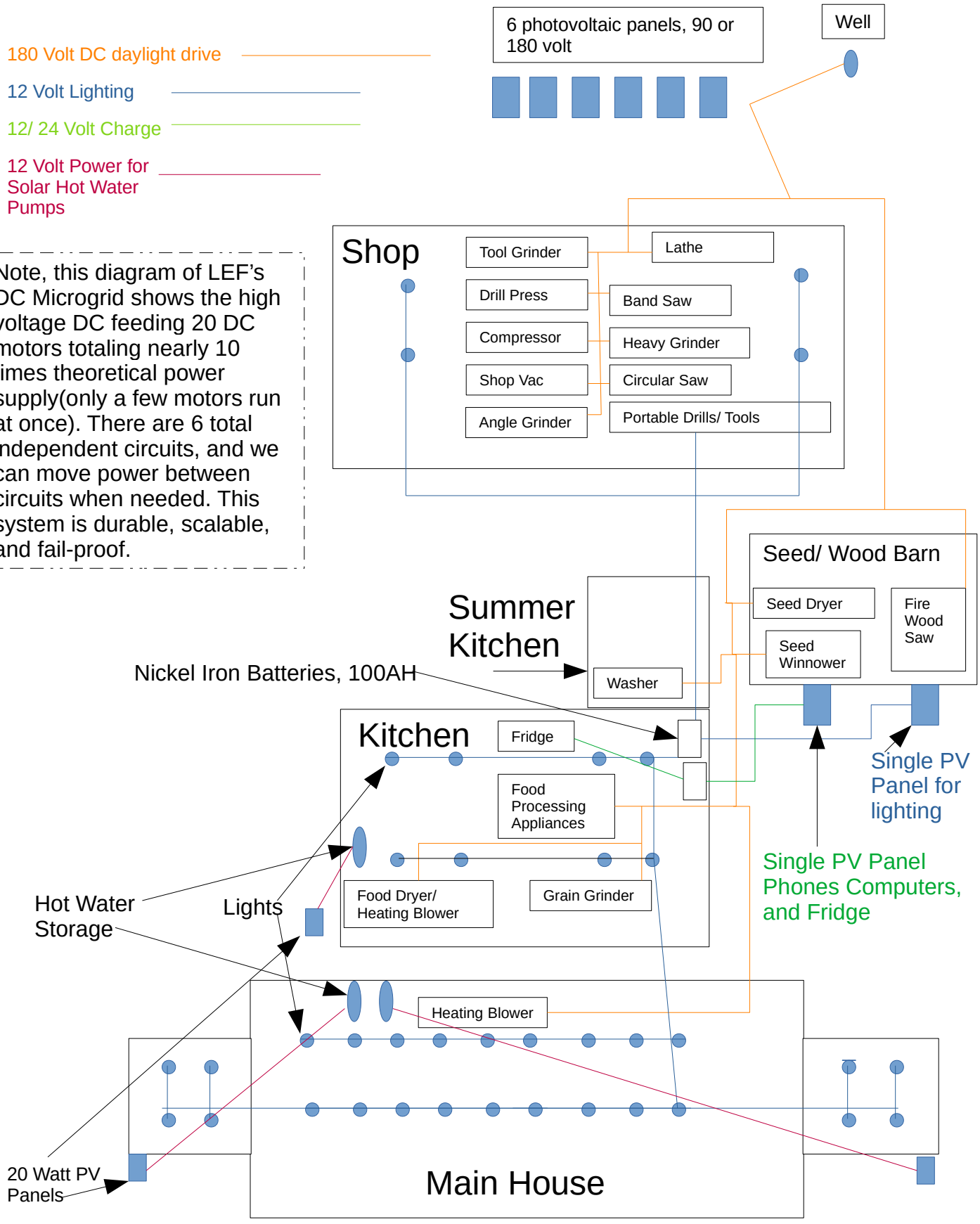


Built with bamboo and crumpled newspaper. Super-insulation is easy and cheap.

Building Super-Insulated Buildings With Community Labor

The trend of adding renewable energy production onto existing houses (such as grid-tie solar electricity) has led people to believe that renewable energy is expensive. The LIVE systems approach makes sustainable living cheap. Context appropriate design means well insulated buildings. Thick-walled, well-insulated buildings can be built with a wide range of materials. Employing community labor makes it work, and keeps it cheap!

