

# Living Off-Grid: Solar-efficient, Resource-efficient, Enjoyable

*SolarTerra Design LLC*



# What is Off-Grid?

- Little or No Infrastructure
  - Electricity
  - Water
  - Propane
  - Sewer
  - Garbage Pick-up
  - Phone Line
  - Road Maintenance
- No Immediate Social or Emergency Support
  - Neighbors
  - Police
  - Medical
  - Fire
- Usually a longer commute!

It's not just being off the  
"electrical grid".

# Some Off-Grid Perceptions

## The Home



- **The Life Style**
  - Lack of Comfort
    - Cold in winter, hot in summer
    - A lot of maintenance
    - Sporadic electricity and water
    - “Stored trash” smell
    - Drone of a generator
  - Lack of Communication
    - No phone, TV, Internet
    - No mail or package delivery

# Some Off-Grid Realities

## The Home



- The Life Style
  - Comfortable
    - Warm in winter, cool in summer
    - Some maintenance
    - Consistent electricity and water
    - Aromas of Nature
    - Quiet enough to hear the sounds of bird wings flapping
  - Connected
    - Cell phone
    - Satellite TV and Internet
    - Mail and package delivery

# So How do you get to Comfortable Off-Grid Living?

- What to look for in an off-grid site
- Learn about your site
- Be a **Steward** of your site
- Learn about off-grid systems & appliances
- Learn how to be solar-efficient
- Learn how to be resource-efficient
- Put it all together and live off-grid\*
- **Enjoy your self-reliance and independence!**

\*DIY and/or expert local resources can assist you



# What to Look For in an Off-Grid Site

- **Solar & Satellite Access !!!**
  - Clear southern exposure with no trees or natural formations between 30 – 70 degrees
- **Slight Site Slope**
  - Good site water drainage
  - Gravity fed septic and gray water irrigation
- **Vegetation / Topography**
  - East and west of house site to provide early morning and late afternoon shade; on north side to help block winter winds
  - Adequate ground cover to cool site and minimize dust
- **Ground Water**
  - Water rights if water table is shallow (50-250 feet)
  - Good tasting with low mineral content
- **Other factors**
  - Road access during inclement weather (evidence of slippery clay or flooded roads?)
  - Wind for power generation (usually need a ridge or open space)
  - Cell coverage (does your phone work?)
  - Garden site

# Learn About Your Site

- **Solar Access**
  - Sun travel across the sky each season (Sun Chart)
  - Natural shading by mountains, trees, fog, etc
- **Prevailing Weather**
  - Winds each season
  - Temperature extremes
  - Precipitation amounts each season
- **Site Slope / Topography**
  - House & driveway considerations
  - Surface and water drainage
  - Wetlands
- **Ground Water**
  - Rights
  - Quality
  - Depth
- **Views**
  - Desirable / Undesirable
  - Protect your best view, keep it special
- **Vegetation**
  - What kind?
  - What to be sure to save
- **Animals**
  - What kind?
  - Potential threats or damage

# Be a Steward of Your Site

- **Be a part of Nature**
  - Pay attention and work WITH it
- **Site**
  - Design your home to be a part of the site
  - Keep natural drainages natural
  - Minimize site disturbance
- **Wildlife**
  - Find out the habits of your wildlife and allow them to continue
  - Work with animals; small fenced-in areas, provide safe corridors, no poison or insecticides, use live traps for pests
  - Feed and water wildlife minimally; prey attracts predators
  - Train your pets to stay close to home
  - Reseed disturbed areas with natural grasses and plants
  - Minimize noise and lights
- **Vegetation**
  - Be sensitive to endangered or scarce plants, protect them and work around them
  - Don't introduce invasive plants; remove those that exist
  - Site your home so natural trees won't grow and block solar access
  - Be careful with your grey water
- **Neighbors**
  - Be sensitive; don't block views, ensure you both have privacy, keep dust, light, noise, trash, etc from heading their way
  - Meet them; protect your area together
- **Indian Artifacts**
  - Enjoy them where you discover them
  - Call the archaeologist at the State or National Forest District

# Learn About Off-Grid Systems

- **Electricity**
  - Solar PV with battery bank
  - Wind generation
  - Back-up generator
- **Hot water**
  - Solar collector
  - Geo-thermal
  - LPG tank or tank-less
- **Heating**
  - Passive Solar
  - Geo-thermal
  - In-floor or below-floor radiant
  - Wood or pellet stoves
- **Drinking Water**
  - Storage Tanks
    - Rainwater catchment
    - Hauled
    - Purification
  - Well (if shallow water table)
- **Septic**
  - Gravity feed if possible
  - Standard design (maybe)
  - Alternative design (probably)
  - Use compost toilets?

Consider protection from weather,  
people and animals.

