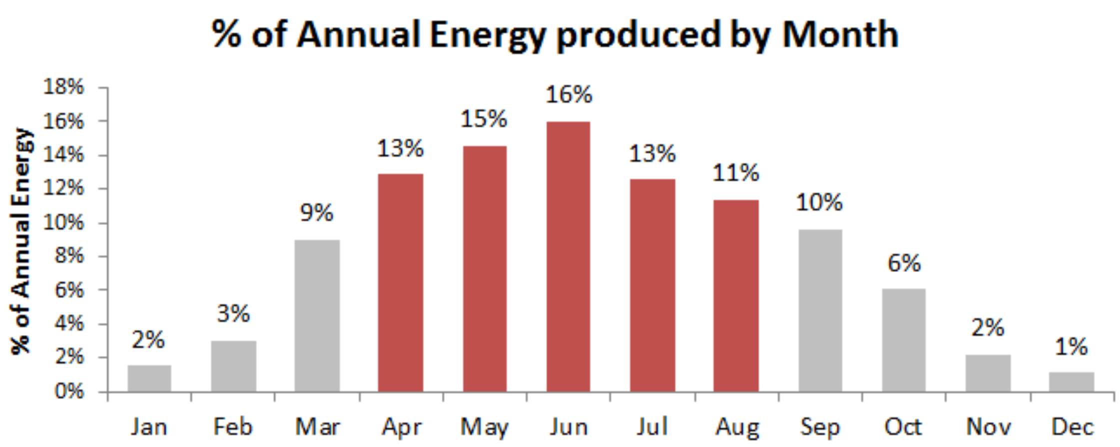
# Energy Efficiency is Critical in Off-Grid Design!!

- Small Energy Loads Translate into Smaller Solar/Battery Systems.
- Example Solar System
  - Southcentral Off-Grid Solar System
  - Designed to Supply about All of April – August Load.
    - Generator Supplement for other Months
  - Every **additional 1 kWh of Monthly Load adds $80 to Installed Cost** of System (plus additional fuel for winter months). This includes benefit of Tax Credit.

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# Tools for Determining Energy Use

- Yellow EnergyGuide Label
- Online Search
- Measure it!


At Home Depot:

**$31.87** /each

- Designed to help you assess the efficiency of your appliances
- Cut down on costs by monitoring your expenses over time
- Features a large LCD display and built-in battery back-up


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# Television Efficiency

| *Assumes 5 hours per day use* | | |
|---|---|---|
| **Appliance** | **Energy Use, kWh / month** | **Extra Solar System Cost, $** |
| 10 year old Rear Projection, 50" | 41 | $ 3,274 |
| Samsung UN50J5500AF, 48" | 6 | $ 442 |
| Solar System Cost Savings from Efficient Appliance: | | **$ 2,832** |

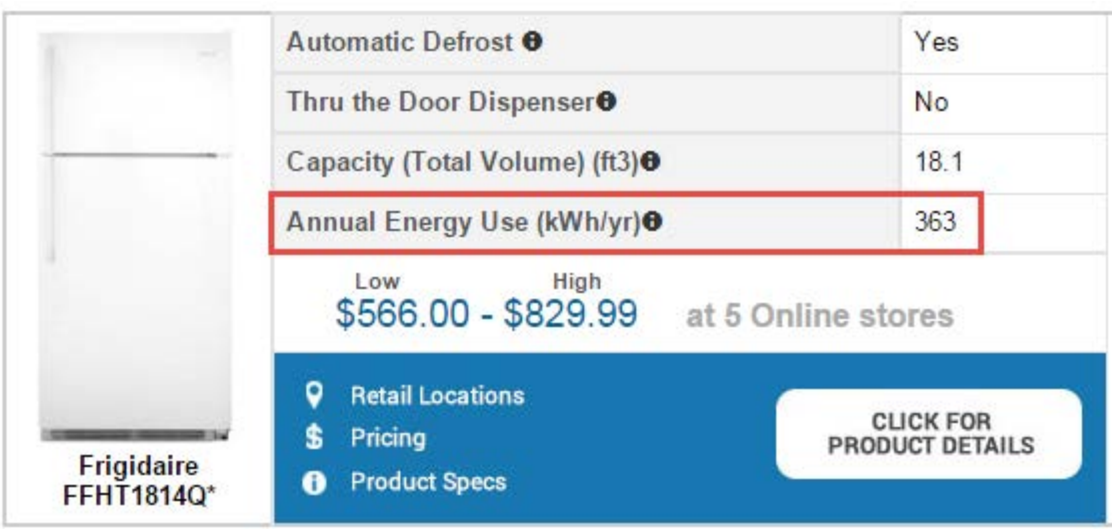
Samsung UN50J5500AF

| | |
|---|---|
| MSRP | $647 |
| Screen Size | 49.5 |
| Resolution | 1920 x 1080 |
| Display Type | LCD |
| Automatic Brightness Control? | Yes |
| Annual Energy Use (kWh)* | 66.3 |
| Annual Cost to Operate** | $7.62 |

Search for "Most Efficient Television" to find this

# Refrigerator Efficiency

| Appliance | Energy Use, kWh / month | Extra Solar System Cost, $ |
|---|---|---|
| Typical 2006 Vintage Refrigerator | 46 | $ 3,680 |
| Frigidaire FFHT1814Q | 30 | $ 2,400 |
| Solar System Cost Savings from Efficient Appliance: | | **$ 1,280** |




Search for "Most Efficient Refrigerator" to find this

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# 2-Tube, 4' "Fluorescent" Fixture

| *Assumes 5 hours per day use* | | |
|---|---|---|
| **Appliance** | **Energy Use, kWh / month** | **Extra Solar System Cost, $** |
| 2 x T-8 Fluorescent Tubes, 60 Watts | 9.2 | $ 732 |
| 2 x LED Tubes, 36 Watts | 5.5 | $ 439 |
| Solar System Cost Savings from Efficient Light: | | **$ 293** |


Search for "LED Tube" to find this

# 60 Watt Equivalent Light Bulb


| *Assumes 5 hours per day use* | | |
|---|---|---|
| **Appliance** | **Energy Use, kWh / month** | **Extra Solar System Cost, $** |
| 13 Watt Compact Fluorescent (CFL) | 2.0 | $ 159 |
| 9.5 Watt LED Bulb | 1.4 | $ 116 |
| Solar System Cost Savings from Efficient Light: | | **$ 43** |

Philips Lighting has a 60 Watt Equivalent bulb using **8 Watts**, although it is Daylight color.