3) Integration of Systems in a DC Microgrid Electrical Schematic of LEF



4) Lowest Cost Energy Storage

Water is the most critical human need. Legacy dictates that we use continuous, AC power. Conventional off-grid systems mimic AC grid power with continuous power supplied by large, disposable battery banks. That's expensive. We employ numerous methods of energy storage to minimize the need for electrical storage, which makes LIVE systems both cheap and durable.

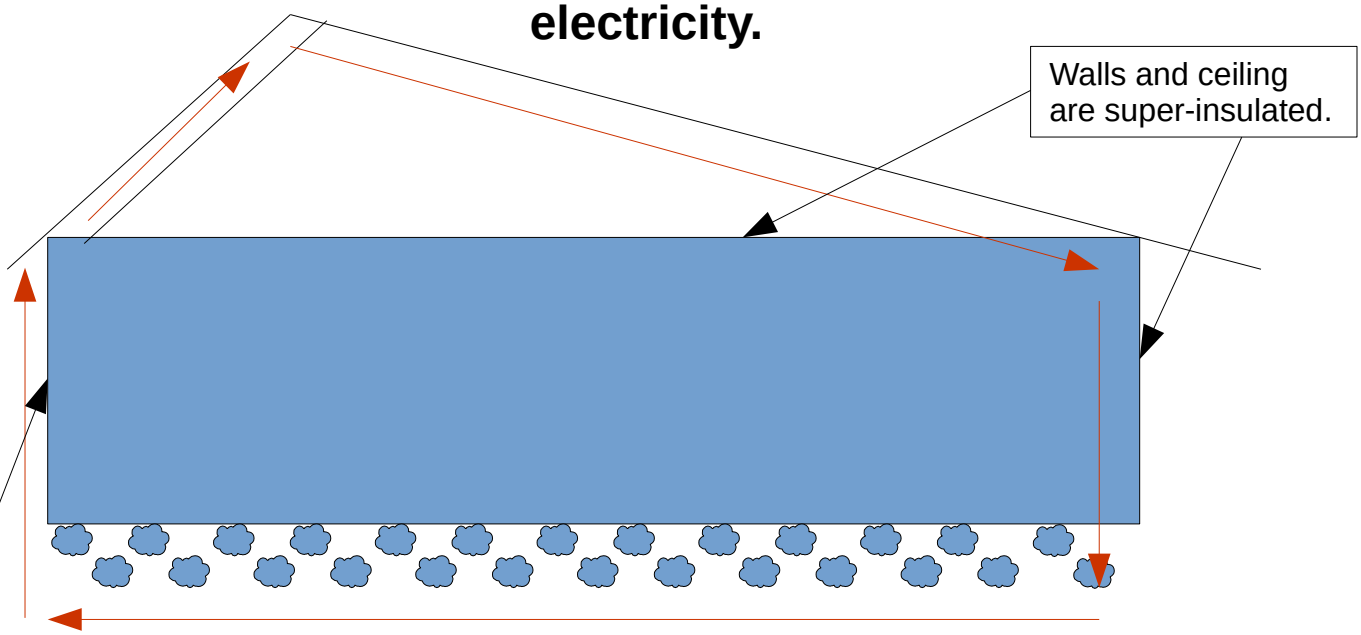
These are the control switches at out high-voltage PV rack. The timer on the right gets turned on once or twice a day to turn on the pump and pressurize the system.

Several pump companies make high voltage DC pumps (Sun Pumps, Grundfos, Lorentz). Most submersible pumps are centrifugal, which means they pump more volume at less pressure. The pump companies, recognizing the floating power supply of daylight drive are now making "helical rotor" pumps that pump high pressure with very low power input. The pump above is a helical rotor pump. It is a very narrow pump so it can fit in hand-dug, narrow pipe wells in non-industrialized countries. With a helical rotor, you don't really need a timer like we have at LEF.

Most rural homes have a 20 - 30 gallon water storage tank, and rely on a pump that can run anytime of the day or night to supply water. Normal off-grid design relies on many thousands of dollars of electrical hardware to run conventional AC pumps at night. At LEF, we have 3 tanks like the one above, 120 gallons each. These tanks are not free, but overall system costs are much lower than conventional design.

