

Returns on Renewable Energy Investments

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National Center for Appropriate Technology

Southern Sustainable Agriculture
Working Group

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National Center
for Appropriate
Technology



ATTRA
National Sustainable Agriculture Information Service
www.attra.ncat.org



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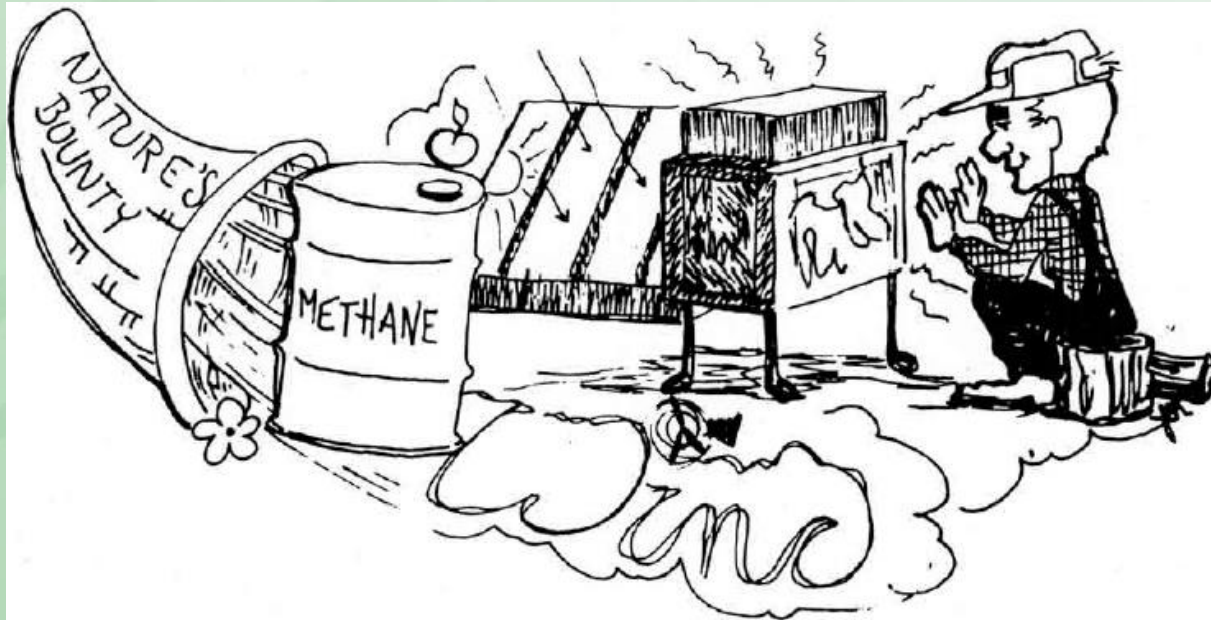
What this talk will cover

1. General advice
 - Realism about cost and risks
 - Finding incentives
 - Finding equipment and technical assistance
 - How to work with dealers and installers
2. Quick survey of some renewable energy projects
 - Ballpark costs
 - Risks and things that can go wrong



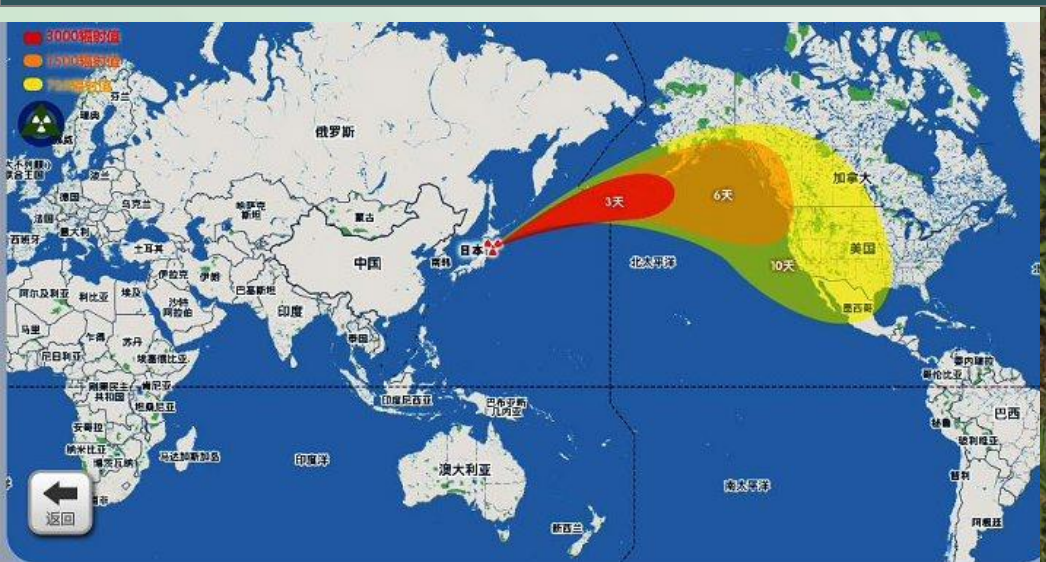
Why we are all here

- “Small family farmers are directly threatened by large-scale mechanization developed in an era of cheap energy...The energy crisis is an economic opportunity for America’s small family farmers.”
- “The small family farmer can make use of renewable energy resources, demonstrating that skill and resourcefulness...is once again at a premium in agriculture.”
 - Final Report, The Small Farm Energy Project (1976-83)



Realism about Cost and Risks

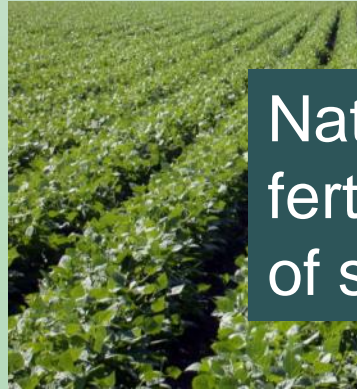
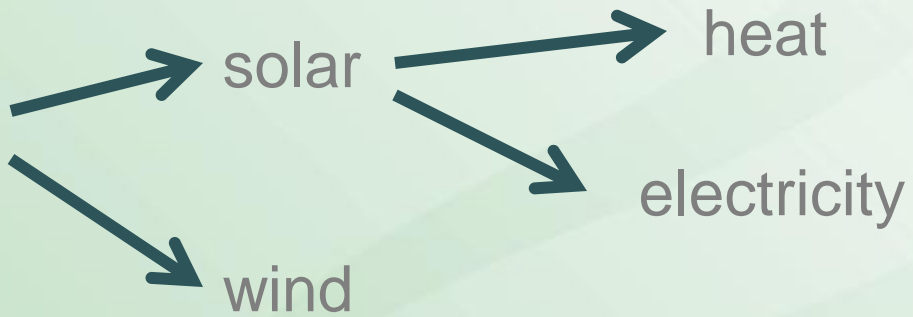
Renewable energy reduces many kinds of risk...



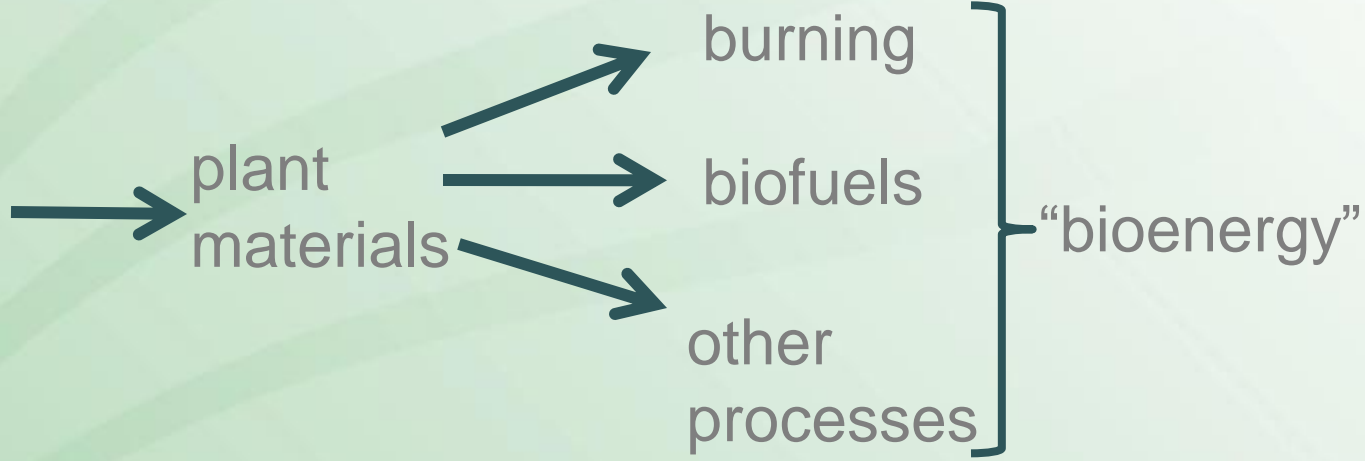
But it is not risk-free.



Renewable sources of energy are all around us...



Natural fertility of soil



Steady internal temperature of Earth



But small-scale renewable energy is (usually) not cheap.

Ballpark Economics for a 4-kW Solar Array

Location	Energy cost (cents/kWh)	Solar radiation (kWh/m ² /yr)	Energy generated (kWh/yr)	Value of energy generated (\$/yr)	System Cost (\$4.10 / watt) *	Simple Payback (years)
Yakima, WA	6.4	4.84	5012	\$320.77	\$16,400	51.1
Nashville, TN	6.9	4.93	5110	\$352.59	\$16,400	46.5
Pierre, SD	7.7	5.15	5550	\$427.35	\$16,400	38.4
Phoenix, AZ	8.7	6.29	6184	\$540.05	\$16,400	30.4
Burlington, VT	12.9	4.33	4668	\$602.17	\$16,400	27.2
Fresno, CA	12.5	5.8	5801	\$725.12	\$16,400	22.6

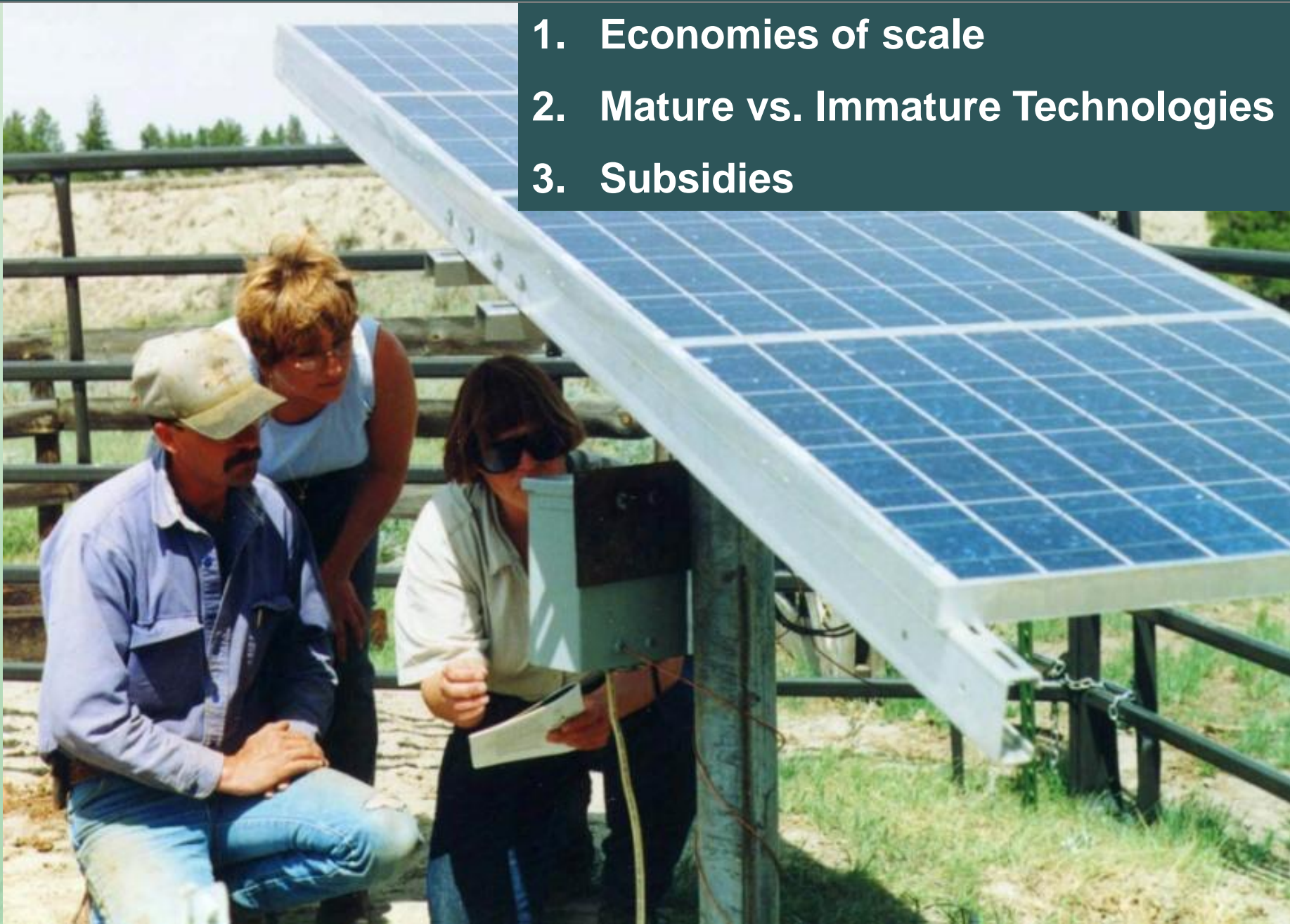
Source: National Renewable Energy Laboratory

* Average installed cost for residential PV systems in 2009, including incentives



3 reasons why it's tough to beat utility and gas station prices

1. Economies of scale
2. Mature vs. Immature Technologies
3. Subsidies

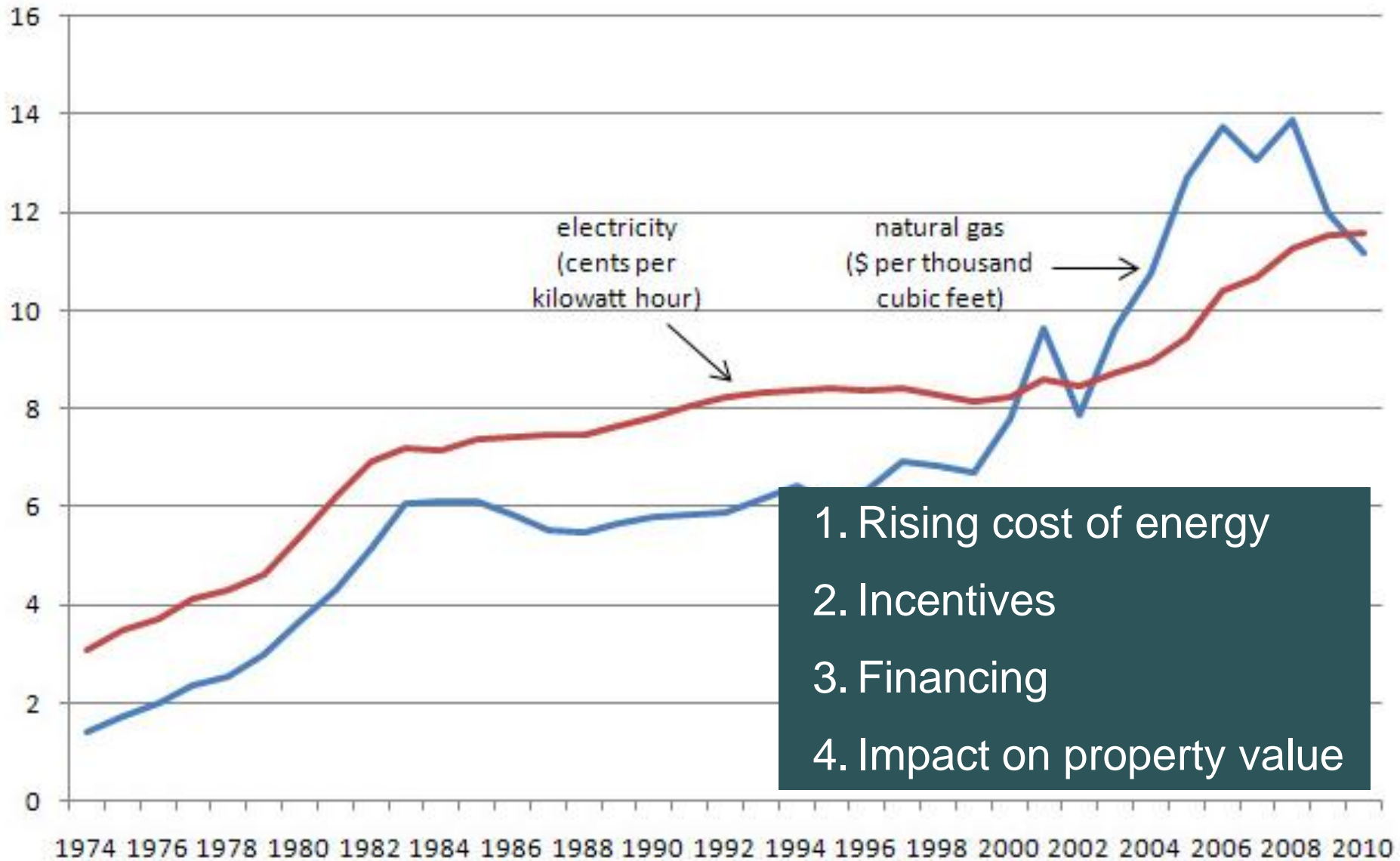


The *time value of money* also works against you.



Four factors that *might* work in your favor

Average U.S. Residential Retail Energy Prices



1. Rising cost of energy
2. Incentives
3. Financing
4. Impact on property value

Five good reasons to consider a renewable energy project



1. Hedge against energy price increases and supply issues
2. New management possibilities
3. Environmental benefits
4. Image and marketing
5. Personal satisfaction



What it might look like: Phil Foster Ranches, Hollister, CA



Finding Incentives

Four good places to look

1. DSIRE (www.dsireusa.org)
2. Dealers/installers
3. Your utility
4. Your state energy office

The screenshot shows the DSIRE website homepage. At the top, there is a red banner with the DSIRE logo and the text "Database of State Incentives for Renewables & Efficiency". To the right of the banner are logos for the U.S. Department of Energy, Energy Efficiency & Renewable Energy, IREC (Interstate Renewable Energy Council), and the North Carolina Solar Center. Below the banner is a navigation menu with links for Home, Team, Glossary, Links, FAQs, Contacts, About Us, and social media icons for Twitter and Facebook.

Below the navigation menu, there is a section for "DSIRE SOLAR" with the text "solar policy information" and a play button icon. To the right of this section is a search bar labeled "Search DSIRE" and a link to "View Federal Incentives" with a US flag icon. Further right is a "follow us on twitter" link.

Below the search bar is a "Resources" section with a dropdown arrow. The resources listed are: RPS Data, Summary Maps, Summary Tables, Library, What's New?, and Search.

At the bottom left of the resources section is a "myDSIRE" section with the text "customize DSIRE for your business" and a play button icon.

Below the resources section is a map of the United States with state abbreviations labeled. The map is a grayscale map of the United States with state abbreviations labeled in black circles. The abbreviations are: WA, OR, CA, NV, UT, AZ, NM, TX, AK, MT, WY, CO, ND, SD, NE, KS, OK, MN, IA, MO, AR, LA, WI, IL, IN, MI, OH, KY, TN, MS, AL, GA, FL, VA, WV, PA, NY, NJ, DE, MD, DC, CT, RI, MA, NH, ME, VT.

**DSIRE
SOLAR**

solar policy
information



ARKANSAS

Incentives/Policies for Renewables & Efficiency



Printable
Version



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[See Residential Incentives Only](#)

Resources

RPS Data

Summary Maps

Summary Tables

Library

What's New?

Search

myDSIRE

customize
DSIRE for your
business



Financial Incentives

Industry Recruitment/Support

- [Wind Energy Manufacturing Tax Incentive](#)

State Loan Program

- [Industrial Energy Technology Revolving Loan Fund](#)
- [Small Business Revolving Loan Fund](#)
- [Sustainable Building Design Revolving Loan Fund](#)

Utility Loan Program

- [First Electric Cooperative - Home Improvement Loans](#)
- [North Arkansas Electric Cooperative, Inc - Residential Energy Efficiency Loan Program](#)
- [OGE - Geothermal Heat Pump Program](#)
- [Ozarks Electric Cooperative - Residential Energy Efficiency Loan Program](#)

Utility Rebate Program

- [AEP SWEPCO - Commercial and Industrial Energy Efficiency Rebate Programs](#)
- [AEP SWEPCO - Residential and Small Commercial Energy Efficiency Rebate Program](#)
- [CenterPoint Energy \(Gas\) - Residential Heating Rebates](#)
- [CenterPoint Energy - Business Gas Heating Rebates](#)
- [Empire District Electric - Commercial & Industrial Energy Efficiency Rebates](#)
- [Empire District Electric - Residential Energy Efficiency Rebate Program](#)
- [Entergy Arkansas - CitySmart Energy Efficiency Program](#)
- [Entergy Arkansas - Commercial and Industrial Energy Efficiency Programs](#)
- [Entergy Arkansas - Residential and Small Commercial Energy Efficiency Programs](#)
- [OGE - Commercial Energy Efficiency Rebate Programs](#)
- [SourceGas - Commercial and Industrial Energy Efficiency Rebate Program](#)
- [SourceGas - Residential Energy Efficiency Rebate Program](#)

Rules, Regulations & Policies

www.dsireusa.org



Sweet Deal #1: Business Energy Investment Tax Credit

- Allows businesses to claim a tax credit of 30% of the cost of solar, small wind, and fuel cells.
- No limit.
- 10% credit for geothermal and some other technologies.
- In place since 2005, expanded by the 2009 American Recovery & Reinvestment Act.
- Will last until December 31, 2016.
- Similar 30% tax credit for homeowners.
- Conditions and exclusions apply.



Sweet Deal #2: USDA's Rural Energy for America Program

- Grants, loans, and loan guarantees for renewable energy and energy efficiency projects.
- Grants up to 25% of eligible project costs.
- Farms and rural small businesses eligible. Nearly 8,000 projects funded from 2003-2010.
- \$99 million 2010 → \$75 million 2011 → \$38.5 million 2012
- Contact your local or state USDA Rural Development office, or your state's energy coordinator.
- Info at www.farmenergy.org



Other USDA programs

- EQIP Agricultural Energy Management Plan (NRCS)
- Conservation Stewardship Program (NRCS)
- Conservation Innovation Grant Program (NRCS)
- Value-Added Producer Grant (USDA Rural Development)
- Biomass Crop Assistance Program (Farm Service Agency)
- And many others



Finding Equipment and Technical Assistance

ATTRA Resources

Home Page: NCAT Sustainable Agriculture Project - Mozilla Firefox

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Popular Publications

- ✦ [Planning for Profit in Sustainable Farming](#)
- ✦ [Evaluating a Farming Enterprise](#)
- ✦ [Financing Your Farm: Guidance for Beginning Farmers](#)
- ✦ [Weed Management in Organic Small Grains](#)
- ✦ [Composting: The Basics](#)
- ✦ [Returns on Renewable Energy Investments](#)
- ✦ [Sustainable Season Extension: Considerations for Design](#)
- ✦ [Specialty Crops for Cold Climates](#)

Webinars

Our webinars are available for viewing in the multimedia section:

- ✦ [Rural Energy for America Program \(REAP\): Financing for Clean Energy in Rural Montana](#)
- ✦ [Organic Apple Production - A Beginner's Guide](#)
- ✦ [Insuring Diversified and Specialty Farms: Is USDA's AGR-LITE Insurance Program Right for You?](#)
- ✦ [Innovative No-Till: Using Multi-Species Cover Crops to Improve Soil Health](#)

News

Calendar

Funding

- [Quivira New Agrarian Conference Presentations Online ~ 01/13/12](#)
- [Nonprofit Anaerobic Digester Project Unites Interests for Clean Water ~ 01/13/12](#)
- [Meat Nutrient Data Sets Available for Download ~ 01/13/12](#)
- [More News...](#)



Learning Opportunities

[Sustainable Farming Internships & Apprenticeships](#)
A directory of on-the-job learning opportunities.



Question of the Week

[What are my options for controlling spider mites on tomatoes?](#) Posted: 01/16/12



Sustainable Agriculture Expert Wanted

www.attra.org



Publications

National Sustainable Agriculture Information Service

Energy-Efficient Lighting for the Farm

By Jeff Mendenhall, National Sustainable Agriculture Information Service

Lighting is a major energy expense for many farms. This publication provides information on energy-efficient lighting options for the farm. It covers various types of lighting, including incandescent, fluorescent, and LED, and discusses how to choose the right lighting for different farm applications. It also includes information on how to calculate lighting needs and how to maintain lighting systems.

ATTRA

Locally Owned Renewable Energy Facilities

Introduction

Renewable energy facilities are becoming increasingly common in rural areas. This publication provides information on how to identify and evaluate locally owned renewable energy facilities. It covers various types of facilities, including wind, solar, and hydro, and discusses the benefits and challenges of each. It also includes information on how to contact local utility companies and how to apply for incentives.

ATTRA

Food Miles: Background and Marketing

Introduction

Food miles refer to the distance food travels from the producer to the consumer. This publication provides information on the background and marketing of food miles. It covers various aspects, including the benefits of local food, the challenges of long-distance food transport, and the role of food miles in marketing. It also includes information on how to calculate food miles and how to use food miles as a marketing tool.

ATTRA

Small-Scale Wind Energy on the Farm

Introduction

Small-scale wind energy can provide a renewable source of energy for the farm. This publication provides information on how to identify and evaluate small-scale wind energy opportunities. It covers various aspects, including the benefits of wind energy, the challenges of wind energy, and the role of small-scale wind energy in the farm. It also includes information on how to calculate wind energy potential and how to apply for incentives.

ATTRA

Conserving Fuel on the Farm

Introduction

Fuel is a major expense for many farms. This publication provides information on how to conserve fuel on the farm. It covers various aspects, including the benefits of fuel conservation, the challenges of fuel conservation, and the role of fuel conservation in the farm. It also includes information on how to calculate fuel consumption and how to apply for incentives.

ATTRA

Renewable Energy Opportunities on the Farm

Introduction

Renewable energy opportunities are becoming increasingly common on the farm. This publication provides information on how to identify and evaluate renewable energy opportunities. It covers various aspects, including the benefits of renewable energy, the challenges of renewable energy, and the role of renewable energy in the farm. It also includes information on how to calculate renewable energy potential and how to apply for incentives.

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Renewable Energy Opportunities on the Farm

Introduction

Renewable energy opportunities are becoming increasingly common on the farm. This publication provides information on how to identify and evaluate renewable energy opportunities. It covers various aspects, including the benefits of renewable energy, the challenges of renewable energy, and the role of renewable energy in the farm. It also includes information on how to calculate renewable energy potential and how to apply for incentives.

ATTRA

Biodiesel Use, Handling, and Fuel Quality

Introduction

Biodiesel is a renewable source of energy for the farm. This publication provides information on how to use, handle, and evaluate biodiesel. It covers various aspects, including the benefits of biodiesel, the challenges of biodiesel, and the role of biodiesel in the farm. It also includes information on how to calculate biodiesel potential and how to apply for incentives.

National Sustainable Agriculture Information Service

Micro-scale Biogas Production: A Beginner's guide

Introduction

Micro-scale biogas production can provide a renewable source of energy for the farm. This publication provides information on how to identify and evaluate micro-scale biogas production opportunities. It covers various aspects, including the benefits of biogas, the challenges of biogas, and the role of biogas in the farm. It also includes information on how to calculate biogas potential and how to apply for incentives.

The California Microirrigation Pocket Guide

System Management & Maintenance

Introduction

Microirrigation is a water-efficient irrigation system for the farm. This publication provides information on how to manage and maintain a microirrigation system. It covers various aspects, including the benefits of microirrigation, the challenges of microirrigation, and the role of microirrigation in the farm. It also includes information on how to calculate microirrigation potential and how to apply for incentives.

The California Microirrigation Pocket Guide

Pumps, Motors, & Engines

Introduction

Microirrigation is a water-efficient irrigation system for the farm. This publication provides information on how to identify and evaluate microirrigation opportunities. It covers various aspects, including the benefits of microirrigation, the challenges of microirrigation, and the role of microirrigation in the farm. It also includes information on how to calculate microirrigation potential and how to apply for incentives.

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Farm Energy Alternatives

Looking for energy-related equipment, funding, or a local business with the right expertise?
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Beginning Farmer

Field Crops

Horticultural Crops

Livestock & Pasture

Local Food Systems

Marketing, Business & Risk Management

Organic Farming

The heavy use of fossil-based fuels and fertilizers in the U.S. food system lies at the heart of many of our environmental, health, and national security problems. Sustainable agriculture and sustainable energy are really two sides of the same coin.

The publications, success stories, and links within these pages explain how to make farm buildings more energy efficient, use the sun's energy to heat greenhouses and pump water, choose and put up wind turbines, make and use biofuels, and much more.

View a comprehensive list of all **Energy Publications**.
Or explore the topic areas below.

RENEWABLE ENERGY	ENERGY EFFICIENCY
» Biodiesel	» Conserving Fuel and Electricity
» Ethanol	» Farm Energy Calculators

New Publications

- Energy-Efficient Lighting for the Farm
- Micro-Scale Biogas Production: A Beginner's Guide
- Dairy Farm Energy Efficiency
- Farm Energy Audits: Availability, Usefulness, and Cost
- Biochar and Sustainable Agriculture
- Agriculture, Climate Change and Carbon Sequestration

Save Energy!
New SARE Publication Helps Farmers Reduce Energy

www.attra.org/dea





Home > Farm Energy Alternatives > Directory



Directory of Energy Alternatives

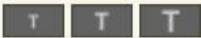
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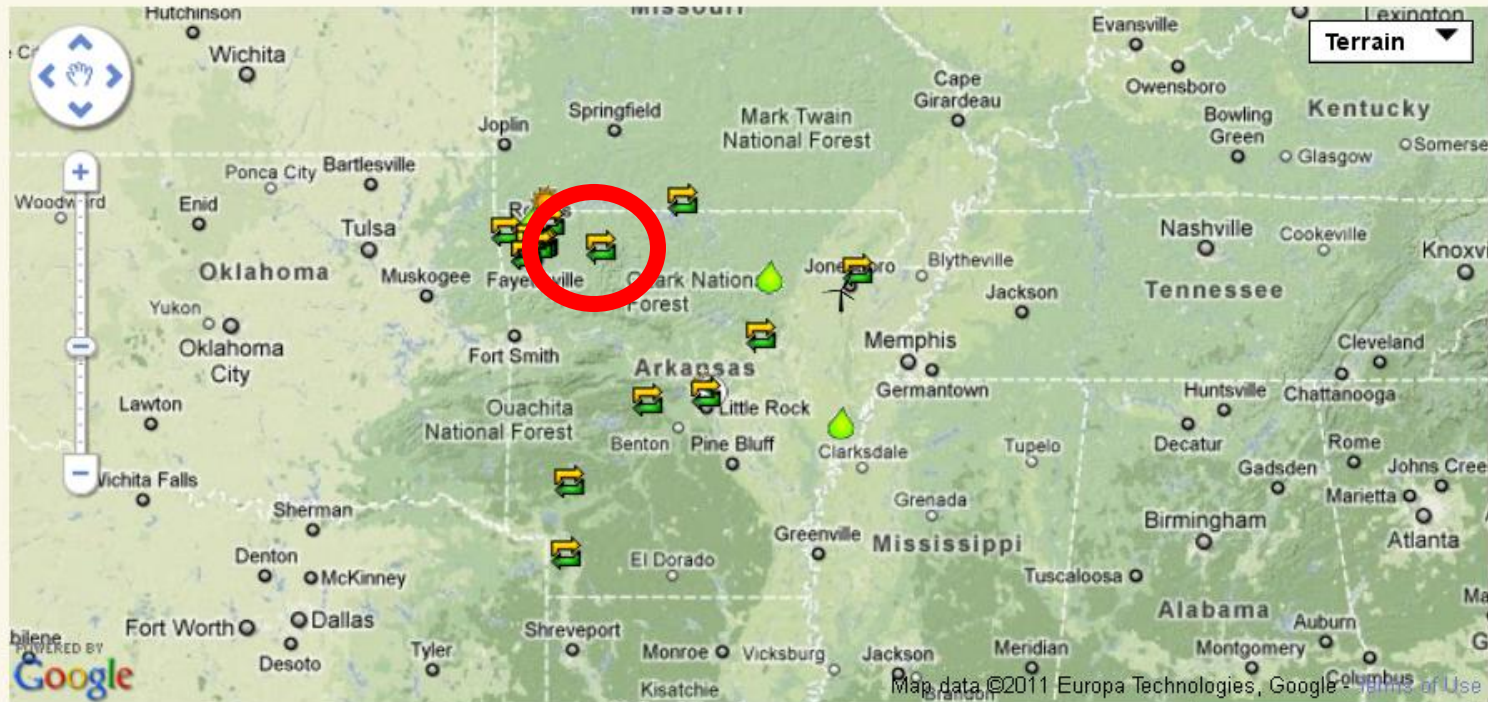
Add your listing to our directory.
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Energy-related businesses and rural people are welcome to submit or update listings, [if you would like it removed click here.](#)

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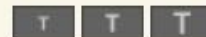
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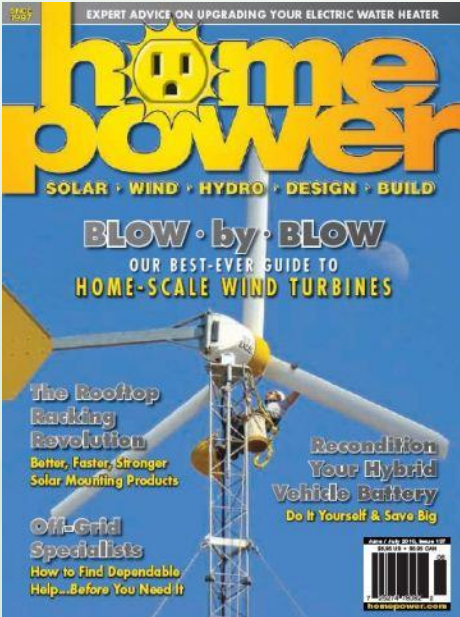
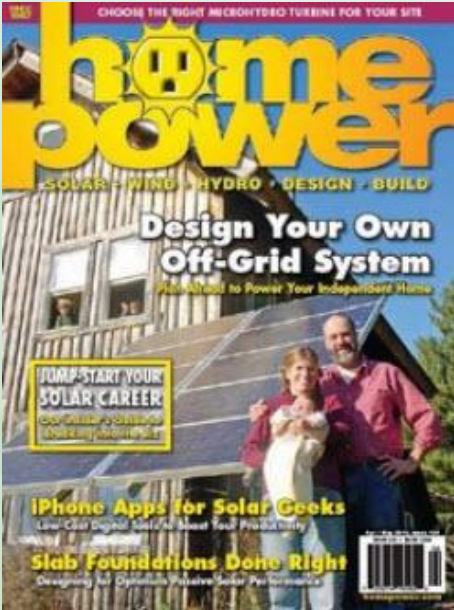
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Rocky Grove Sun Company provides consulting, design, installation, and mail order sales for Solar Electric, Wind, Microhydro, Solar Hot Water, Grid-Tie & Stand Alone Systems. Rocky Grove offers extensive hands-on experience with a variety of renewable energy equipment and accessories.
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Home Power Magazine



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Working with Dealers and Installers

Can I do it myself?

BuildItSolar: Solar energy projects for Do It Yourselfers to save money and reduce pollution - Mozilla

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BUILD IT SOLAR

The Renewable Energy site for Do-It-Yourselfers

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Welcome To Build-It-Solar

Plans, tools and information to help you build renewable energy and conservation projects.

Hundreds of [projects](#) -- from changing a light bulb to building a solar home.

Design [information and tools](#) for building renewable energy projects.

An [Experimental](#) section for backyard inventors.

[Nothing For Sale here](#) -- just free ideas, plans, and information.



New On the Blog

[Solar Cooking After Dark -- A DIY Stored Heat Solar Cooker](#)



A Few Example Projects (from a thousand or so)



New Content

Last update **January 17, 2012**

[An easy/good DIY LED can light retrofit...](#)

[Extensive R Values table...](#)

[Using stored solar heat to cook after sunset...](#)

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SC Solar, Inc.
146 Rental Ct.
Rock Hill, SC 29732

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Quote Number: SAMPLE
Quote Date: Mar 12, 2007
Page: 1

Voice: 866-856-9819
Fax:

Quoted To:
QUOTE YOUR COMPANY

Customer ID	Good Thru	Payment Terms	Sales Rep
QUOTE	4/11/07	Prepaid	

Quantity	Item	Description	Unit Price	Amount
1.00	96078028	6 SQF-2 SQFlex Solar Pump 51x4x3 1 NPT MSF 3 MOTOR"	1,475.00	1,475.00
2.00	NE-170U1	170 WATT SHARP W/MC CONNECT CARTON SIZE IS 67 X 39 X 6 CARTON CONTAINS 2 PANELS	790.00	1,580.00
1.00	500106	TOP OF POLE RACK FOR 2- SHARP 175 USES 3 INCH SCHEDULE 40 POLE	199.00	199.00
1.00	cgyl-10101	MC Connector 2.5 Meter	25.00	25.00
1.00	96467801	CU200 SQFlex Control Box Solar/Wind Monitor with Float Switch Terminals DIMENSIONS 13 X 7 X 5	260.00	260.00
1.00	96481502	IO 101-115 SQFlex Generator Interface Box DIMENSIONS 11 X 8 X 9	285.00	285.00
1.00	DSP-02502	Submersible Splice Kit	10.00	10.00
Subtotal				3,834.00
Sales Tax				
TOTAL				3,834.00



Some questions to ask

- What is your experience designing/building this type of system? How many years? How many projects?
- Can you provide references—past clients that I can talk to?
- Are you certified by NABCEP (North American Board of Certified Energy Practitioners)?
- Is a site assessment part of the bid? If so, what is included?
- What incentives are available? Who handles the paperwork?
- Do you provide a maintenance or service warranty?
- Does your bid reflect total costs?
- Are there interconnection costs? Do you work with my utility to complete grid interconnection?

Grid-Tied Solar-Electric (Photovoltaics)

Average-sized grid-tied system



\$26,173
< \$7,851 >
< \$9,196 >

for 4,700 watts @ \$5.56/watt
for 30% fed tax credit
for Arkansas state rebate

\$9,126

final system cost

System should produce 6,131 kWh per year.

Large grid system offsets 90% of residential use



\$79,252 for 19,200 watts @ \$4.12 / watt
< \$23,776 > for 30% fed tax credit

\$55,476 final system cost

System should produce 25,728 kWh per year.



Battery-based system



\$27,509 for 2,820 watts @ \$9.75/ watt
< \$8,253 > for 30% fed tax credit
< \$5,562 > for Arkansas state rebate

\$13,694 final system cost

System should produce 3,666 kWh per year.



Ballpark Costs & Risks

- ✓ Expect to pay \$3-\$9 per watt, including incentives.
- ✓ Among the least risky renewable energy projects; a fairly “mature” technology.
- ✓ Low maintenance requirements
- ✓ Typical warranties of > 20 years on panels
- ✓ Experienced installers can be found in most locations
- ✓ Rapidly dropping prices on panels

Common problems/concerns

- ✓ Disappointing energy output
- ✓ Interconnection complications



Off-Grid / Remote Solar-Electric

Agricultural Uses

Common

- Electric fence chargers
- Pumping
- Lighting
- Small motors, e.g. fans
- Crop drying
- Irrigation system surge valves

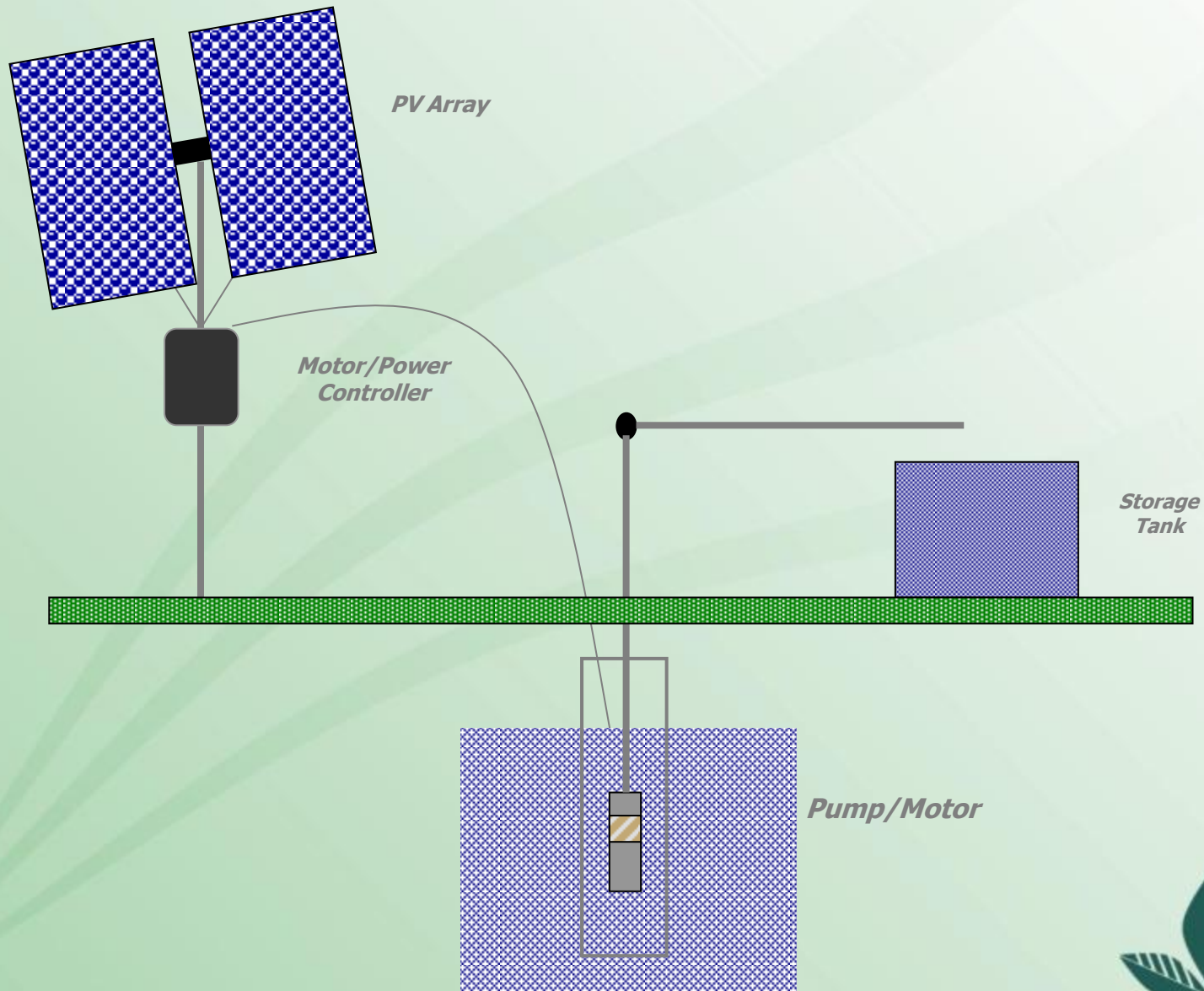
Less common

- Side roll sprinkler mover
- Solar tractors

New management possibilities



How a solar pumping system works



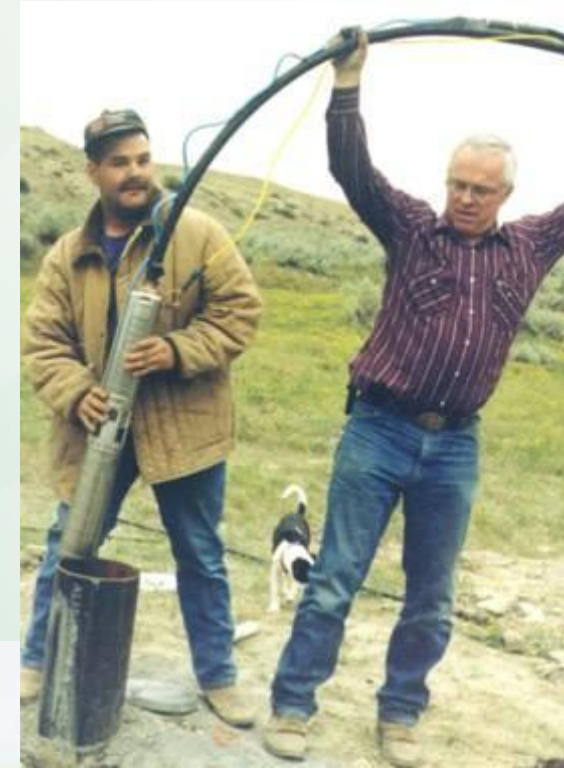
Small pumping system with tracking rack

- 25 cow-calf pairs; 2-3 miles from power
- Two 120-Watt solar panels
- Submersible diaphragm pump delivers 1 GPM from 160' well or 900 GPD
- Cost of solar components: \$3,200



Trailer mounted system

- 150 cow-calf pairs; over a mile from power
- Seven 60-Watt solar panels (trailer-mounted)
- Submersible centrifugal pump delivers 6.5 GPM from 60' well or 3,600-4,000 GPD.
- Cost of solar components: \$10,650



Very large system

- 350 cow-calf pairs; >5 miles from power
- 24 120-Watt solar panels on two tracking racks
- Surface piston pump delivers 11 GPM or 7,500 GPD.
- Cost of solar components \$24,500



- Pumps surface water over two miles to the top of a ridge, against over 400 feet of head.
- Fills 8,000 gallon storage tank and six 1,000+ gallon stock tanks



Ballpark Costs & Risks (Solar Water-Pumping)

- ✓ Expect to pay \$2,000 - \$8,000 for installed solar components.
- ✓ Tracker \$750-\$2,000, increases power 30-50% in summer.

Common problems/concerns

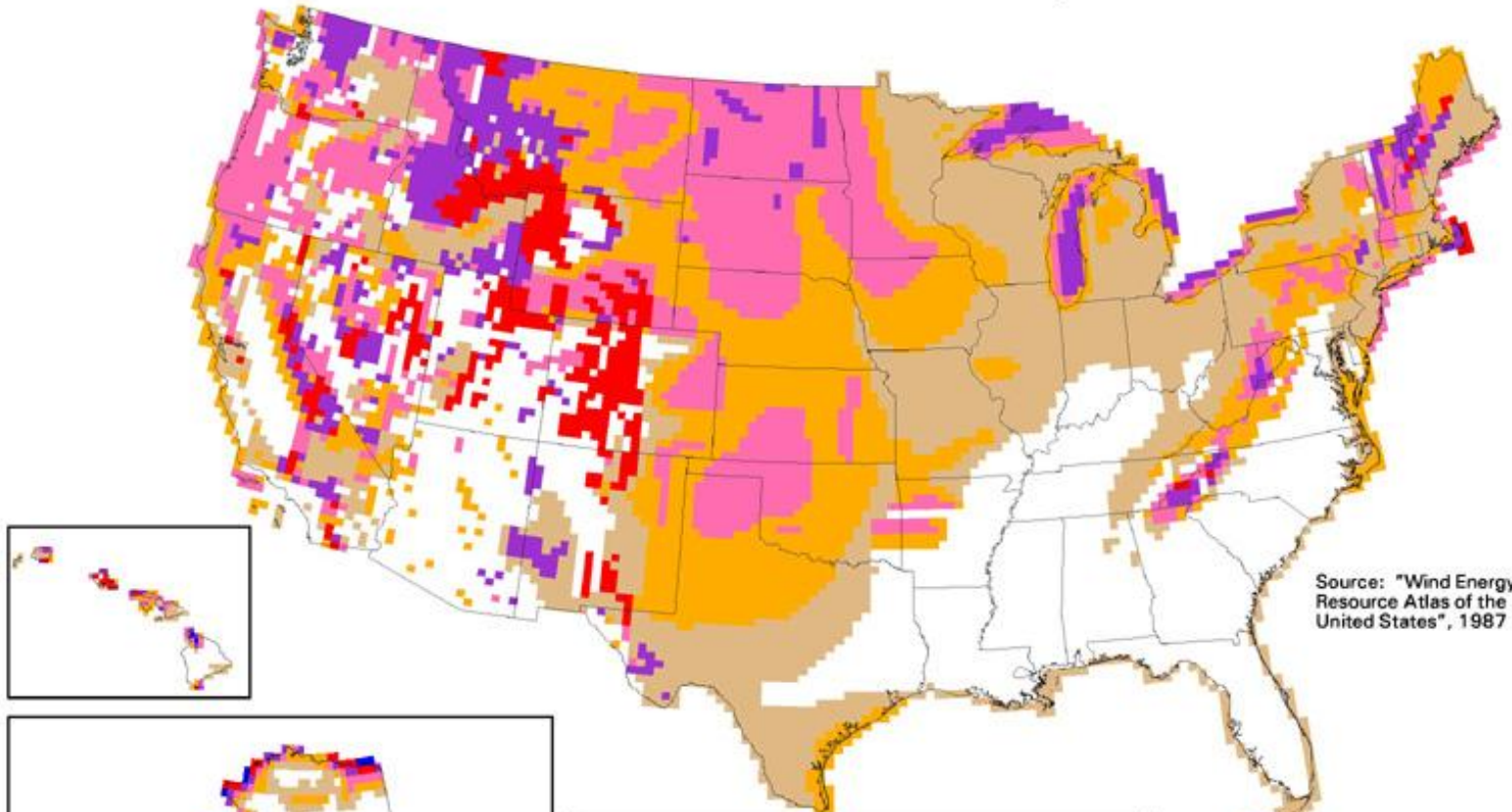
- ✓ Best-suited to low-flow, low-pressure, and low-head situations.
- ✓ Pumping from deep wells (>250 feet) is expensive.
- ✓ Well-drilling cost and complications.
- ✓ Complications related to remote locations
- ✓ Disappointing flow volumes
- ✓ Vandalism?
- ✓ Cold weather/freezing issues



Small Wind

The South is not known for its wind resource.

United States - Wind Resource Map



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m ²	Wind Speed ^a at 50 m m/s	Wind Speed ^a at 50 m mph
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

^a Wind speeds are based on a Weibull k value of 2.0

U.S. Department of Energy
National Renewable Energy Laboratory

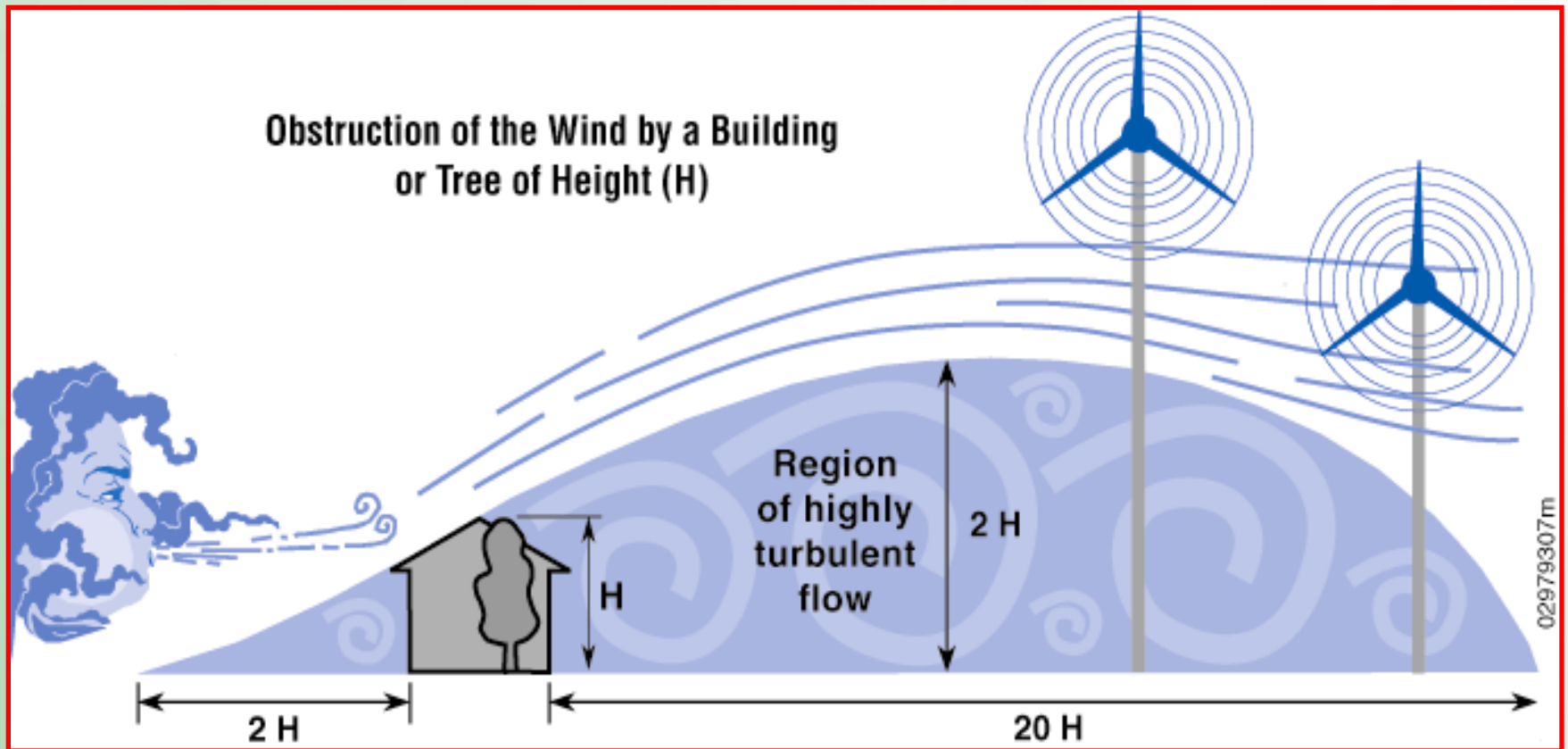


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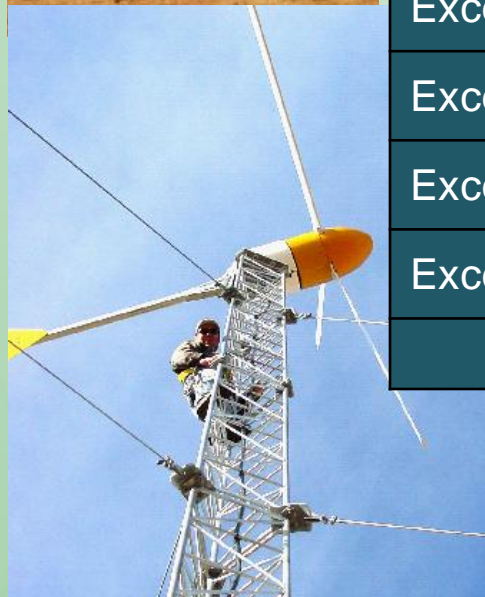


NCAT

Siting is everything.



Ballpark Economics for Bergey 10-kW BWC Excel-S (assuming retail price of 12 cents per kWh) *



Wind speed	Installed cost	Energy generated (kWh/yr)	Value of energy generated (\$/yr)	Incentive	Installed cost	Simple payback
Fair	High	12,000	\$1,440	None	\$65,000	45.1
Fair	Low	12,000	\$1,440	None	\$48,000	33.3
Fair	High	12,000	\$1,440	50%	\$32,500	22.6
Fair	Low	12,000	\$1,440	50%	\$24,000	16.7
Excellent	High	24,000	\$2,880	None	\$65,000	22.6
Excellent	Low	24,000	\$2,880	None	\$48,000	16.7
Excellent	High	24,000	\$2,880	50%	\$32,500	11.3
Excellent	Low	24,000	\$2,880	50%	\$24,000	8.3

Source: Bergey Wind Power

* Approximate average U.S. retail price in 2011.



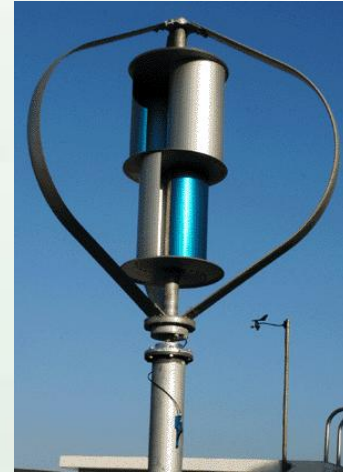
Ballpark Costs & Risks

- ✓ Expect to pay \$5-\$15 per watt of installed capacity, including cost of the tower.

Common problems/concerns

- ✓ Zoning and permitting issues
- ✓ Disappointing output
 - Generally need >10 mph average wind speed @ 30 meters.
 - Highly site-specific; professional assessment if you can.
 - Distrust power output ratings; insist on measured power curve.
- ✓ Maintenance issues
 - Most systems need maintenance at least every 1-2 years.
 - Catastrophic failure not uncommon.
- ✓ Safety issues
 - Never climb tower without safety training & proper equipment.

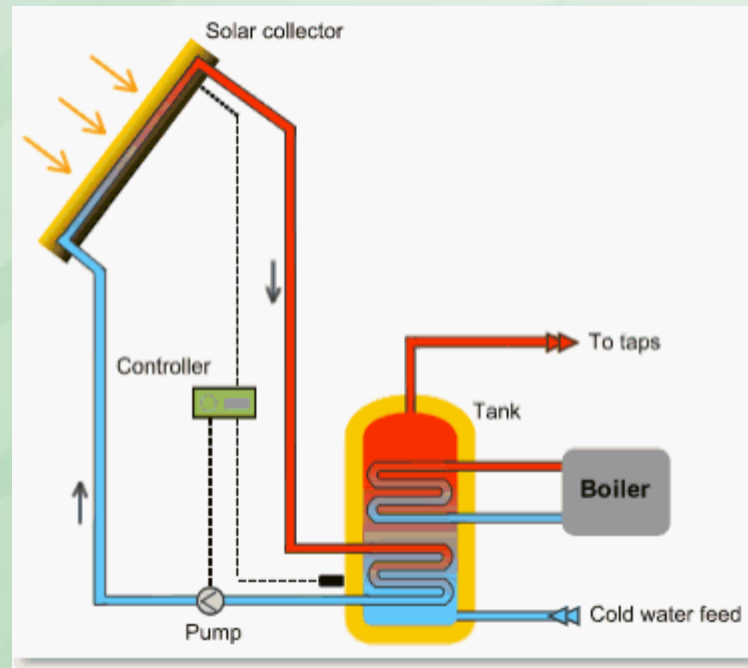
- Distrust novel designs.
- Small Wind Certification Council: www.smallwindcertification.org
- Think hard before attaching a wind turbine to a building or roof.



Solar Water Heating ("Solar Thermal")

Agricultural Applications

- Suitable for any farming operation that uses a lot of hot water.
- Consider as replacement for electric or propane water-heating.
- Dairies should probably do heat recovery on refrigeration system and/or heat exchange on milk first.



From www.builditsolar.com

Heating transplant tables and space-heating

- Cost \$8,000; \$3,900 after NC and federal incentives.
- 250 gallon “drain down” system
- Cut propane costs from \$3,000 to \$1,000 per year.



Solar Water Heating for Greenhouses

Design issues

- Freeze protection a must.
- No toxic fluids around crops or leaking into soil.
- Need to dump heat (or disable) in summer months, if sized for winter needs.
- Backup heating system desirable.
- Tubing can be buried or above-ground, depending on use of greenhouse.



Flat plate collectors: simple and durable



Evacuated Tube Collector

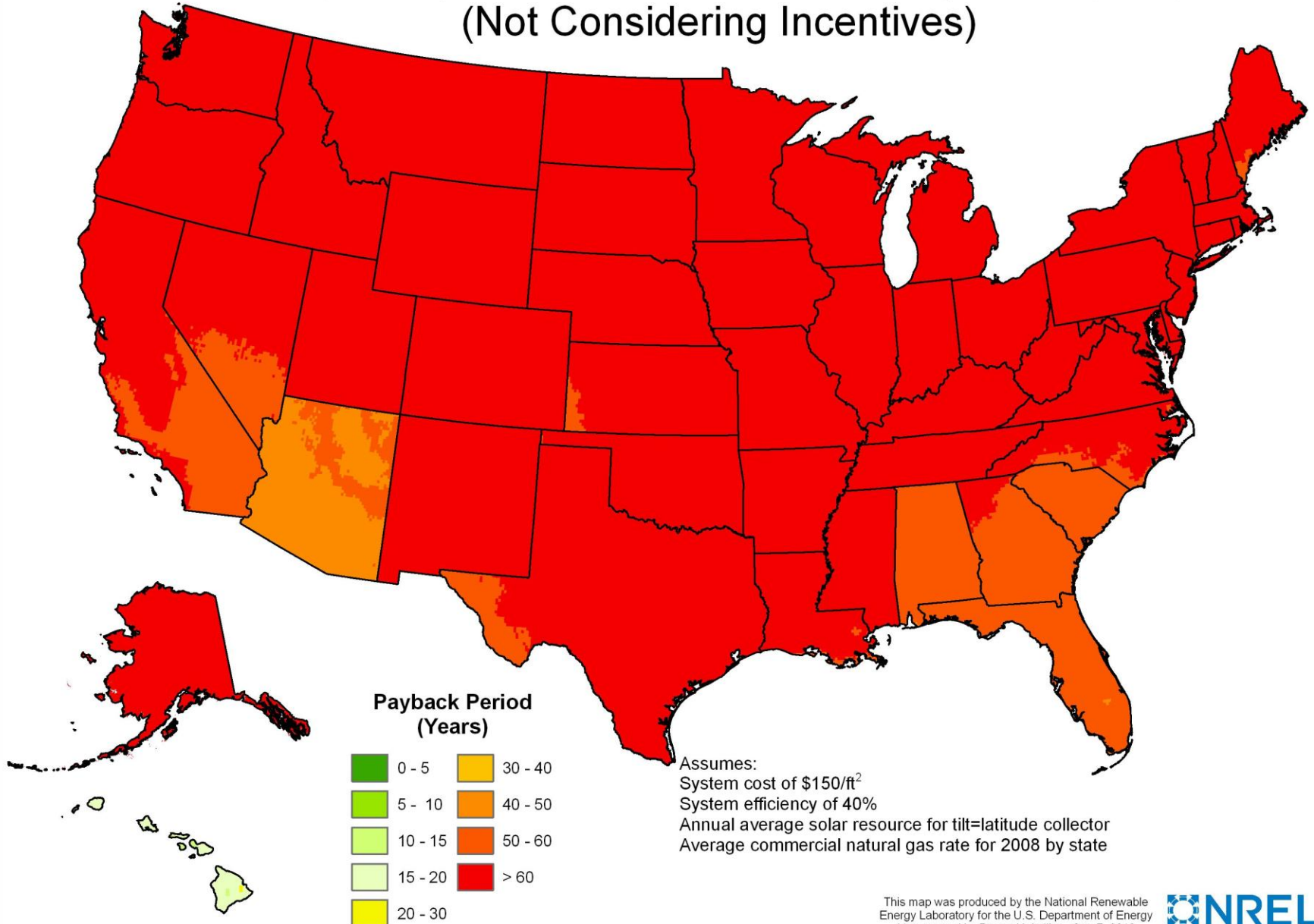


SC Solar, Inc.