**Incandescent Bulb?**
*Forget about it!*
(**$600** Solar System cost savings)

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# Off-Grid Design Issues

- EE first - Design approach – Weighing your options
- Being an Energy Manager
- Year around use? - Deep Winter Solar Power tradeoffs
- Be realistic
  - I have a 2,000 sq/foot house, what size solar array do I need?
  - How much money are you willing to spend to simulate your luxurious grid-tied life.

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# Audit – Add everything up

EE first - Design approach – Weighing your options

| | | Power Needs Table | | | | |
|---|---|---|---|---|---|---|
| Appliances/Loads | (A) Power (watts) | Power used at one time | (B) Hours used in a day | (C) Days per week | Watt-hours per week (A) x (B) x (C) | |
| Fridge | 58 | 131* | 24 | 7 | 9744.00 | |
| Lights: | | | | | | |
| Office | 15 | 15 | 3.5 | 7 | 367.50 | |
| Kitchen (2) | 26 | 26 | 2 | 7 | 364.00 | |
| Living room | 20 | | 5 | 7 | 700.00 | |
| Bathroom | 15 | | 0.75 | 7 | 78.75 | |
| Bedroom (2) | 120 | | 0 | 7 | 0.00 | |
| Hallway | 60 | | 0 | 7 | 0.00 | |
| Computer & monitor | 118 | 118 | 4 | 7 | 3304.00 | |
| Modem | 10 | 10 | 3 | 7 | 210.00 | |
| TV | 103 | 103 | 2 | 5 | 1030.00 | |
| Radio | 1 | 1 | 1 | 5 | 5.00 | |
| Kitchen fan | 16 | 16 | 5 | 7 | 560.00 | |
| Bedroom fan | 0 | | 11 | 3 | 0.00 | |
| Alarm clock | 0 | 0 | 24 | 7 | 0.00 | |
| Answering machine | 0 | 0 | 24 | 7 | 0.00 | |
| Highest power used at one time: | | 420 | Total power per week: | | 16363.25 | Wh/w |

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# Audit – Add everything up

EE first - Design approach – Weighing your options

- What do you already have? How does it fit together?
  - Generators
  - Well
  - Battery/inverter space
  - Area for the solar panels, where is it?
  - DC/AC
  - 3 phase or single phase

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# What does the future hold?

EE first - Design approach – Weighing your options

| | | Power Needs Table | | | | |
|---|---|---|---|---|---|---|
| | (A) Power (watts) | Power used at one time | (B) Hours used in a day | (C) Days per week | Watt-hours per week (A) x (B) x (C) | |
| **Appliances/Loads** | | | | | | |
| Fridge | 58 | 131* | 24 | 7 | 9744.00 | |
| Lights: | | | | | | |
| Office | 15 | 15 | 3.5 | 7 | 367.50 | |
| Kitchen (2) | [illegible] | 26 | 2 | 7 | 364.00 | |
| Living room | [illegible] | | 5 | 7 | 700.00 | |
| Bathroom | [illegible] | | 0.75 | 7 | 78.75 | |
| Bedroom (2) | 120 | | 0 | 7 | 0.00 | |
| Hallway | [illegible] | [illegible] | 0 | 7 | 0.00 | |
| Computer & monitor | [illegible] | [illegible] | 4 | 7 | 3304.00 | |
| Modem | [illegible] | [illegible] | 3 | 7 | 210.00 | |
| TV | 103 | 103 | 2 | 5 | 1030.00 | |
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| Answering machine | 0 | 0 | 24 | 7 | 0.00 | |
| Highest power used at one time: | | 420 | Total power per week: | | 16363.25 | Wh/w |

Well Pump

Retirement

Net Zero Goal

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# Off-Grid Systems Require an Energy Manager

- Can you manage each of these electrical loads (current and future)?
- Understand risks and plan ahead.

Well Pump

Retirement – More use

Net Zero Goal

| | | Power Needs Table | | | | |
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| Highest power used at one time: | | 420 | Total power per week: | | 16363.25 | Wh/w |

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# Off-Grid Systems Require an Energy Manager

- Can you manage each of these electrical loads (current and future)?
- Understand risks and plan ahead.

- Peak power
- Daily power
- Weekly routine
- Phantom Loads

Power Needs Table

| Appliances/Loads | (A) Power (watts) | Power used at one time | (B) Hours used in a day | (C) Days per week | Watt-hours per week (A) x (B) x (C) | |
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| Answering machine | 0 | 0 | 24 | 7 | 0.00 | |
| Highest power used at one time: | | 420 | Total power per week: | | 16363.25 | Wh/w |

- Decided how much back-up (fossil fuels) you are willing to use.
  Look at costs $$$

- Too expensive …. Re-evaluate - Are there things you can mange better or eliminate to save money?