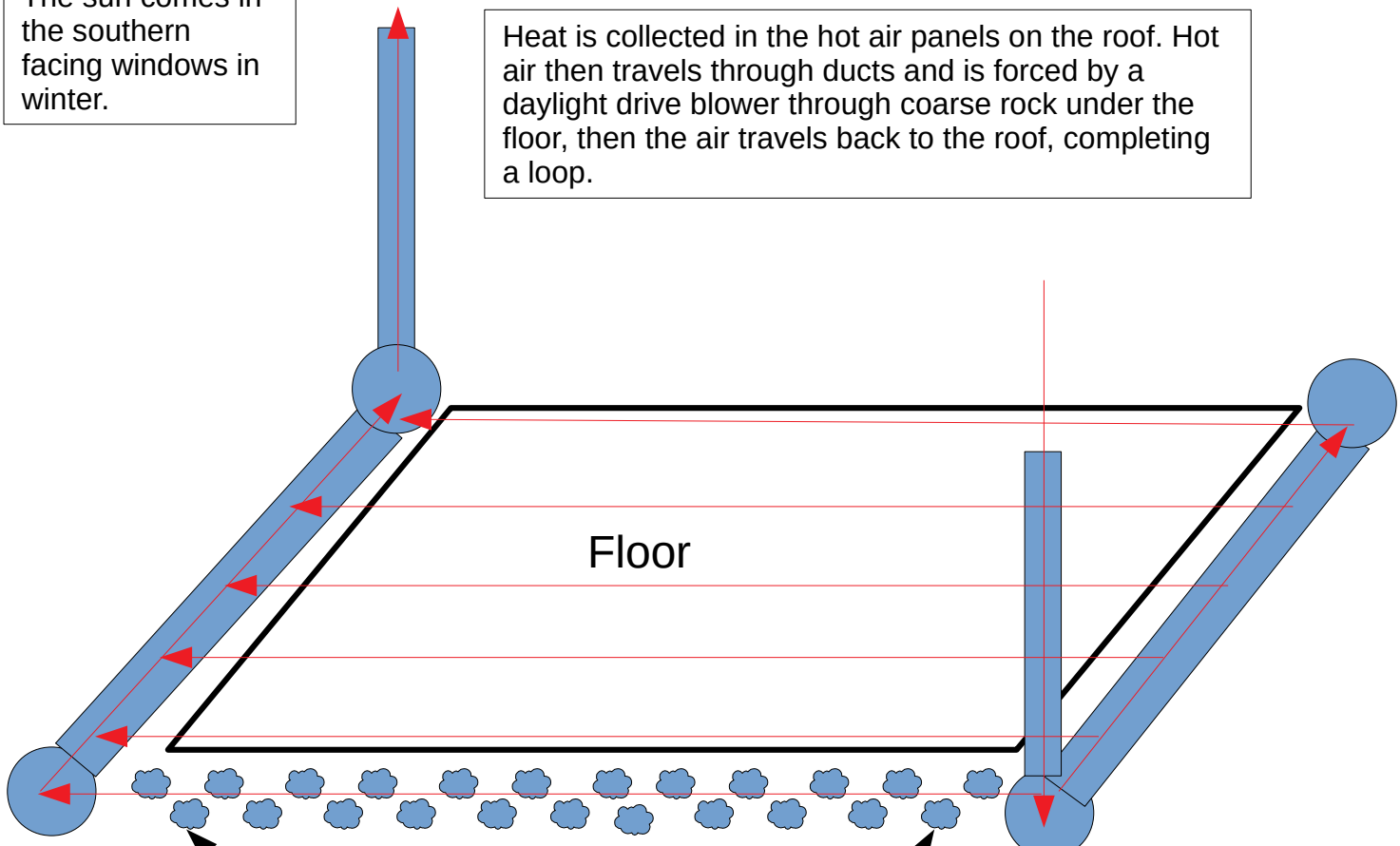
5) **Leveraging** involves using DC electricity to capture large amounts of thermal energy using industrial DC motors.

Living Energy Farm Solar Design
Stores energy as heat, eliminating need for stored electricity.



The sun comes in the southern facing windows in winter.

Heat is collected in the hot air panels on the roof. Hot air then travels through ducts and is forced by a daylight drive blower through coarse rock under the floor, then the air travels back to the roof, completing a loop.



Dirt and rock under the floor store heat from collectors on roof.

This is what leveraging looks like.

Solar hot water, closed loop to storage tanks, daylight drive.

