DOE OFFICE OF INDIAN ENERGY

EERE Technologies for Alaska

Sherry Stout



U.S. DEPARTMENT OF ENERGY | Office of Indian Energy


ENERGY EFFICIENCY

Why Efficiency?

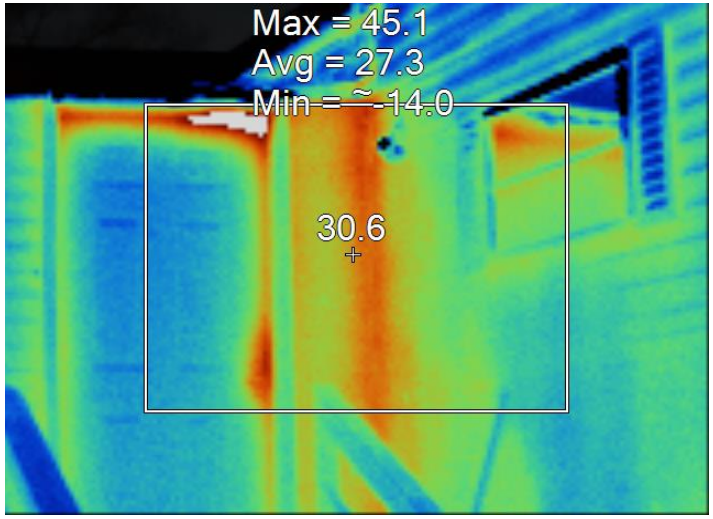
- The cheapest kWh is the one you're not using
- Savings add up to free up money that can be spent on other things
- Often easier and faster than implementing other energy projects
- Payback time is generally shorter – often less than 5 years

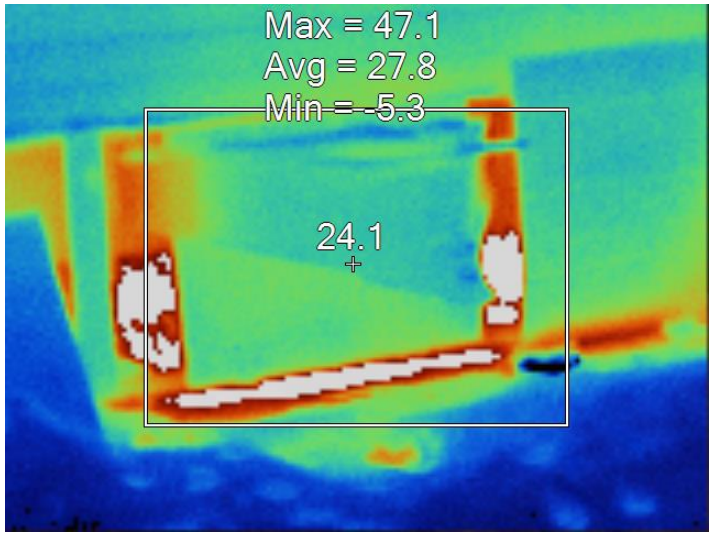
Example Building Efficiency Upgrades

End Use	Upgrades that Reduce Loads	Upgrades that Help Meet Loads More Efficiently
Heating, Ventilating and Air-Conditioning (HVAC)	• Insulation (attic, walls, floors, etc.) • Air-Sealing • Windows/Doors/Skylights • Smart Thermostats	• High-Efficiency Furnace • High-Efficiency AC • Duct Insulation
Water Heating	• Low-flow faucets and showerheads	• High-Efficiency Water Heaters • Tank Insulation
Appliances, Lighting, Misc.	• Lighting Sensors/Controls • Smart Power Strips	• ENERGY STAR Appliances • CFL/LED Lighting • Efficient Electronics