**Surrette**

## RENEWABLE BATTERY BANK CAPACITY


| Surrette Battery Model | Individual Battery Weight Wet (lbs) | Individual Battery Amp Hours (100-hr rate) | Battery Voltage | Multiplied by | Total Number of Batteries | Equals | Total System Voltage | Multiplied by | Individual Battery Amp Hours (100-hr rate) | Equals | Total Battery Bank Watts | 50% DOD Realistic (Usable) Wattage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S-550 | 127 | 550 | 6 | x | 2 | = | 12 | x | 550 | = | 6600 | 3300 |
| S-1660 | 121 | 1660 | 2 | x | 6 | = | 12 | x | 1660 | = | 19920 | 9960 |
| 6-CS-25PS | 318 | 1156 | 6 | x | 2 | = | 12 | x | 1156 | = | 13872 | 6936 |
| 4-KS-25PS | 315 | 1904 | 4 | x | 3 | = | 12 | x | 1904 | = | 22848 | 11424 |
| 2-KS-33PS | 208 | 2490 | 2 | x | 6 | = | 12 | x | 2490 | = | 29880 | 14940 |
| 2-YS-31PS | 285 | 3232 | 2 | x | 6 | = | 12 | x | 3232 | = | 38784 | 19392 |
| S-550 | 127 | 550 | 6 | x | 4 | = | 24 | x | 550 | = | 13200 | 6600 |
| S-1660 | 121 | 1660 | 2 | x | 12 | = | 24 | x | 1660 | = | 39840 | 19920 |
| 6-CS-25PS | 318 | 1156 | 6 | x | 4 | = | 24 | x | 1156 | = | 27744 | 13872 |
| 4-KS-25PS | 315 | 1904 | 4 | x | 6 | = | 24 | x | 1904 | = | 45696 | 22848 |
| 2-KS-33PS | 208 | 2490 | 2 | x | 12 | = | 24 | x | 2490 | = | 59760 | 29880 |
| 2-YS-31PS | 285 | 3232 | 2 | x | 12 | = | 24 | x | 3232 | = | 77568 | 38784 |
| S-550 | 127 | 550 | 6 | x | 8 | = | 48 | x | 550 | = | 26400 | 13200 |

# RENEWABLE BATTERY BANK CAPACITY


| Surrette Battery Model | Individual Battery Weight Wet (lbs) | Individual Battery Amp Hours (100-hr rate) | Battery Voltage | *Multiplied by* | Total Number of Batteries | *Equals* | Total System Voltage | *Multiplied by* | Individual Battery Amp Hours (100-hr rate) | *Equals* | Total Battery Bank Watts | 50% DOD Realistic (Usable) Wattage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| S-1660 | 121 | 1660 | 2 | x | 24 | = | 48 | x | 1660 | = | 79680 | 39840 |
| 6-CS-25PS | 318 | 1156 | 6 | x | 8 | = | 48 | x | 1156 | = | 55488 | 27744 |
| 4-KS-25PS | 315 | 1904 | 4 | x | 12 | = | 48 | x | 1904 | = | 91392 | 45696 |
| 2-KS-33PS | 208 | 2490 | 2 | x | 24 | = | 48 | x | 2490 | = | 119520 | 59760 |
| 2-YS-31PS | 285 | 3232 | 2 | x | 24 | = | 48 | x | 3232 | = | 155136 | 77568 |

# Off-Grid Systems Require an Energy Manager

EE first - Design approach – Weighing your options

- Relationship between components

**Peak power**

**Daily power**

**Weekly routine**

**Phantom Loads**

**Inverter/Charger** - 3 phase or Single - Important in ability to properly recharge batteries and handle peak loads

**Battery Bank Size (A/hr and Volt)**

**Generator Size** – Important in ability to properly recharge batteries – *related to Inverter/Charger* Important in ability to carry peak loads

**Solar array size and solar charge controller** - Important to keep batteries charged – easily adjusted - Not the big decision here.

# Off-Grid Design Issues

- EE first - Design approach – Weighing your options
- Being an Energy Manager
- Year around use? - Deep Winter Solar Power tradeoffs
- Be realistic
  - I have a 2,000 sq/foot house, what size solar array do I need?
  - How much money are you willing to spend to simulate your luxurious grid-tied life.

# Off-Grid Design Issues

- Battery Issues
  - Sizing, maintenance, type, etc
- DC vs AC
  - Inverter Styles
  - System Effieciency
  - Cost effectiveness

# Off-Grid Design Issues

## Storage= Batteries

The amount of power needed is directly related to how many batteries you need in your system. If you use very little power then you will need a small amount of batteries. If you consume a lot of power then you need a larger battery bank.

**Batteries are the heart of an off grid system. If you have bad batteries you have a useless system.**


# Off-Grid Design Issues

## Battery

Electrochemical form of storing energy. There are many different sizes and types. But the are classified by their: chemistry, voltage, size, specific energy (capacity), specific power, (delivery of power).

Direct Current (DC Power)

# Off-Grid Design Issues

## Types of Batteries

Automotive Batteries
Starting Battering made for quick charge and discharge

Marine Batteries
Made for quick discharge but can be used for extended periods also

Deep Cycle Batteries
Made for long term charge/discharge

# Off-Grid Design Issues

## Composition of Batteries

**Lead Acid** – Constructed of Lead Plates and Sulfuric Acid Electrolyte Solution
**Absorbed Glass Mat** - Acid is absorbed by a very fine fiberglass mat, making the battery spill-proof.
**Thin Plate Pure Lead**– Sealed lead plated battery, it is lighter than LA and AGM batteries.
**Lithium Ion**- Constructed of lithium, the lightest of all metals and a very high specific energy.

# Off-Grid Design Issues

## Battery Bank Size

**12 Volt**- The most common battery bank size, it requires the fewest amount of batteries but it is limited.

**24 Volt**- This system size is generally good for most systems however it also is limited.

**48 Volt**- This system has the highest voltage and therefore the least amount of power loss. It also does require the most batteries.