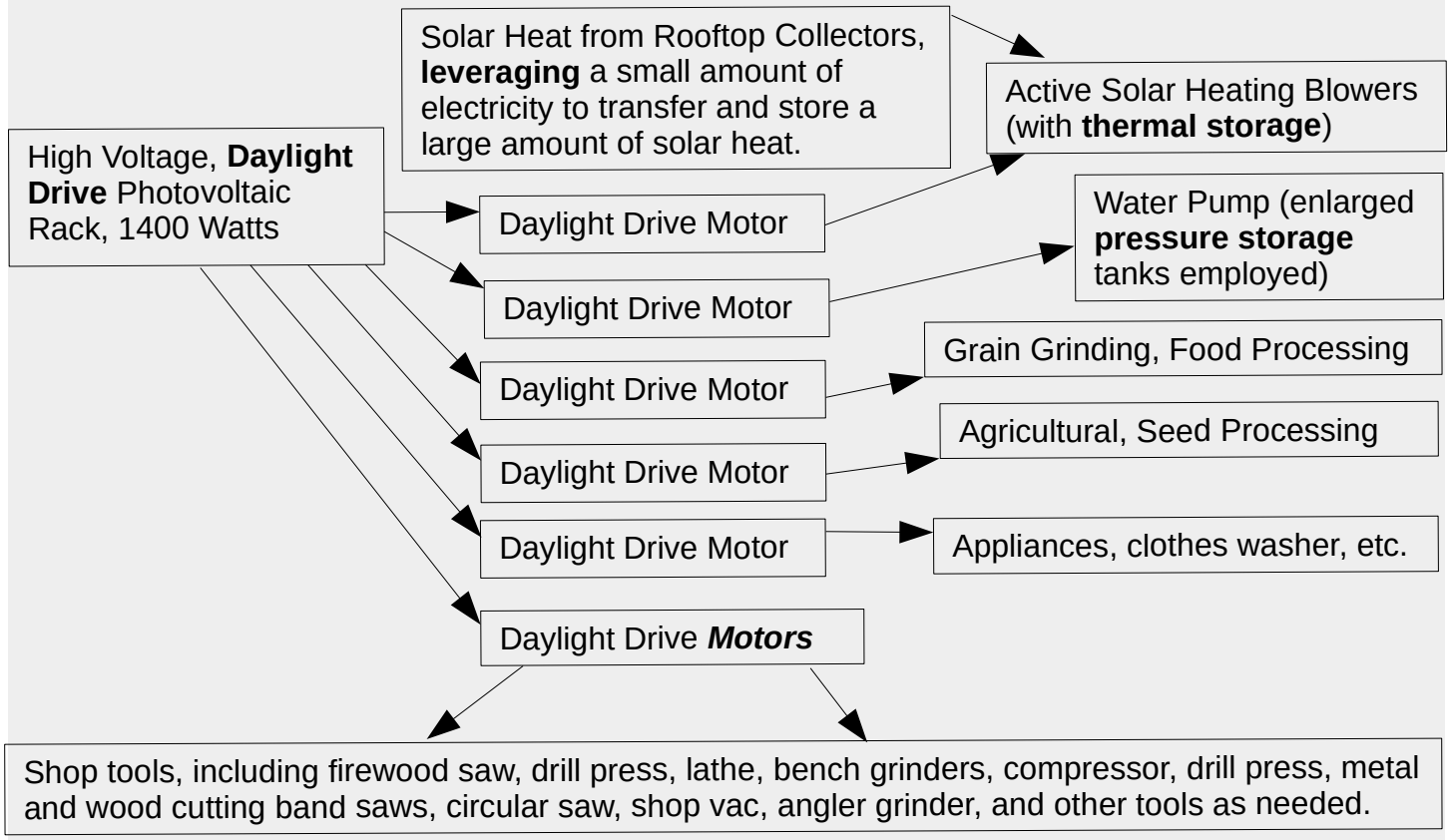
Solar hot air from roofs pumped under the floors by daylight drive DC blowers.