- Newer technology; more expensive.
- Highest temperature output.
- Does not shed snow & ice.



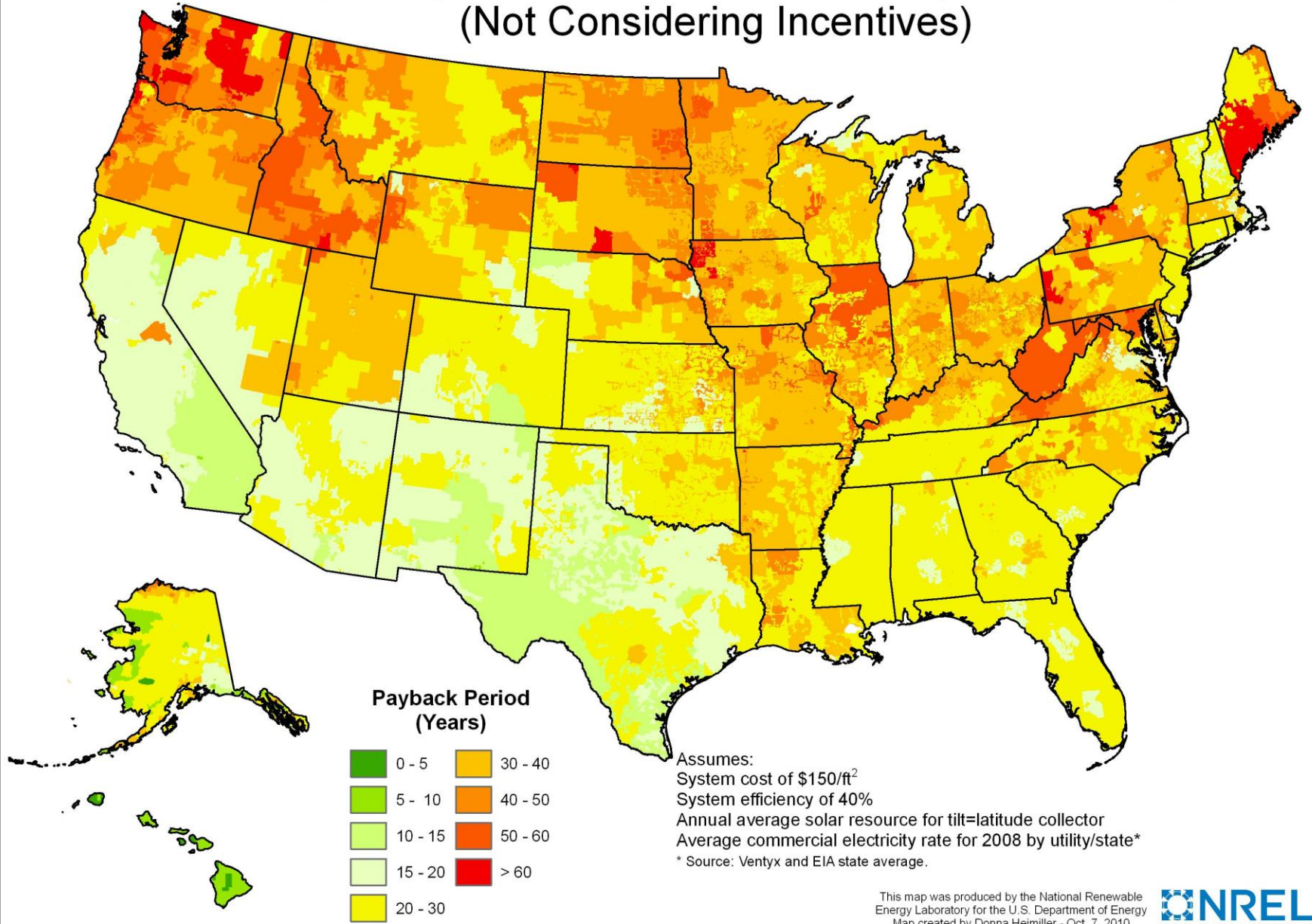
Simple Payback for Solar Hot Water Systems (Gas) (Not Considering Incentives)



This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy
Map created by Donna Heimiller - Oct. 7, 2010



Simple Payback for Solar Hot Water Systems (Elec) (Not Considering Incentives)



Assumes:
System cost of \$150/ft²
System efficiency of 40%
Annual average solar resource for tilt=latitude collector
Average commercial electricity rate for 2008 by utility/state*
* Source: Ventyx and EIA state average.

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy
Map created by Donna Heimiller - Oct. 7, 2010

Ballpark Costs & Risks

- Typical residential system \$6,000-\$10,000 without incentives.
- Collectors usually have 10-20 year warranty and should last 30 years or more.
- Modest maintenance requirements. Transfer fluid normally lasts 10-20 years.

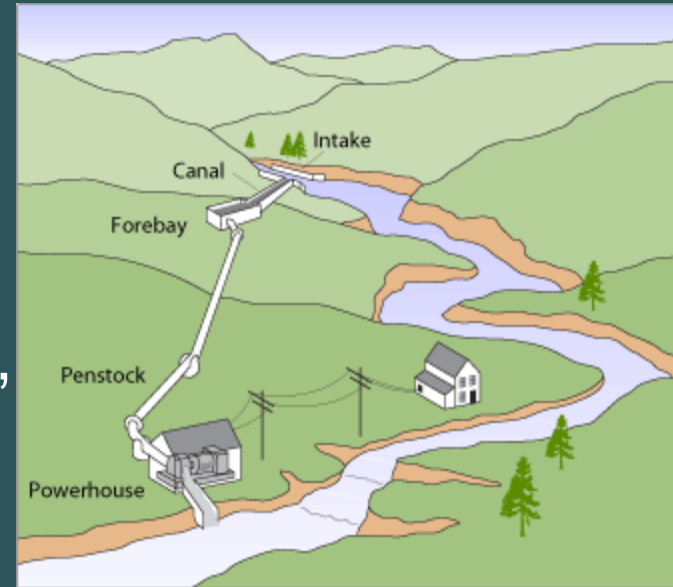
Common problems/concerns

- Lingering image problems from market crash in early 1980s.
- Poor system design, leading to disappointing output or (worse) frozen and bursting pipes.
- Reports of gradual loss of vacuum in evacuated tube collectors (which may not be covered by the warranty).
- Degraded performance over time, e.g. from scale buildup.

Small Hydro

Small Hydro Ballpark Costs & Risks

- Expect to pay \$1.50-\$4.00 per watt of installed capacity, depending on site.
- Reliable: water flows 24/7.
- Need at least 10 GPM or 10 feet of head, or both.
- 100 GPM and 10 feet of head = 83 watts
- Permitting can be a major obstacle.
- Few rules of thumb. Installations vary widely depending on characteristics of the site.



Courtesy DOE/EERE

Biodiesel and Straight Vegetable Oil

**Phillip Barker (Oxford, NC): \$1.35 per gallon (from waste oil).
Petroleum diesel cost reduced from \$12-\$14,000 to zero.**



Thad Doye (Walters, OK): \$4.38 per gallon after 3 years from sunflower seeds grown on the farm



Ballpark Costs & Risks

- Equipment costs range from \$500 to tens of thousands.

Common problems/concerns

- Not fully mature; the realm of creative do-it-yourselfers.
- Failed reactions, messy/sticky
- Challenging to make high-quality fuel that is safe, legal, and environmentally benign.
- Engine damage is a possibility, especially from SVO.
- Fires and explosions have happened.
- Permitting problems
- Waste-handling problems











Some other options

Small biogas: an option on any small farm.

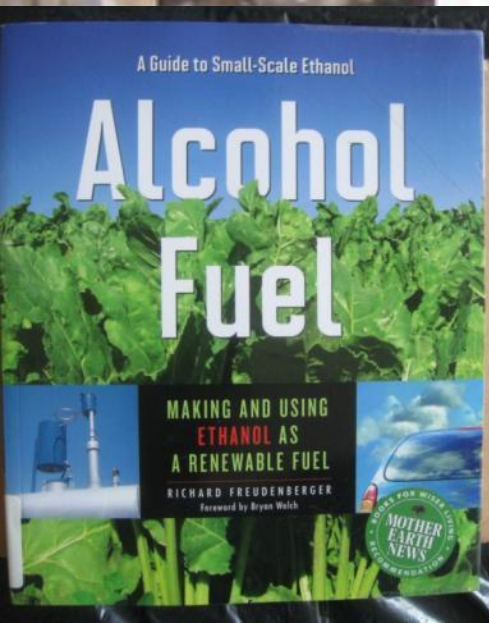


**BIOGAS
HANDBOOK**

BEING A COMPENDIUM OF THE
☆ ART ☆ & SCIENCE  OF
USING ANYTHING ONCE ALIVE
   TO PRODUCE A
BURNABLE GAS FOR POWERING
LIGHT,  AUTOMOBILES, 
OVENS,  TRACTORS, WATER
HEATERS, FURNACES &
VARIOUS CONTRAPTIONS. 

BY DAVID HOUSE

Small ethanol



Vern Grubinger photo

Thank you for your attention!

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