# Off-Grid Design Issues

## Conversion from DC to AC

Batteries Store Energy in Direct Current DC
Household Appliances utilize Alternating Current AC
In order to convert from DC to AC you need an Inverter

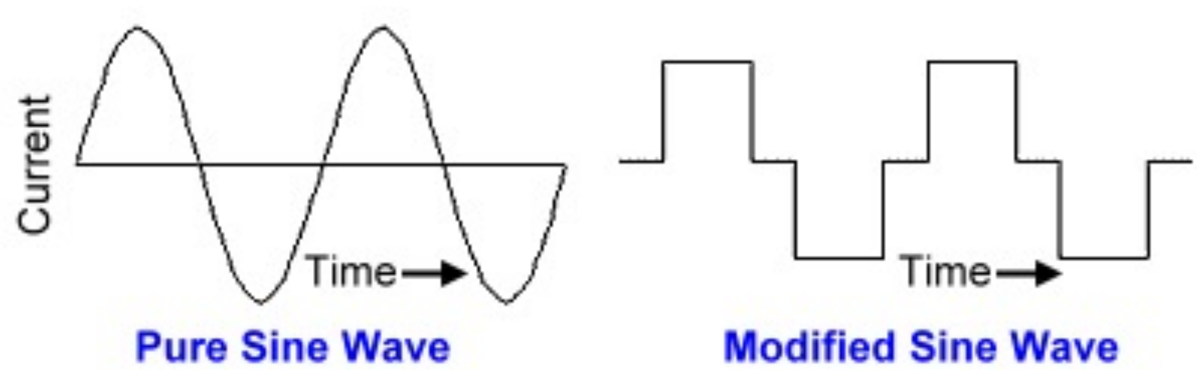


# Off-Grid Design Issues

## Types of Inverters

Modified Sine Wave – Output is similar to a square wave, which works for most appliances just not sensitive electronics.

Pure Sine Wave – A pure sine wave inverter produces a nearly perfect sine wave output that is essentially the same as utility-supplied grid power.



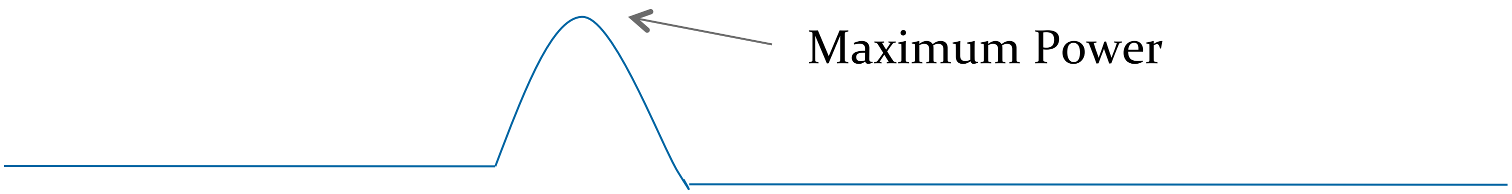
# Off-Grid Design Issues

## Inverter Sizes

Based on DC Voltage: 12, 24, 48 Volts

Based on Wattage: Maximum Capacity at any time.

Based on AC Voltage: 120 VAC, 240 VAC, 120/240VAC



# Off-Grid Design Issues

**Inverters** regulate the power taken out of the batteries
**Chargers** regulate the power going into them.

If a power source is not properly regulated the batteries could be undercharged, overcharged, burnt out, or destroyed.


# Off-Grid Design Issues

## Charge Cycles

Bulk – Initial Charge of High Amperage High Voltage

Absorb – Steady Charge of Voltage, slowly reducing Amperage

Float –Trickle Charge to "top off" the batteries voltage

Equalize –Maintenance Charge to burn off sulfation on the plates and revive battery voltage.

# Off-Grid Design Issues

## AC vs DC

- A lot of people think that it may benefit them to only use dc appliances and run dc power from the batteries.
- Inverter Efficiency has increased to 96-98%
- DC Wiring has to be upsized to handle the amperage which can be expensive.
- Also DC appliances are usually more expensive than just the regular AC appliances

# Alaskan Off-Grid Solar PV examples

- 3.36 kW home
- 480 watt system for DC LED lights in a ski cabin
- 11.5 kW lodge in Chicken, AK
- 2 kW Solar Oyster Farm

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# Heite's System - 3.36 kW

- Picture of Heite's System

3.36 KW Array

Nikiski, AK

Top of Pole Mount

Off Grid with Battery and 9 KW Generator Backup

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# Heite's System - 3.36 kW

- System details

XW 6848 Inverter/Charger

# Heite's System - 3.36 kW

- System details

US Lead Acid Battery L16


# Heite's System - 3.36 kW

- Cost of Electricity

Cost to bring grid-power to location = $27,000 from Homer Electric Association
Estimated Electric Bill: 240kwh/month approximately $67.20/ month
Power Quality: Occasion Blackouts for 1-2 day periods
Annual Estimated Energy Cost: $806.40 (Without the cost of Inflation factored)

Solar PV System Installed Cost = $20,000
Tax Credit: $6,000
Net Cost of System $14,000
Estimated Generator run time in summer (Apr – Oct): 0 -10 hours
Estimated Generator run time in winter (Nov-Mar): 240 Hours approximately (240 gallons)
Annual Estimated Cost per year for Diesel: $875 ($3.50/gallon * 250 Gallons/ Yr)