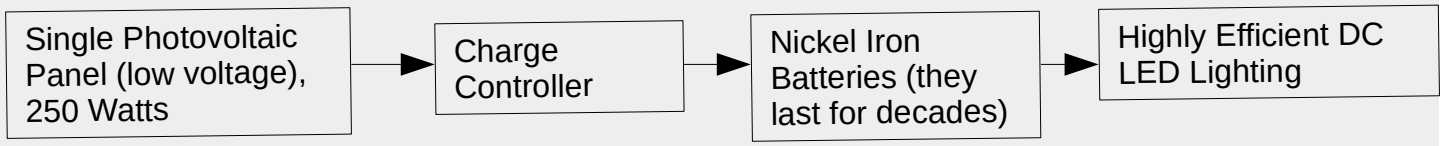
Doors and windows on opposing walls, facilitates ventilation.

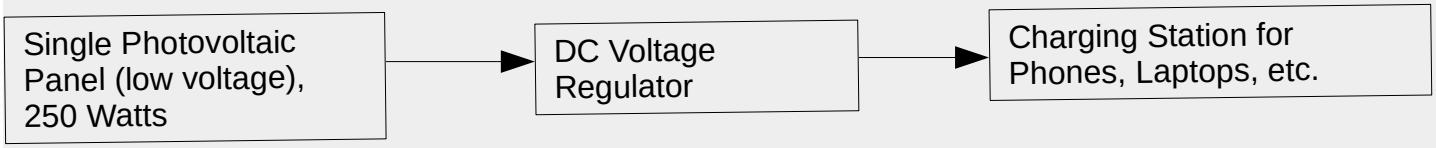
Passive solar, windows on south side.

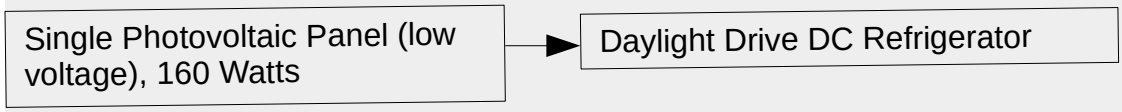
Stud frame house with strawbales leaned against the walls, super-insulation at the same price as conventional construction, well suited to community building parties.

6) DC Microgrid Flow Chart, As Developed at Living Energy Farm, 90% of Energy Employed in **Daylight Drive** Configuration