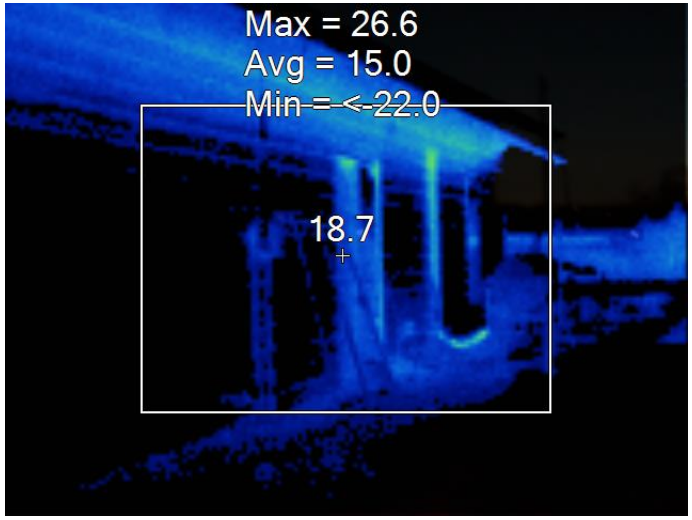
Building Envelope

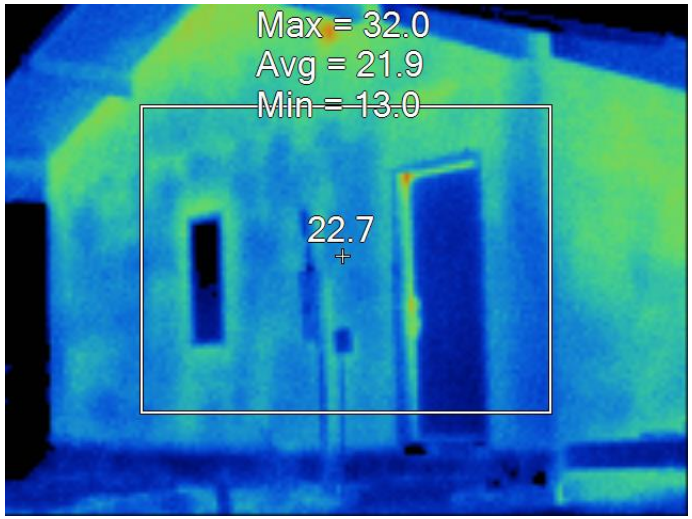
Mobile Home





Straw Bale & SIPs





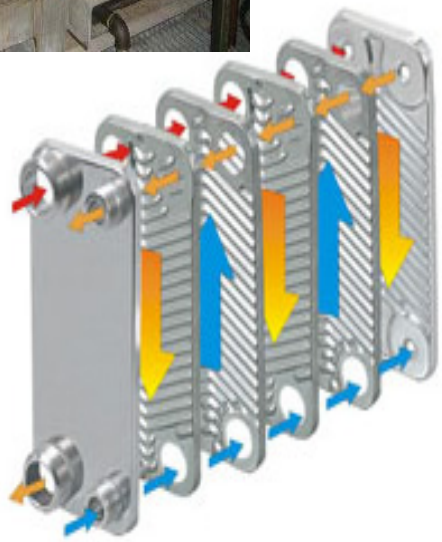
Lighting

- Replace T-12 with T-8 electronic ballasts
- CFLs save 75% over a traditional incandescent lightbulb
- LED lighting saves 85% over a traditional incandescent lightbulb, but lasts much longer

All bulbs deliver equivalent brightness	Single bulb wattage	Wattage used for whole house
Incandescent bulbs	60 watts	1200 watts
CFL bulbs	14 watts	280 watts
LED bulbs	9.5 watts	190 watts

Diesel Heat Recovery

- Basic Infrastructure that provides heat to multiple buildings
  - Heating Source is waste heat from the diesel generator
  - Heat Exchangers, Controls, and Meters
  - Circulating Pumps and Arctic Piping
- Design Considerations
  - Buildings should be near the power house for diesel waste heat.
  - Hot water boiler using excess wind or hydro can be placed in any building
  - Can provide heat from multiple, different sources – biomass, excess wind, excess hydro



WHAT OTHER COMMUNITIES ARE DOING

What Other Communities are Doing: Kwethluk

What if we replaced ALL the bulbs and lamps in the village with LED's?

How much would that cost?

How much would it save?

What if we replaced the thermostats in every building with programmable models?

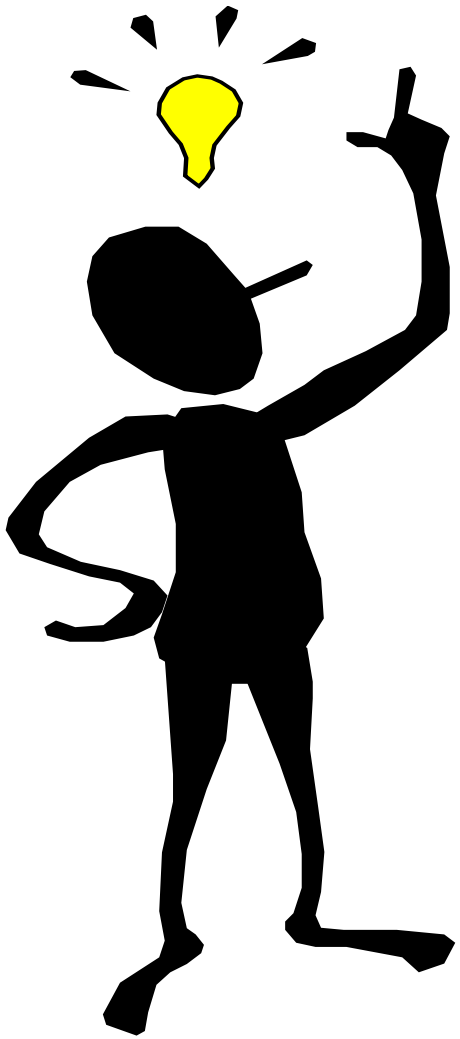
What if we bought a blow-in insulation machine and added R-30 insulation to every attic?

What if we trained a couple folks and did air-sealed every home?

What would the end result be?

Energy Audits of Alaska

Kwethluk



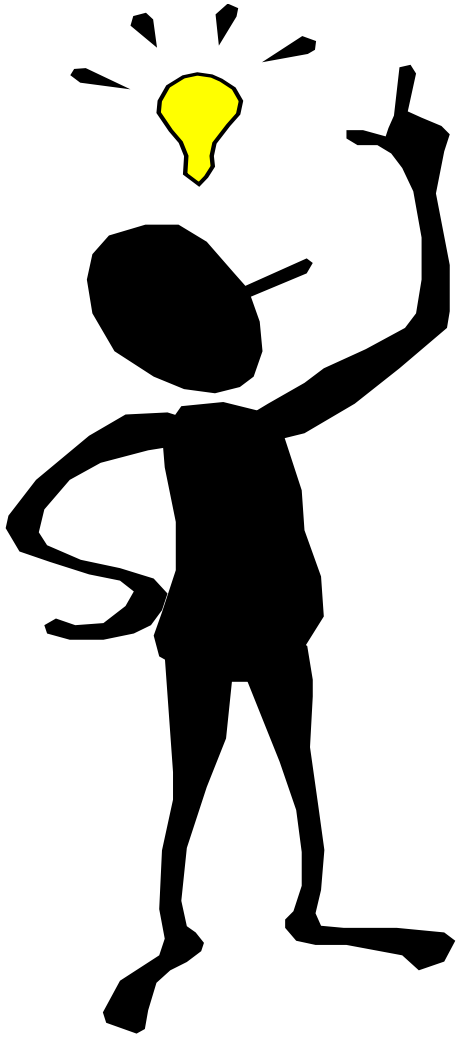
Energy Audits of Alaska

188 residences, 25 commercial buildings:

ENERGY COSTS

Average homeowner electric cost	$ 1,214
Average homeowner fuel oil cost	$ 4,062
Total residential electric costs	$ 228,232
Total residential fuel oil costs	$ 763,656
Total Residential energy costs	**$ 991,888**
Total non-residential energy cost	$ 515,816
COMMUNITY-WIDE ENERGY COST	**$1,507,704**

Potential Savings in Kwethluk:



ALL the bulbs and lamps in the village replaced with LED's: $8,404 + $31,276 = **$39,680**

Programmable thermostats in all buildings: $36,002 + $30,676 = **$66,678**

Buy a blow-in insulation machine, increase attic insulation to R-60: $30,832 + $7,367 = **$38,199**

Trained community members to air-seal every building: $56,118 + $27,189 = **$83,307**

Total Community-Wide Upgrade Costs $30,188 + $381,628 = **$411,816**

Energy Audits of Alaska

Potential Savings in Kwethluk:

Residential:

Total Savings $131,356/year

Average homeowner saves $699/year

Average residential upgrade cost $3,019

Payback in 4.4 years

Non-residential:

Total Savings $96,508/year

Average building savings $3,860/year

Average building upgrade cost $15,265

Payback in 3.9 years

Energy Audits of Alaska

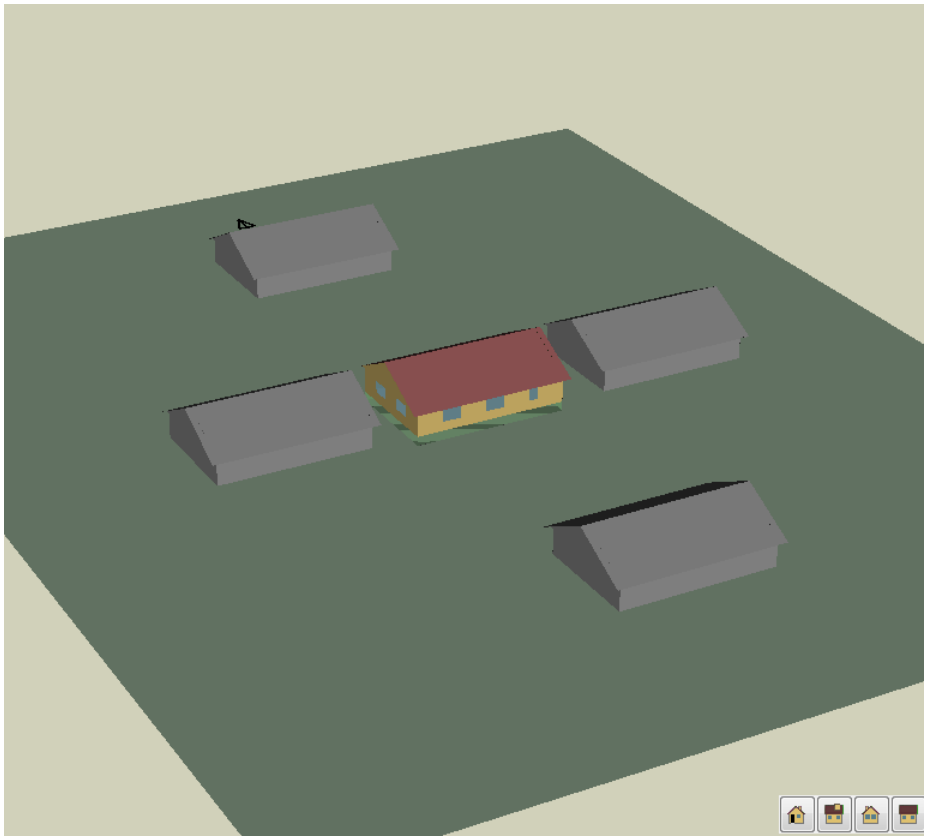
What are some Interior Projects

- What was the planning process?
- How was the system funded?
- Who was responsible for keeping the project going?
- Is there anything you would do differently next time?

Minto Lodge
Source: Dave PM

How Can DOE Help?

- Resource page at energy.gov/indianenergy
- Technical Assistance
  - PCE Support
  - Energy baselining and line loss analysis
  - Building energy assessments
  - Energy efficiency measures modeling



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Renewable Energy Technology Options

Sherry Stout



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GRID INTEGRATION OF RENEWABLE ENERGY

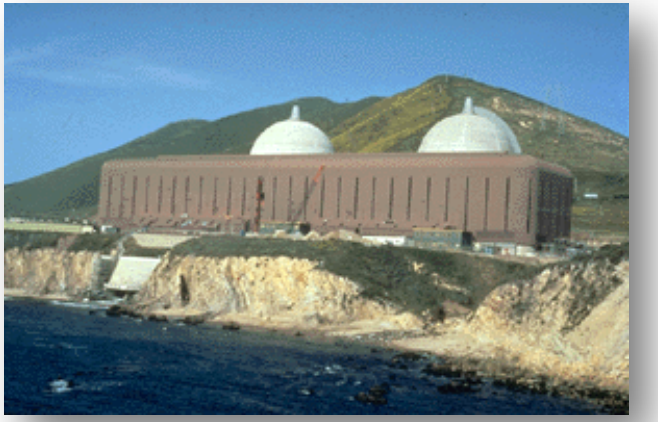
Conventional Generation Sources

Dispatchable

- Energy stored in fuel such as diesel
- Use when needed
- Well understood
- Highly Reliable
- Easy to control

Characteristics:

- Low thermal efficiency (35%)
- Considered a base load unit
- Large capital costs
- Lower operating costs



Source: http://www.osha.gov/SLTC/etools/electric_power/illustrated_glossary/index.html

Renewable Energy Generation Sources

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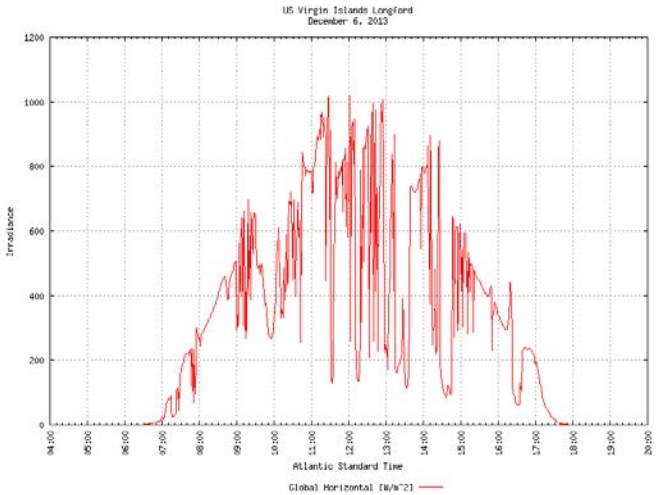


Non-Dispatchable

- Considered to be unconventional generation sources
- Characterized by variability and uncertainty
- Energy source must be used when available
- More difficult to control
- More difficult to schedule
- Use it or lose it!

Considerations Before Going Renewable

- Is your power plant operating efficiently (~13 kwh/gal or better)?
- Are your generators and switchgear capable of operating automatically and in parallel?
- Is your distribution system balanced and how much line loss are you experiencing?
- Have you tackled efficiency first?

AVEC Power House in Teller, Alaska

AEA Site Visit Photo

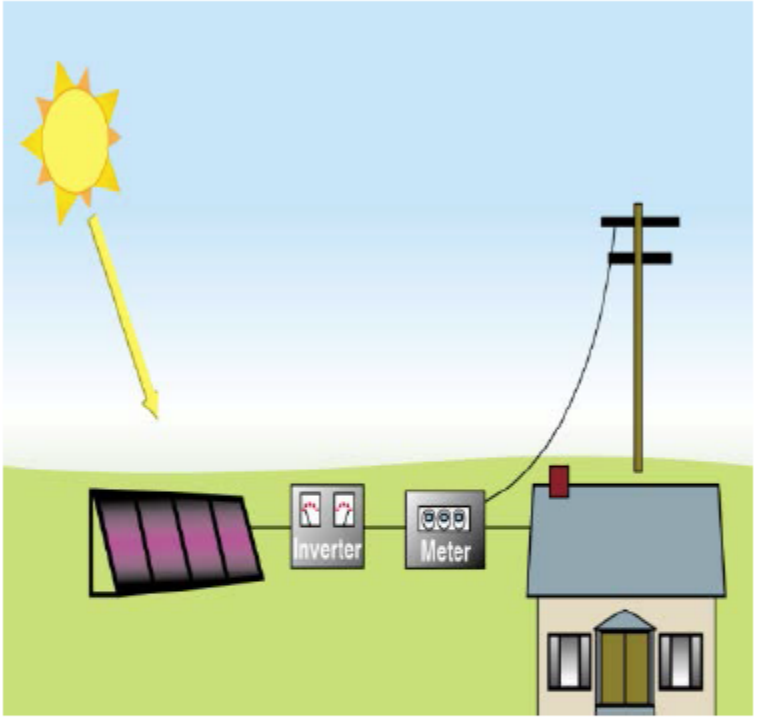
Do you have a local renewable energy source?

- DOE Technical Assistance can provide resource assessments
- AEA also has staff and programs that can help identify possible renewable options

SOLAR PHOTOVOLTAICS (PV)

Flat Plate Photovoltaics

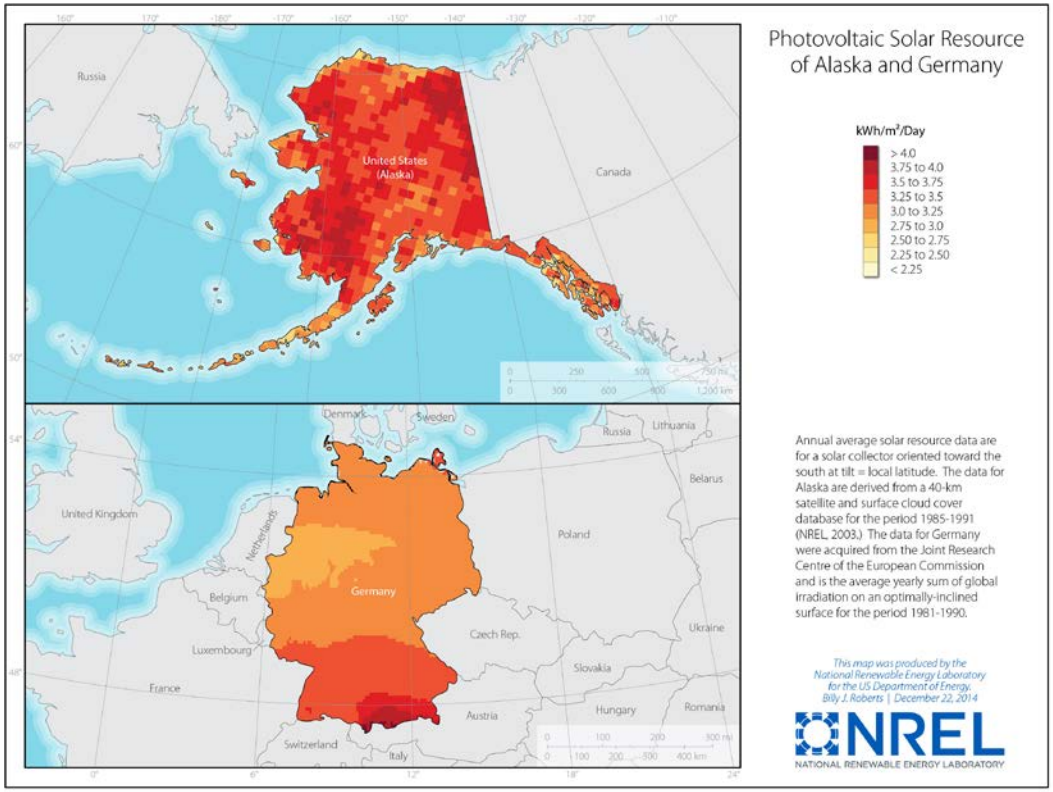
- Direct conversion of sunlight into direct current (DC) electricity
- DC converted to alternating current (AC) by inverter
- Solid-state electronics, no-moving parts



- High reliability, warranties of 20 years or more
- PV modules are wired in series and parallel to meet voltage and current requirements