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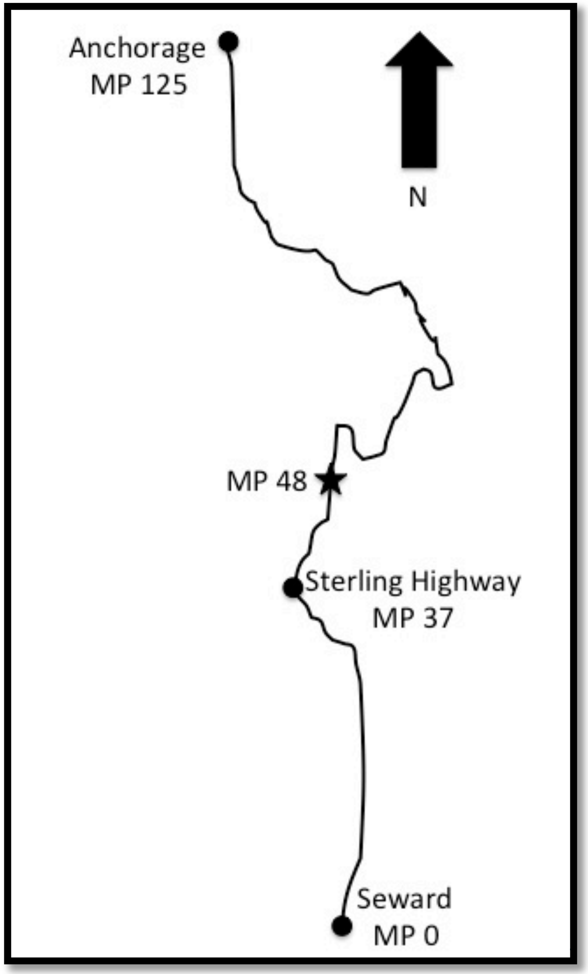
AK Mountain and Wilderness Hut Association

# Manitoba Cabin

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AK Mountain and Wilderness Hut Association

# Manitoba Cabin

- Using a lot of mantels $$$
- Using a lot of batteries
- Ski groups wanted lights
- Photography classes ...
- Propane lamps added to humidity

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AK Mountain and Wilderness Hut Association

# Manitoba Cabin

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ALASKA CENTER for Appropriate Technology

AK Mountain and Wilderness Hut Association

# Manitoba Cabin

- Using a lot of mantels $$$
- Using a lot of batteries
- Ski groups wanted lights
- Photography classes … Audubon Society ….
- Propane lamps added to humidity

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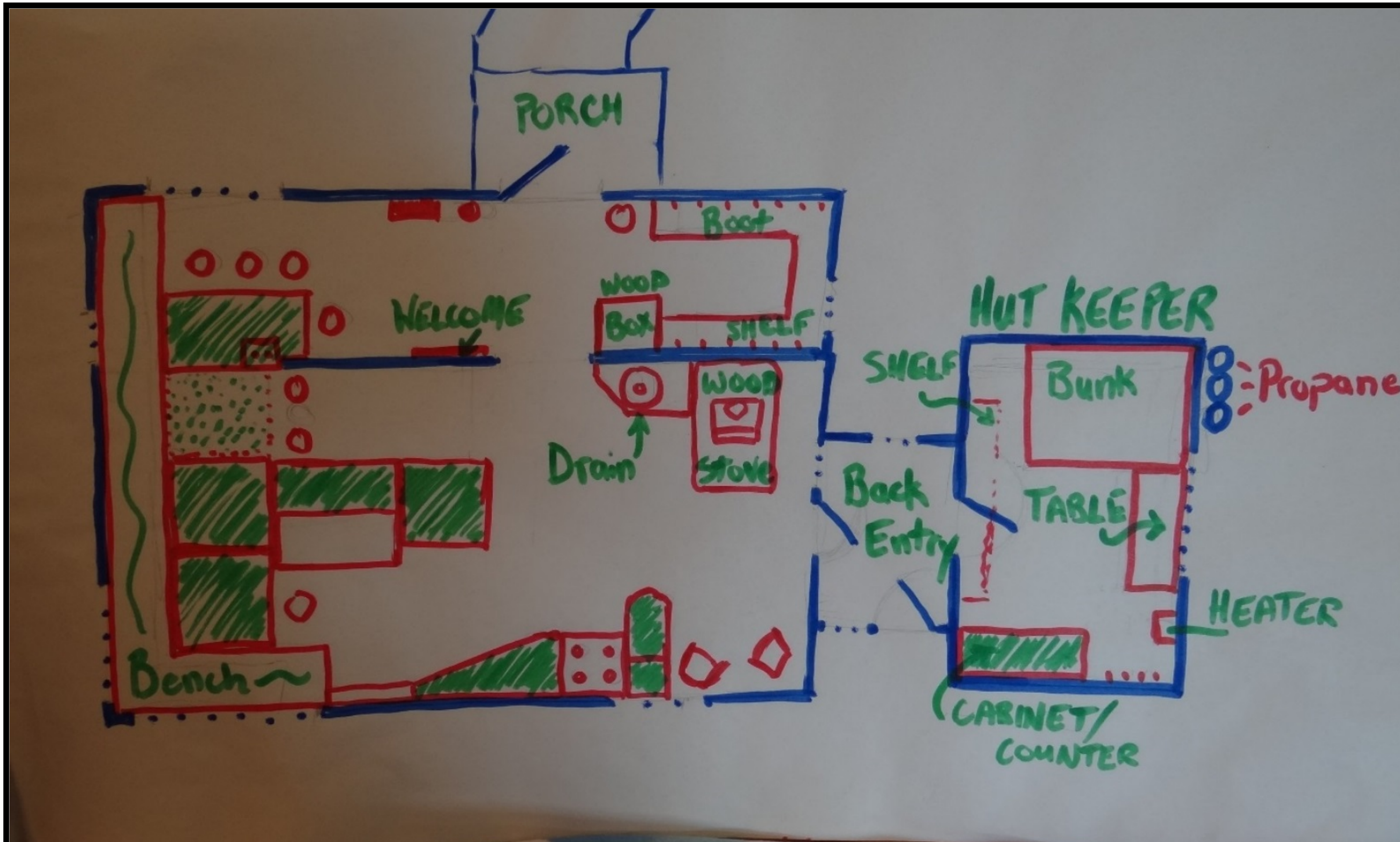
AK Mountain and Wilderness Hut Association

# Manitoba Cabin

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[Link to PDF]

Est: 4 90w = 360 w

**Actual:** three 160 w = 480w

Est: Battery 415 amp/hr

**Actual:** 460 Amp/hr

Est: 46 Ah day

**Worst case scenario**: four 4 watt lights left on continuous. = 32 Ah/day

5.4 days @415 A/hr

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### Site Summary

*Site Name:* Manitoba Cabin Hut Site
*Location:* ANCHORAGE, AK, USA
*Latitude:* 61.17N *Longitude:* 150.02W *Elevation:* 35 m
*Comments:* NREL : 26451

### Load / System Summary

*Design Load:* 46.0 Ah Day @ 12.0 VDC
*Tilt:* 90S *Azimuth:* 0E *Tracking:* Fixed
*Min ALR:* 0.73 *Avg ALR:* 5.40
*LOLP:* 68.642% *Avail:* 87.339% *Avg BSOC:* 85%

### System Summary

*PV (Module / Array)*

*Model:* 490J
*Rating:* 90W/ 360Wp
*Modules:* 4
*Config:* 2 S x 2 P
*Vmpp:* 17.90 / 35.8
*Impp:* 5.03 / 10.1
*Voc:* 22.20 / 44.4
*Isc:* 5.58 / 11.2
*Volts:* 10.1

*Battery (Unit / Total)*

*Model:* AGM 6V
*Rated kWh:* 4.98
*# Units:* 1
*Config:* 1 S x 1 P
*Voltage:* 6.0 / 12.0
*Amp-hr:* 415.0 / 415.0
*Rated Days:* 5.4

*Controller:*

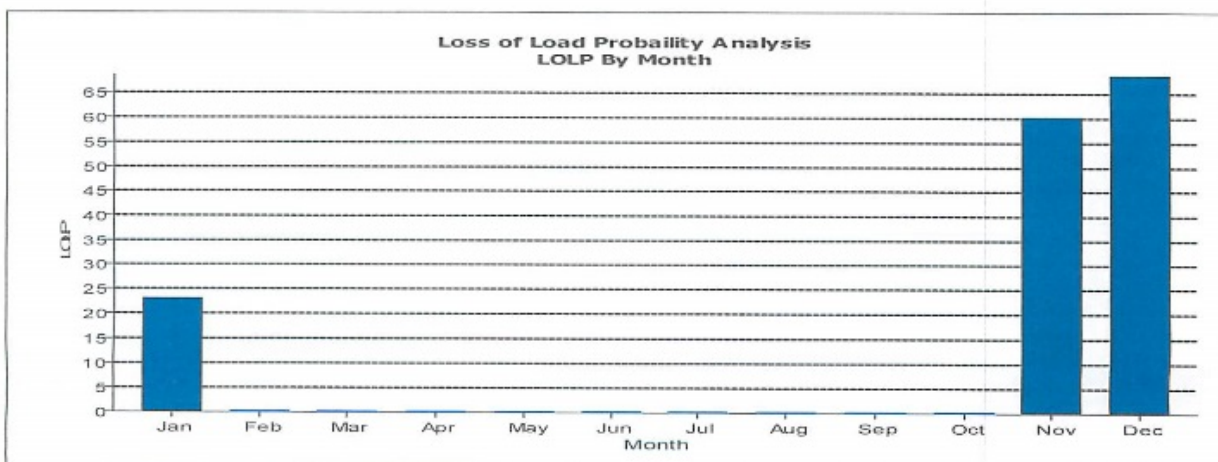
*Model:* TS-MPPT-60
*Type:* MPPT
*Voltage:* 12
*Rating:* 60
*Quantity* xxx

*Inverter:*

*Model:* n/a
*Voltage:* n/a
*Rating:* n/a
*Quantity* n/a

### Availability Analysis

| Month | Array Insol (kWh/m2/d) | Insolation Variability | Day to Day Correlation | Array / Load Ratio | Batt Size (days) | Avg BSOC (%) | LOLP (%) | SEP (%) |
|---|---|---|---|---|---|---|---|---|
| Jan | 1.80 | 0.27 | 0.23 | 0.95 | 4.8 | 48 | 23.177 | 0.028 |
| Feb | 2.81 | 0.46 | 0.35 | 1.86 | 6.3 | 97 | 0.000 | 85.498 |
| Mar | 3.44 | 0.40 | 0.33 | 2.94 | 8.5 | 98 | 0.000 | 94.306 |
| Apr | 3.30 | 0.44 | 0.32 | 3.82 | 12.0 | 99 | 0.000 | 97.495 |
| May | 3.26 | 0.39 | 0.27 | 8.48 | 28.3 | 99 | 0.000 | 99.179 |
| Jun | 3.06 | 0.37 | 0.37 | 23.69 | 86.7 | 100 | 0.000 | 100.000 |
| Jul | 3.01 | 0.38 | 0.26 | 13.90 | 52.5 | 99 | 0.000 | 99.987 |
| Aug | 2.70 | 0.43 | 0.30 | 4.03 | 16.9 | 99 | 0.000 | 97.845 |
| Sep | 2.25 | 0.56 | 0.22 | 2.15 | 10.5 | 98 | 0.000 | 80.726 |
| Oct | 1.84 | 0.67 | 0.31 | 1.39 | 7.8 | 94 | 0.010 | 49.820 |
| Nov | 1.30 | 0.70 | 0.30 | 0.73 | 5.4 | 45 | 60.104 | 0.021 |
| Dec | 1.20 | 0.17 | 0.23 | 0.90 | 4.6 | 41 | 68.642 | 0.000 |



AK Mountain and Wilderness Hut Association

# Manitoba Cabin – 480 watts

Three 160 watt panels

AGM 460 Amp Hr Battery

No Back up

DC LED Lights

Public facility

Winter and summer breakers

ALASKA CENTER for Appropriate Technology

# Manitoba Cabin – 480 watts

Three 160 watt panels

AGM 460 Amp Hr Battery

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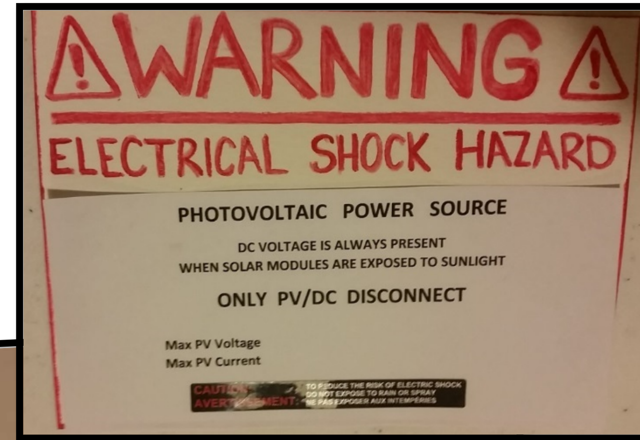
ALASKA CENTER for Appropriate Technology

AK Mountain and Wilderness Hut Association

# Manitoba Cabin

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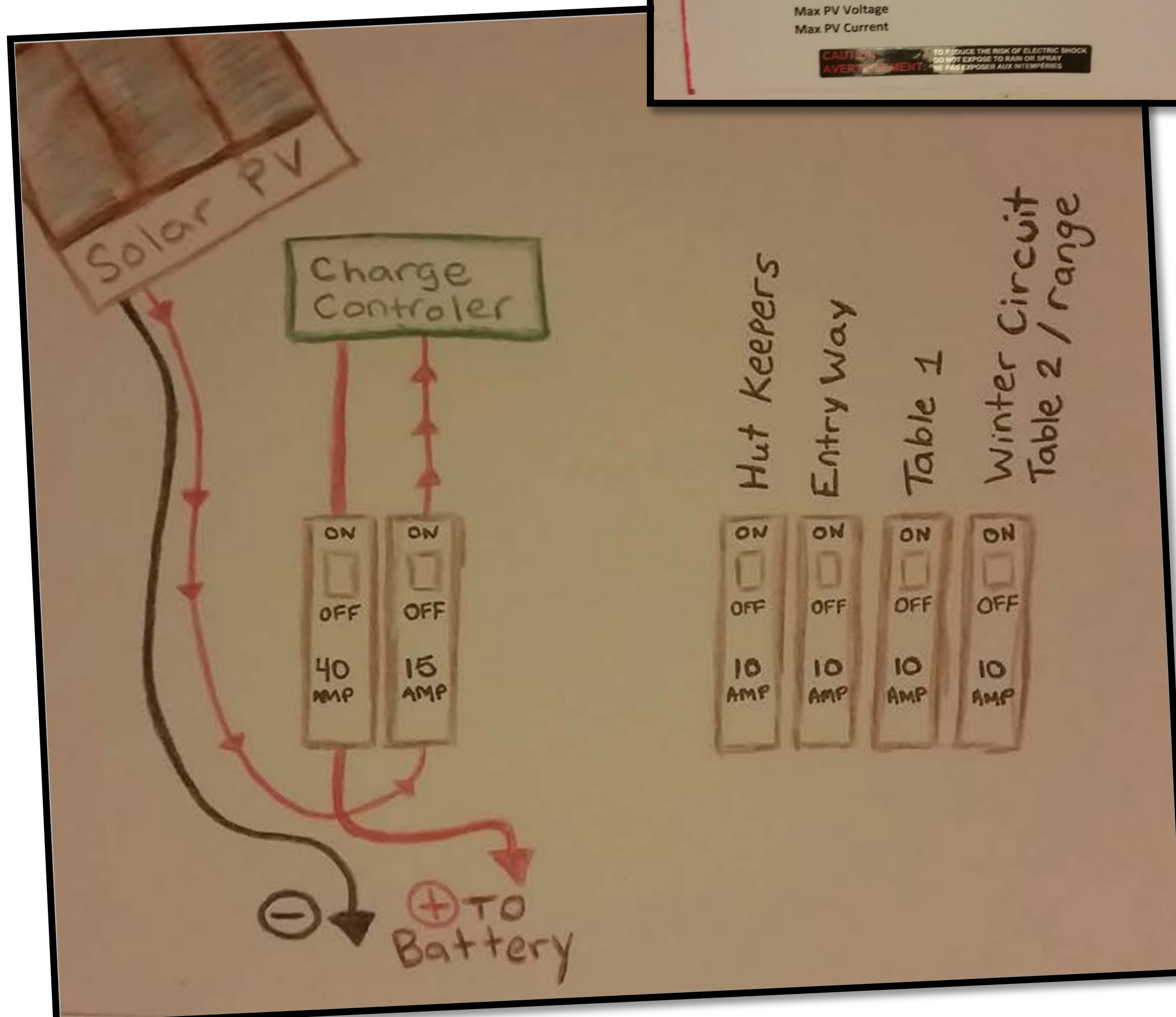


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# Manitoba Cabin

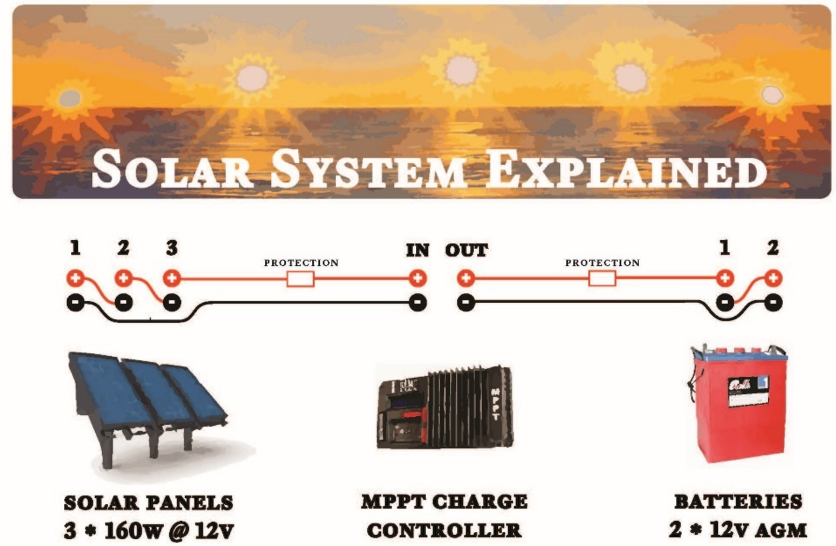
PDF link

Educational

Guest help us monitor the system

Added a charging device for potential resident hut keeper

Plan to install a pure sine  inverter for events




## How Solar Works

**1. The panels collect electromagnetic radiation from the sun.**

Solar electricity is the conversion of solar radiation into electricity. This system converts the solar radiation into electricity through photovoltaic cells, commonly called a solar PV cell. Each panel has multiple PV cells, and there are three panels outside on the roof. PV cells are composed of thin, transparent layers of boron and phosphorous enriched silicon. When sunlight hits the silicon, it dislodges electrons. The PV cell guides the electrons in such a way that their flow creates an electrical current. It is important that the panels are clear from snow and shade.

**2. Power is sent to the charge controller.**

The amount of electricity produced can vary greatly depending on the intensity of the sun on the panels. And because we are storing this energy in batteries, we need to have a charge controller. The charge controller protects our batteries from being overcharged. It also features an LED display so we can track the system performance.

**3. The batteries act as a storage tank and buffer.**

All the electricity used by the lights passes through the batteries first. As users of the system, we need to be careful not to empty the battery fuel tank. This is why conservation is important. Please only keep lights on when they are in use. You can also help ensure that solar energy can refill the tank by monitoring snow cover on the panels. The material in these batteries is Absorbed Glass Mat (AGM). The batteries use lead acid suspended in a solid form, which prevents freezing and damage caused by cold.

## System Capacity

Two 6 volt batteries
■ 12 volt system voltage
* 460 amp hours (at 100 hr rate)
= 5520 watts
* 50% (because we only empty batteries to half capacity)
= 2760 usable watts

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Part of **Alaska Huts' mission is to promote wilderness stewardship**. We invested in solar electric with this mission in mind: it provides clean electric light and the opportunity to educate guests about solar PV technology and use in Alaska. This system will benefit us by (1) reducing our spending on propane and mantels for gas lanterns and (2) decreasing the amount of humidity caused by propane combustion. This solar PV system is designed to get Manitoba through our busy winters without a backup generator.

The solar panels and batteries are "oversized" for Alaska's summer, but will help keep the lights on during our most difficult solar months, November, December and January. **It is important to always turn the lights off when they are not needed**. The lights are very efficient, so even small conservation efforts help to ensure that there will be enough power for all of our guests and will extend the overall life of our batteries. Have a great stay at Manitoba.

## THE GOLDEN RULES

### 1. TURN OFF THE LIGHTS WHEN NOT IN USE.

The image at the top of this page shows the path of the sun over Alaska during the winter months, when daylight can last less than six hours. Conservation is crucial due to the low angle and limited duration of potential sunlight.

### 2. WARMER BATTERIES ARE BETTER BATTERIES.

The warmer the batteries are in the winter, the more efficient they are. If you keep the cabin warm when you are using the batteries you will save a lot of power and help extend the life of our battery bank.

### 3. DO NOT USE IF BATTERIES ARE BELOW 12V.

The target voltage for this system is 12.5 volts. The readout is shown on the MPPT charge controller attached to the wall.

This solar PV system was designed and installed by our volunteer board members and friends of Alaska Huts. Our total installed cost was $6.25 a watt. If we would have paid full price for equipment, labor @20/hr and gas expenses, our true cost would have been about $10.30 a watt installed. This is a 480 watt system. We are very thankful to everyone who helped to make this project a success.

Alaska Huts

Renewable Energy Systems

# Manitoba Cabin

This solar PV system was designed and installed by our volunteer board members and friends of Alaska Huts.

Our total installed cost was $6.25 a watt. – WINTER USE

If we would have paid full price for equipment, labor @20/hr, and gas expenses, our true cost would have been about $10.30 a watt installed.

This is a 480 watt system, for $3,000. We are very thankful to everyone who helped to make this project a success.

## Alpine Holdings Inc.
## EE UPGRADE
## In two locations (Tok and Chicken , AK)

LED lights
410 Bulbs changed out

- $22,473 Total Project Cost
- **$5,618 REAP 25% EE Grant**
- **≈ $7,000 less than projected due to LED cost decline**

8,591 kWh/yr saved (w/GHG Calc .914)
7,168 kWh/yr saved on electric bill

**Approximately $8,521 saved annually**


ALASKA CENTER
for Appropriate Technology


# Renewable Energy


Alpine Holdings Inc.
**Renewable Project – Solar PV/ Battery system**
Chicken , AK

**11.5 kW Solar PV** (4 poll mounts)

- $33,047 Total Project Cost
- **$5,871 REAP 25% EE Grant**

- Two year average of 8.8 kWh/yr production
- 810 hours of Generator OFF time
- ≈ $5,000 savings in diesel fuel and generator maintenance per/yr
- **Recommendations: Build the full size of the system up front!**

## Pristine Products
## Solar PV for Oyster Farm – April 2015

**2 KW Solar Array**
Breaker box
Charge controller (Outback)
Battery bank 24v
Efficient electric motor
Paddle wheel

- $14,951 **Total Cost**
- $3,735 **REAP Grant**

- Did not use his generator all year, saving 960 gallons of Diesel
- At $4.00 a gallon delivered = $3,840 savings a summer.
- Increased production from 4 months to 6 months

# Solar Powered Oyster Farm

Video Link

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