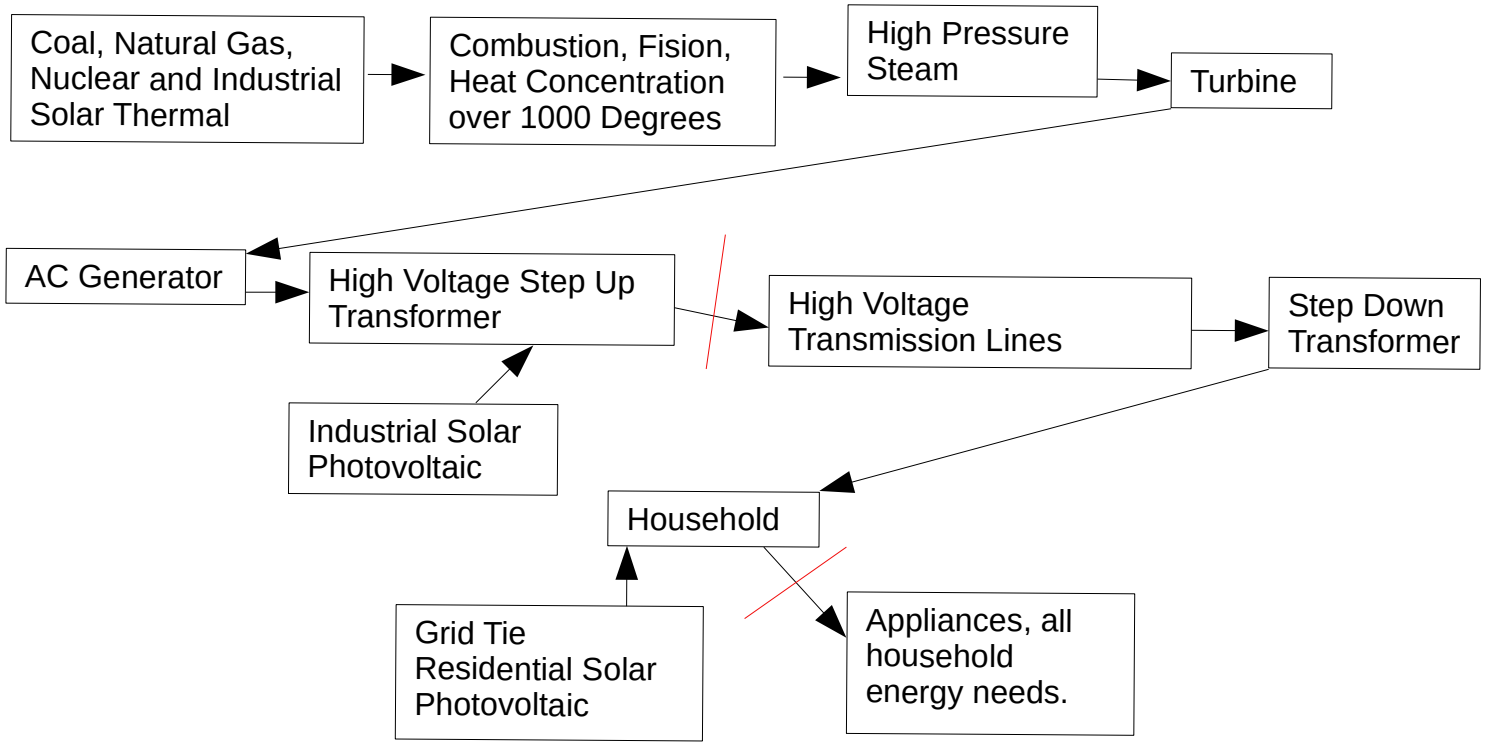




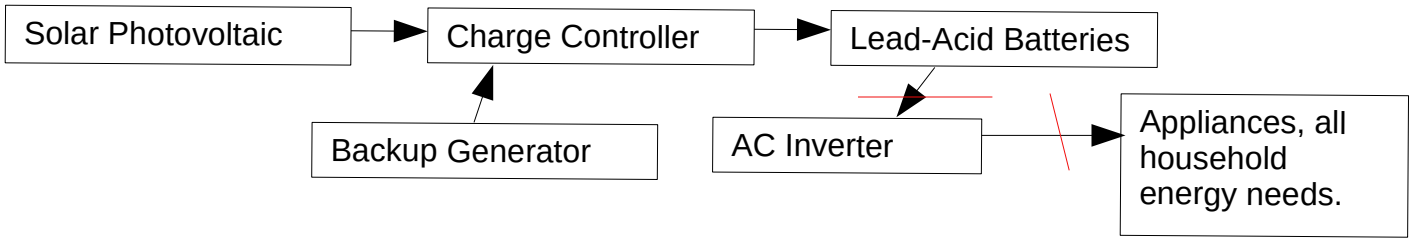


All other energy supply systems linear, which means any break in the supply chain and ALL systems fail. Having the locus of capital at the power plant encourages consumption.