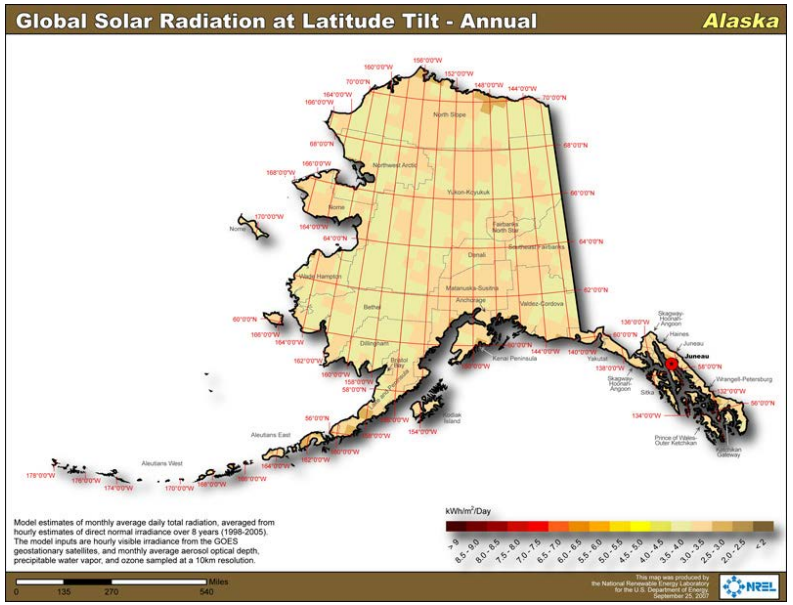
Illustration by Jim Leyshon, NREL

Alaska Has Significant Solar Potential



Summertime Opportunity:

- Combine solar PV with wind energy for winter
- Invest in storage
- Use electric heat in summer for cold climate regions



What are Some Interior Solar Projects

Fort Yukon Solar Array

- What was the planning process?
- How was the system funded?
- Who was responsible for keeping the project going?
- Is there anything you would do differently next time?

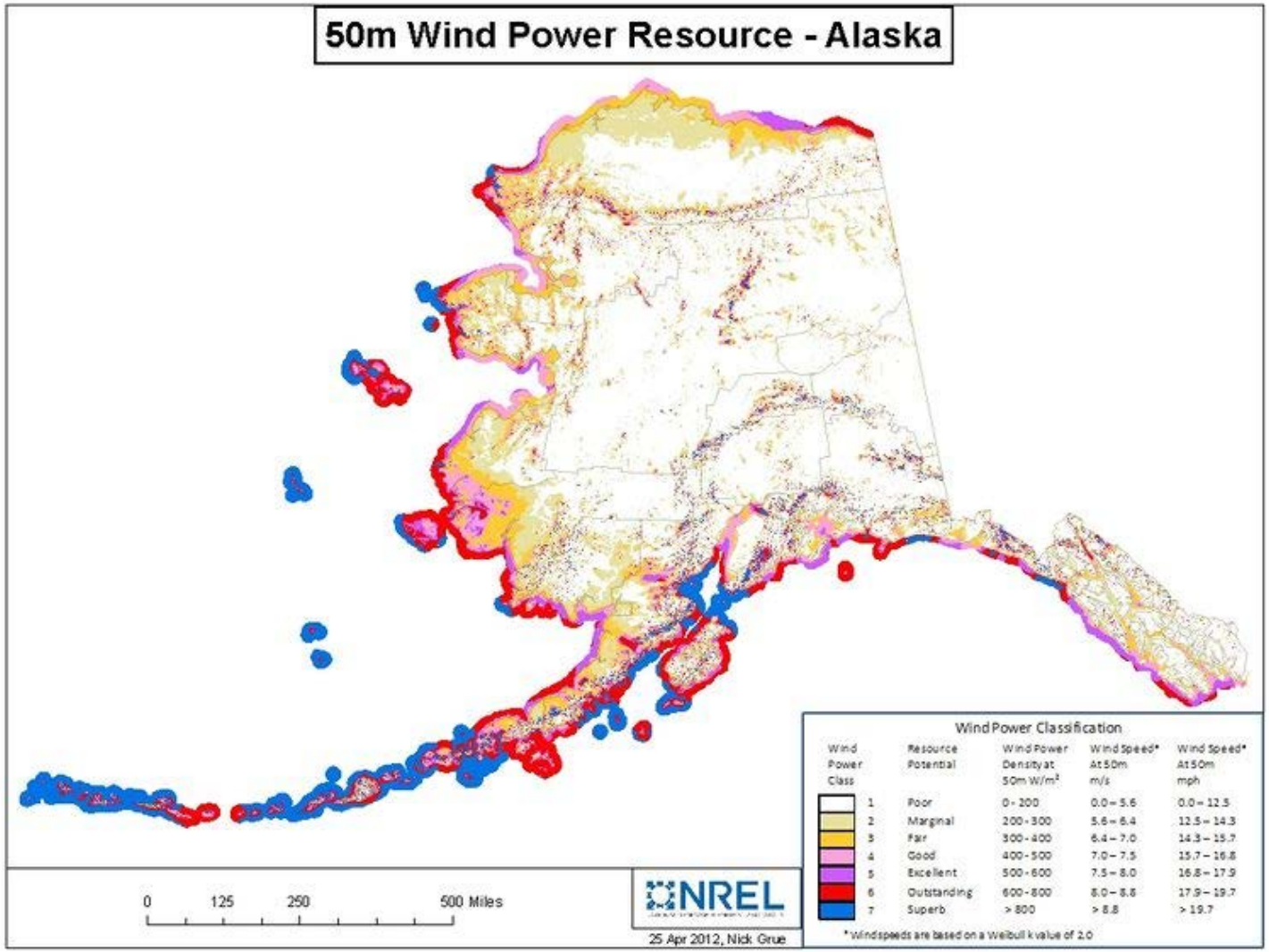
WIND POWER

Wind and PV

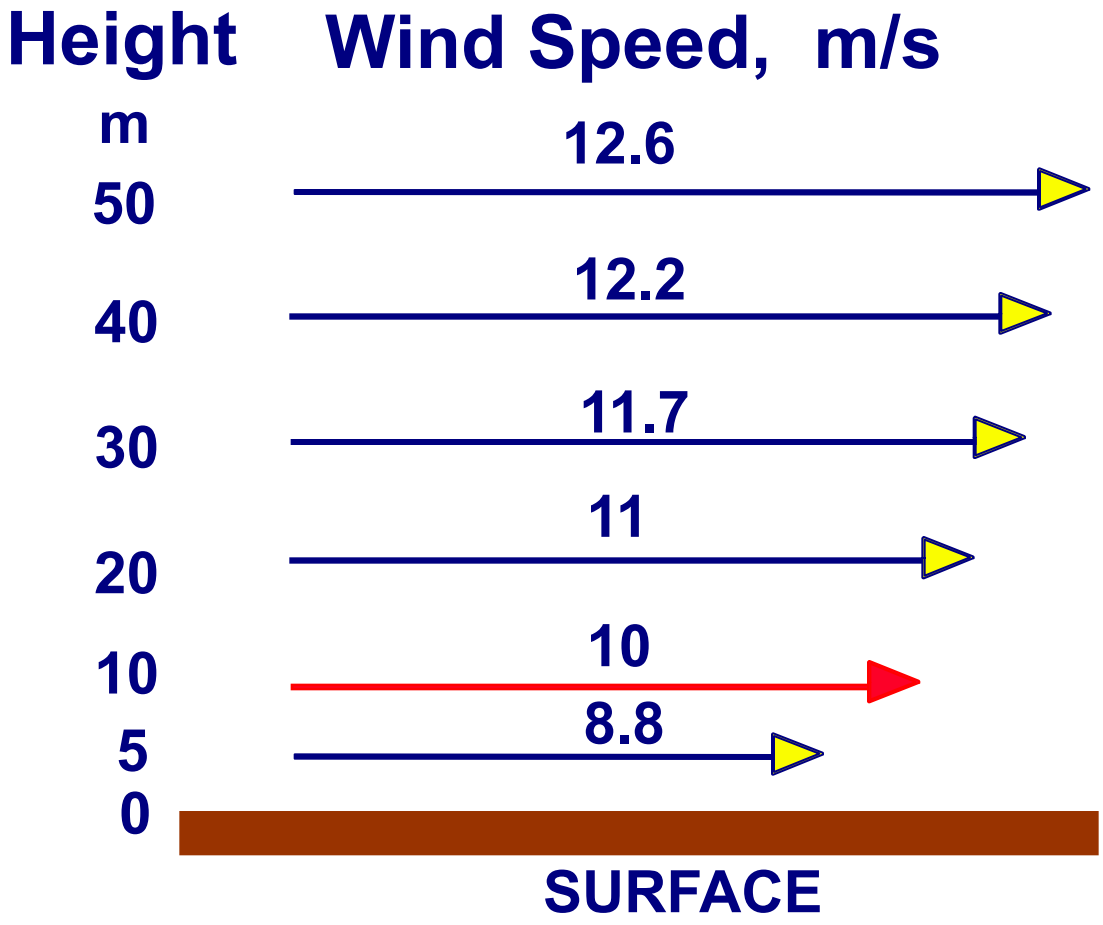
- Generation
  - 1 Megawatt installed PV capacity powers ~120 homes (in AK)
  - 1 Megawatt installed wind capacity fuels 240-300 homes (US average)
- Employment
  - US Wind industry employs 88,000 (AWEA 2015 http://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=8736)
  - US Solar industry employs 208,859 (TSF 2015 http://www.thesolarfoundation.org/national/)

Solar soccer stadium in Mainz, Germany

Wind Resources and Opportunity in Alaska



WIND SHEAR



Courtesy: Alternative Energy Institute

Sizes and Applications

Small (≤10 kW)
- Homes
- Farms
- Remote Applications

(e.g. water pumping, telecom sites, icemaking)

Intermediate (10 kW-1 MW)
- Village Power
- Hybrid Systems
- Distributed Power

Large (1 MW +)
- Central Station Wind Farms
- Distributed Power
- Community Wind

Characteristics of a Good Wind Site

- Good Wind Resource
- Adequate Transmission
- Reasonable Transportation
- Permitting
- Receptive Community/Utility
- Few Environmental Concerns

- 4 x 50 kW Wind Turbines, Selawik

- 9 x 95 kW Wind Turbines, Tuntutuliak

Operations and Maintenance

- Skilled jobs
- Grease gears
- Check wiring
- Look for environmental wear and tear

Interior Wind Projects Lessons and Successes

- What was the planning process?
- How was the system funded?
- Who was responsible for keeping the project going?
- Is there anything you would do differently next time?

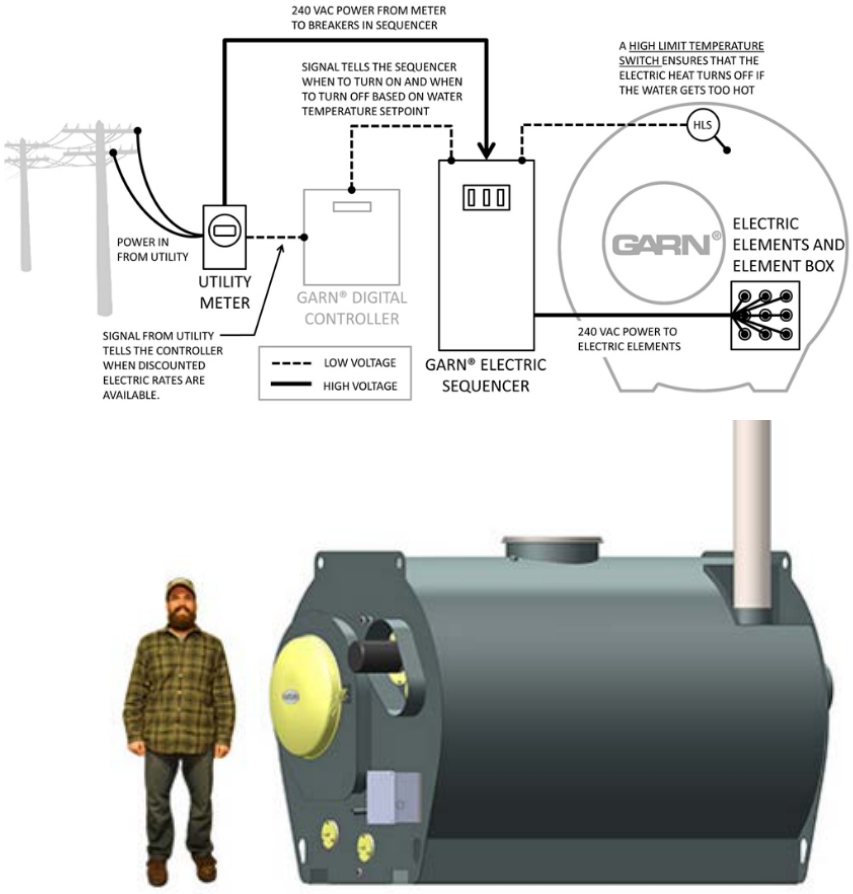
BIO-ENERGY

Why Biomass?

- Lowers energy costs with a local fuel
- Maintains cash flow within a community
- Creates local jobs and businesses
  - Construction
  - Operation/Maintenance
  - Harvest/Thinning/Resource Management
  - Heat Utilities

Cord Wood Boilers

- Wider band of fuel sources
- Some combine heat storage with wood-gasifier storage (Garn)
- Considerations:
  - Wood drying
  - Size of feedstock
  - Species of stock (heating values)



Small-scale Biopower

Vegetable Oil Generators

Vegetable Oil Generator (between 12kW and 1 MW, CHP option available) by Alternative Technology Group

- Straight vegetable oil, used cooking oil, or diesel fuel
- Filtration is required
- Stand-alone or as backup system, off-grid systems
- Safe operation
- Simple maintenance
- Suitable for any season, in any climate

Things to Remember

- Storage space is needed for drying wood
- Secure your fuel – then match the boiler
- O&M costs some of the highest of renewable technologies
  - Fuel costs
  - Fuel loading
  - Cleaning of boilers

Interior Projects: Lessons and Successes

- What was the planning process?
- How was the system funded?
- Who was responsible for keeping the project going?
- Is there anything you would do differently next time?

Technical Assistance!

- Help Identify efficiency measures
- Provide PCE support
- Identify renewable options
- Identify grid integration options
- Create strategic energy plans
- Assistance with climate resilience/relocation planning

Questions?

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