# More Off-Grid Systems / Appliances

- **Communication**
  - Phones (cell)
  - TV (satellite)
  - Internet (satellite)
  - Mail (USPS or private box, UPS, FedEx, DHL will deliver)
- **Trash - Recycle**
  - Compost organics
  - Recycle packaging or remove at source
  - Haul recyclables and small volume of “trash”
- **Appliances, etc**
  - Stove/Oven: LPG
  - Refrigerator: LPG or electric
  - Clothes Dryer: LPG or outdoor clothes line
  - Low flush toilets
  - Automatic on/off faucets
  - Motion sensor light controls
  - Exhaust fan timers
  - IR water sterilization
  - Etc, etc, etc

Consider protection from weather,  
people and animals.

# Learn about Solar-efficient Design

- **Use Passive Solar Strategies**
  - Design Strategy: Capture and store the sun's heat in the winter, capture and store cool air in the summer
  - Orient the house as close to east-west as possible
  - Place highest percentage of glazing on south side, lowest on east and west sides
  - Install overhangs that allow full sun into south windows in winter, and no sun in summer
  - Ensure enough thermal mass inside of the house to act as a thermal battery and balance incoming solar radiation
- **Use Daylighting**
  - Have daylight light all rooms during the day, including interior rooms when possible
  - Minimize glare
- **Install Shading**
  - **Overhangs** (they protect the building walls from storms too)
  - **Natural:** vegetation, hills, large rocks, etc
  - **Mechanical:** interior blinds, exterior shade mechanisms
- **Invest in your Insulation**
  - Use adequate insulation in walls and ceiling/roof
  - Pay attention to doors and windows
  - Minimize skylights, use solar tubes instead if necessary

Manage your solar or it will manage you!

# More Solar-efficient Design Elements

- **Floors**
  - Consider thermal mass value
  - Go for low maintenance
  - Insulate under floor
  - Need tight air seal!
- **Walls / Ceiling**
  - Match system to requirement: SIPs, ICFs, AAC block, adobe, rammed earth, straw bale, frame, etc
  - Insulation installation is important
  - Need tight air seal!
- **Roofing**
  - Rainwater catchment surface, metal is preferred and recyclable
- **Glazing (windows)**
  - Values
    - U-Value (inverse of R-Value), lower value is higher insulation (maximum .35)
    - SHGC (Solar Heat Gain Coefficient), higher value allows more radiant heat
    - VT (Visible Transmittance), higher value allows more light
    - AL (Air Leakage) , lower value is less leakage
  - Need tight air seal!
- **Systems**
  - Incorporate solar PV and hot-water collectors in overall design
  - Plan for thermo-siphon for your solar hot water

Use sustainable components and source locally whenever possible.

# Learn about Resource-efficient Design

- **Collect Rainwater from all gutters**
  - Store in completely dark tanks
  - Use for drinking water and/or irrigation
- **Re-use gray water from washer, tubs and bathroom sinks**
  - Irrigate vegetation and gardens
- **Fresh air ventilation**
  - Open windows and use cool night air to remove heat and odors
  - Chimney effect; high windows to exhaust hot air and draw in lower cool air
  - Whole house fans and/or mechanical air-exchangers
- **Re-use site and building materials**
  - Save topsoil for re-use
  - Chip tree prunings and drywall for soil amendments
- **Conserve Electricity**
  - Install master on/off switch for “always-on” electronics
  - Install CFL or LED lights
  - Automatic controls...
- **Grow Fruits and Vegetables**
  - Reduce trips to store for food
  - Use compost for fertilizer
- **Use indigenous plants for landscaping**
  - Little need for pesticides or fertilizer
  - Low water & maintenance

Manage your resources as if they were investments – they are!

# Put it all Together to Live Off-Grid

- **Do-it-yourself Resources**
  - Local colleges and organizations
  - Books and web sites
  - Industry lectures and workshops
  - Coconino County Sustainable Building Program
- **With Assistance**
  - Local architects
  - Local builders
  - Contact the United States Green Building Association to find members in northern Arizona ([www.usgbc.org](http://www.usgbc.org))
  - Coconino County Sustainable Building Program Resource Directory

**IMPORTANT:** Integrate site orientation, off-grid systems, building components and lifestyle choices in your design from the beginning!

# Enjoy your Self-reliance and Independence

- **Personal Responsibility and Confidence**
  - You have direct knowledge of the natural and industrial infrastructure and “costs” that are required to support your life style
  - The ramifications of your life style choices are immediate
  - You are as comfortable and “in communication” as you want to be
  - You can fix what needs fixing when it needs fixing
- **Satisfaction**
  - You notice the seasonal changes in temperature, rainfall, winds, vegetation, animals, birds, insects - they all affect you
  - You’re not affected by increasing grid costs or outages
  - You’re less affected by food costs and shortages
  - You have actual “quiet” time
  - You have a real connection and an appreciation of Nature

# SolarTerra Design LLC

Specializing in **solar, energy** and **resource-efficient**  
off-grid home design and construction

If you'd like a copy of this presentation, or recommendations for books,  
web sites or workshops, please contact –

SolarTerra Design LLC  
7709 West Painted Rock Trail  
Williams, AZ 86046  
928-310-6644  
[www.solarterra.com](http://www.solarterra.com)



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