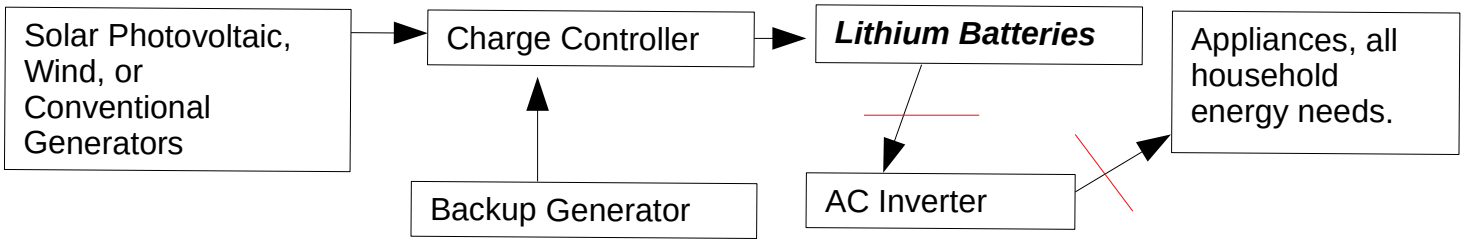
Conventional Grid Power



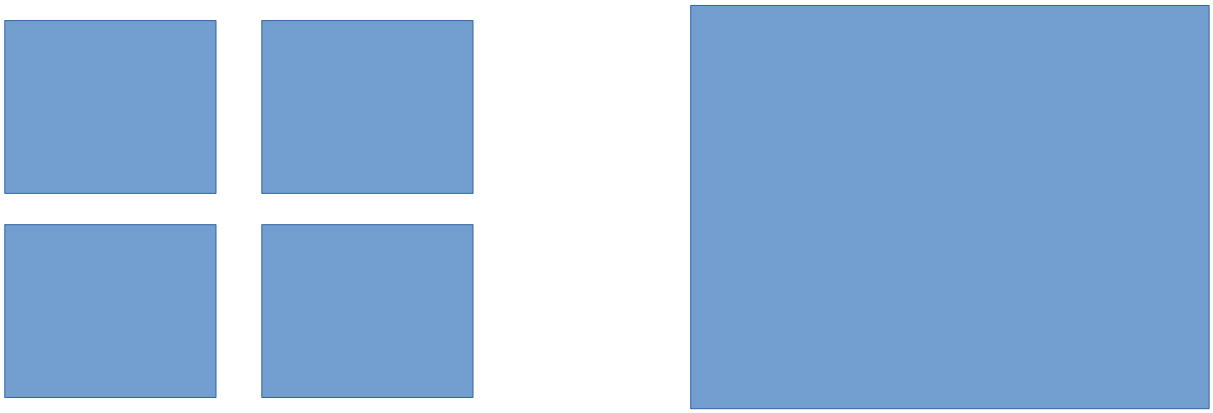
Conventional Off-Grid Energy



AC Microgrid



7) Context Appropriate Design



7) Appropriate design in cold climates means wrapping a well-insulated shell around shared structures rather than breaking down houses into “tiny houses.” The square on the right has as much area with half as much surface area as the squares on the left, thus representing the tradeoff between four small houses versus shared wall housing.

If LIVE design is so effective, why haven’t I heard of it already?

In a word – consumerism. The LIVE design is a *conservationist* approach. Our entire modern economy is built on encouraging people to consume more and more. LIVE design is not a simple product you can buy and put in a bag. The widespread adoption of LIVE systems would allow us to dramatically reduce our ecological impact. But it would require a substantial reorientation of our economy. Sounds drastic? Well, that “reorientation” is going to be forced upon us by climate change, and by the fact that the Earth itself if limited in size, whether we like it or not. We have learned to be aware that products do not always live up to their advertisements. But we are not so wise about energy because it is integral to our whole economy. It is time we wised up We have been sold an extremely consumptive lifestyle, not for our benefit, but for the benefit of others.

But isn’t Grid-Tie solar electricity the best of both worlds? I get to have the convenience of being tied to the grid.

Grid supplied power encourages consumption because the locus of capital investment at the power plant. Enormous quantities of energy are supplied to consumers while the long-term consequences are hidden from view. Cheap energy is the elixir of the consumer economy. Given the history energy consumptive design, we have been led to believe that large amounts of energy are necessary to provide comfort. That just isn’t true. Cheap energy is addictive. If you have a friend who drinks too much, the best solution is to provide them with new sources of alcohol (??!!!) That is the logic of grid-tie, and it ADDS to our environmental footprint while simultaneously crippling our will and ability to seek real solutions.

Cost Comparison of Conventional AC Grid Power Versus Conventional Off-Grid Energy Versus LIVE Systems

	Conventional AC Grid Power	Conventional Off-Grid Energy	LIVE System
Annual Energy Cost	$1,300/ yr is the average in the USA	$1,000 – $2,000/ yr degradation of batteries	**$25/ year**
Leveraging to enhance efficiency?	**Extreme inverse leveraging**, high grade energy spent to make low grade heat	No	Leveraging extensively employed
Vulnerability to power outages?	Linear system, highly vulnerable, catastrophic failure in storms	Linear system, highly vulnerable, batteries cause frequent failure	**No system failure**
Redundancy needed? (Does supply need to be bigger than demand?)	High degree of redundancy required	Redundancy required	The flexibility of DC equipment allows supply smaller than demand, “reverse redundancy”
Behavioral impact	Encourages consumption	Adherence to AC power tradition encourages consumption	Slowly weakening systems encourage conservation without system failure
Environmental impact	Massive	Too expensive to be widely adopted, but wide adoption would have massive impact	There is no “free lunch,” but impact relative to other systems is extremely small
Toxicity impacts	Massive, from mining and burning fossil fuel	Large, reliance on toxic heavy metals	Small, no reliance on toxic heavy metals
Scalability	Up front cost is enormous	Up front cost is high and systems cannot be scaled up once built	Easily scaled, can be stacked like building blocks as money allows

$1340 avg elec expenditure
https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf