

Living Energy Lighting and Charging Systems (LELCS) Parts Lists and Suppliers

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Background

Living Energy Lighting and Charging Systems (LELCS) were developed at Living Energy Farm in Louisa Virginia. They are small solar powered electrical kits that can provide lighting for a small house, and charge cell phones, smart phones, and laptops/ portable computers. These kits are *not* intended to power appliances or AC inverters. LELCS are DC based, which means they can function through changes in power input and have a higher voltage range than inverter-based solar electric kits.

LELCS use nickel-iron (NiFe) batteries. NiFe batteries are extremely tough and durable compared to any other battery technology. LELCS kits are repairable. Solar electric systems based on lead-acid or lithium batteries are not repairable, and do not stand up to changes in power input and output nearly as well as LELCS kits. That said, LELCS kits are small. Our base kit is intended to be as inexpensive as possible (to maximize reach in low-income communities) while still maintaining a robust functionality. We distribute larger kits as well.

NiFe batteries have an incredible tenacity in their ability to continue electrical output for a very, very long time, during periods of cloudy weather when power input is low, and across a duration of years as the system gets older. Ever other battery runs into a "cliff," a point where the battery stops working. We have all had the experience of using a flashlight or other battery-powered device that suddenly stops working. With NiFes, if you load them too heavily, the power will drain down and voltage will drop. But if you reduce the load, then they will appear to spontaneously recharge. That affect is caused by the way NiFes are built. The electrical activity in the battery is caused by the circulation of the electrolyte into the powder-filled pockets inside the battery. That circulation happens slowly. *If you are using an LELCS system with 4 bulbs and the power level starts to drop, all you need to do is reduce the load to 2 or 3 bulbs and the power output level will climb back upwards and stabilize.*

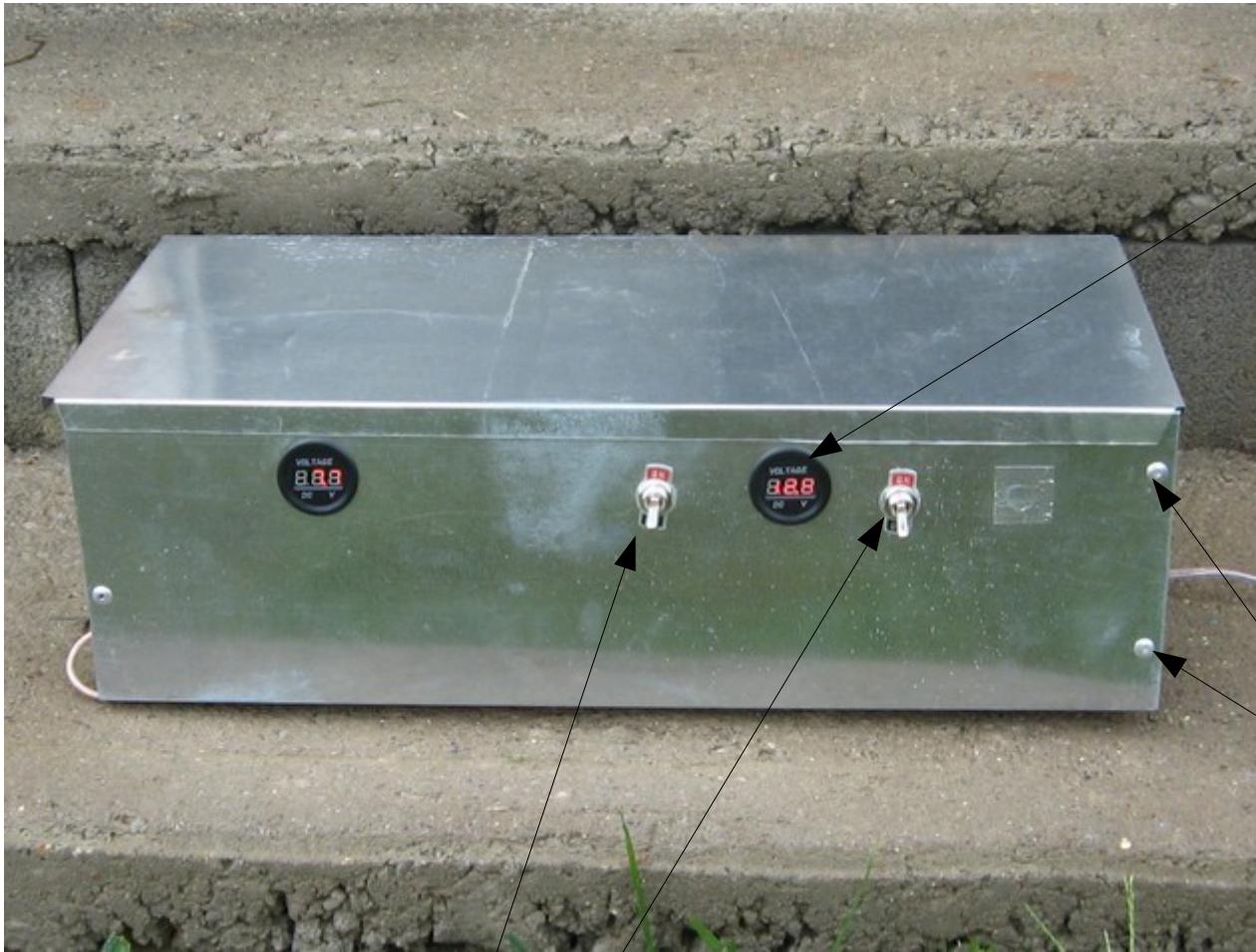
The slow discharge capacity of NiFes is noted by some battery suppliers as a negative aspect of NiFe batteries. But when tied to a daily input from a PV panel, the slow discharge capacity of NiFe batteries is their strongest asset. It means the lights never go out. One should be aware that this capacity for very long term, sustained power output is not part of the "amp hour" rating of batteries, which is to say that for extended use a LELCS kit will perform more effectively than other solar electric systems with a comparatively higher "amp hour" rating.



LELCS with PV panel. Note, LELCS have a charge controller built into the box. These controllers are small, inexpensive circuits that can handle a maximum 50 watt PV panel. To use a LELCS with a panel larger than 50 watts requires the use of a different charge controller.

Photovoltaic (PV) panel. We have been using 30 - 40 watt panels from New Powa, newpowa.com, model number NPA30-12
A good-quality from any other supplier would work fine, but the panel must be a nominal 12 volt panel.

The outer enclosure for LELCS boxes are custom made from "duct metal." That is galvanized 26 gauge steel normally used to make plenums. It has to be picked up locally. The price around here is \$20 - \$30 per sheet. We get 5 boxes out of a sheet. <https://www.greschlers.com/4-x-8-26-gauge-galvanized-sheet-metal/>



Voltmeter -- a normal LECLS box has only one voltmeter. We use a DC voltmeter, ebay item no. 283351933785 This voltmeter fits a 3/4 inch knockout hole made by the large lever punch specified later. Items can be found on ebay by searching with the item number.

Pop rivets, any local supplier, steel or aluminum. We use 1/8 inch rivets, holes made by Roper Whitney No. 5 Jr punch, rivets installed with pop rivet tool.

Switches -- current supplier is at item number 392054239394 on ebay. These are 20 amp switches. Do NOT use lower amperage switches. DC electricity requires heavier switches. These switches come with a waterproof seal which we do not use. Cost is \$1.60 each

Necessary Tools:

Aviation shears, any good brand (aka metal shears). Used ones on ebay.

Sheet metal brake, we use Harbor Freight SKU 62335, 62518

Roper Whitney No. 5 (No. 5 Jr) **hand punch** used ones on ebay.

Roper Whitney No. XX **hand punch** (Note, it is possible to use only the XX punch and swap dies for smaller punches for rivets, but the No. 5 punch is fairly cheap used. The XX punch is usually available used as well on ebay.)

Lever punch, TEMCo Industrial TH0021 Manual Lever Sheet Metal Stud Punch, Ebay item No. 371255513543, not available used.

Optional Tools:

Wire Stripper, we use Klein Tools 11063W Katapult Wire Stripper/Cutter, ebay item 191078080910 Cheaper wire stripper will work.

Crimper, Thomas & Betts WT111M STA-KON, cheaper one will work.

Sheet metal bending pliers, as per ebay number 262829460378

We use Husky 8 in 1 **screwdriver** set for dealing with small screws, ebay item no. 323300384305

Materials:

Prices are highly variable on **wire/ cable** products, check prices as various suppliers. We use both ebay and local suppliers.

For the **wire from the solar panel to the box**, we use 14/2 SJ00W cable. Supplier on ebay item number 392400165695

Light bulbs, we use bulb from Ranpo Lighting, marketed by Sanny Technology on Ebay. The relevant specs are e26 or e27 base (the two are interchangeable), 12 volt, DC LED. Note, these bulbs burn out quickly if left on all day because the voltage runs higher during the day. Ebay item number 362008048864

Charge control circuit, we use XL4005 5A DC Buck Step Down Voltage Converter Constant Current Power Module. Note, the circuit has a 50 watt maximum power input, and it must be adjusted to 15 volts/ 2.5 amps output. Ebay item number 142632518904 The metal mounting holes and base of this charge control circuit are electrically connected to the rest of the circuit. You cannot use metallic connectors to connect this circuit to the metal box. We use **plastic screws** (number 2 screws) available from McMaster Carr, and **plastic washers** cut from small diameter plastic tubing. The No. 5 Jr. punches 1/8 inch holes. We set up a template to punch holes for the circuit to mount it to the front of the box.

14-16 Gauge Blue AWG Heat Shrink Butt **Wire Connectors**, for making connections on the cable coming down from the solar electric panel to the box. Ebay item no. 173938372538 Available from local suppliers, but prices vary.

Fuse holder, we use 14AWG ATM / Mini blade fuse holder (inline), ebay item no. 132729158664

Fuses, 10 Amp ATS/ATC Mini blade 12v automotive fuse, ebay item no. 263323881416, also available through any auto parts store.

For the male side of the **cigarette lighter plugs/ wires** we use 15A Male Plug Cigarette Lighter Adapter Power Supply Cord 60cm Cable Wire, ebay item 162827537806. Bulk supplier through Alibaba is Shenzhen Lemon Electronics Co., Ltd., Contact Name: Linda Liu, Email: linda@szlemon.net

For **switches**, we use Toggle Switch Heavy Duty 20A 125V SPST 2 Terminal ON/OFF, ebay item no. 392054239394

For filling the batteries with distilled water, we use **Ear Washing Syringe Squeeze Bulb**, ebay item no. 153044891848

Flashlight, Mini LED Light USB Rechargeable Flashlight Lamp Pocket Keychain Torch Waterproof, ebay item no. 223492658020

The **cable** that we use for mounting light fixtures is no. 10 speaker wire. This mates with the fixtures that we use. Smaller wire will not work. Beware prices vary. Ebay item no. 261634702290

The female side of the **cigarette lighter plugs**, there are a few options, but we used ones that fit standard 3/4 inch knockout holes (made with the lever punch). Some of the other plugs do not fit the 3/4 inch holes. Waterproof Fireproof Universal 12V Motorcycle Marine USB Female Car Cigarette Lighter Power Socket, purchased through Alibaba from Ningbo Guhang Electronic Technology Co., Ltd., contact Anlly Han, guhang1812@126.com

To make the connection on the cable from the solar electric panel to the box waterproof, we use .45 inch high adhesive flow **heat shrink tubing** from cableorganizer.com Part number NSPA-HST543C-48

For **light sockets**, we use Midland Hardware item no. 244517

<https://www.midlandhardware.com/244517.html> These light sockets ONLY fit flexible, no. 10 wire. We use the speaker cable previously mentioned.

If you want to connect this box to a panel larger than 50 watts, you will need a **larger charge controller**. You can use Schneider Electric, Xantrex C35 Charge Controller, RNWC35 PWM 35A, 12/24V (1208), cheapest source we have found is Solarflexion, Inc., 38365 Innovation Ct Suite 1005 Murrieta, CA 92563, (800) 942-2424

info@solarflexion.com Beware that to use this controller, the panel must be nominal 12 volt (actual 16 - 17 volt), and the charge controller cost about \$90. Generally, it's cheaper to buy a new panel than pay for this controller.

Nickel-Iron Batteries

The single biggest constraint in making LELCS boxes is getting the batteries. To our knowledge, there are four manufacturing facilities on the planet that make nickel-iron battery pocket plates. There are several companies that take plates made by one company and re-market them under their own name. The batteries we use (10 amp-hour, 20 amp-hour, and 100 amp-hour) are small. The first two especially are non-standard items for most companies. That means they will have high minimum order quantities. Most companies ship their batteries liquid-filled, which means they travel as hazmats (hazardous material).

Here is what we know about nickel-iron battery companies and how to reach them;

- 1) Henan Troily, this is the company we are dealing with. They have good quality and good prices, and are into helping our project. They do not normally export to the U.S. Contact us if you want to get in touch with Troily.
- 2) Changhong, high quality batteries, available through qualmega.com. The guy who runs that company is Lance Chen.
- 3) Henan Hengming, Chinese state owned company. Inexpensive, but lower quality than Changhong. Can be contacted through alibaba.com
- 4) Seawill, re-marketing Henan Hengming batteries (?) Can be contacted through alibaba.com
- 5) Ciyi Battery (Zhuhai Ciyi), likely re-marketing another manufacturer
- 6) ADS (from Ukraine, the only non-Chinese company) Independent company, ships dry (nonhazmat), can be contacted via alibaba.com
- 7) Henan Xintaihang, possibly re-marketing other manufacturers, can be contacted via alibaba.com

Accelerating Battery Box Production with a Shear

The LELCS boxes are easily made and wired with simple hand tools. The boxes can be wired using simple wire cutters, stripers, and crimpers. The boxes can be made using hand shears, different sized punches (as previous indicated), and pop rivets. A sheet metal brake is needed. The sum total cost is less than \$800, provided some of the tools are purchased used (the punches in particular).

It is slow to cut the metal boxes using simple hand shears. A tool that greatly accelerates box production is a foot shear, also called a stomp shear. Total build time for a LELCS box using handheld shears is 4 - 5 hours. A foot shear can cut that time in half. If one wants to make a lot of boxes, then a foot shear is a useful tool, but they are costly. An "inexpensive" foot shear is about \$1400. See item 49677 at Northern Tool, https://www.northerntool.com/shop/tools/product_200659548_200659548

This inexpensive shear is not recommended for thicker metal, but the thin metal (26 gauge) used for the LELCS boxes works fine in a less expensive shear. Used, higher quality shears are easily found on ebay. But given that the metal we are working with comes in 4 foot X 8 foot sheets, one needs a 52 inch shear. Higher quality shears of this size are consistently more than \$2000 on the used market.