Forest Service – *"Off the Grid"*

A Path to Net Zero Energy Consumption

Senior Leader Program 5

Action Learning Project

October 7, 2008

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Executive Summary

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National Forests present an opportunity for a rich source of renewable energy that Forest Services offices could tap for their own energy needs and potentially generate a surplus of energy back on the electrical grid to offset agency energy use elsewhere. Maps are displayed that show the distribution of energy resources and National Forest offices. The project includes a DVD that visually summarizes efforts in the field aimed at minimizing the environmental footprint of the Forest Service. The projects highlighted in the DVD focus on renewable energy sources such as solar, geothermal, hydro, and biomass conversion that have been installed at Forest Service units throughout the western U.S.

Renewable Technology

The intent of the technology section is to highlight types of renewable energy technology available, and practical, to Forest Service application. The intent is not to highlight commercially available energy, but technology that can be applied locally. The areas that we will touch will be biomass, wind, solar, geothermal, and hydropower. This report includes maps of these renewable energy resources and Forest Service unit locations.

Financial Considerations

National Forest System Lands contain plentiful renewable energy sources and opportunities for development that could be tapped for meeting renewable energy mandates for federal facilities and benefiting the country as a whole. A cursory look at financial feasibility factors related to moving FS facilities to renewable energy reveals that the concept of getting all facilities “off-the-grid” is a naive and impractical. There are several reasons for this, including severe shortage of appropriated funding; the small and isolated nature of many of our buildings, the high percentage of leased facilities, and the inability of contractors or partners to develop profitable retrofits for many facilities. Creative contracting and partnerships can likely go a long way in meeting the agency’s renewable energy goals. Through propagation of projects such as the Spearfish Biomass Plant, Snowmass Wind Turbines, and many others, the Forest Service truly could be the conservation leader in renewable energy application and generation for the federal government.

Security and Environmental Impacts

The very high price of being a "civilized nation" is now being paid by our environment. With all of the comforts and technology now expected and demanded it is unrealistic to believe that humanity, as we know ourselves, can do without those amenities. We have created a huge environmental impact on our world, and yet our very national security depends on maintaining

the advancements that have been made. It is our responsibility to minimize the damage done, and find a better, more eco-friendly way to sustain our energy needs and way of life. Our immediate focus is reducing the U.S. Forest Service demand on traditional energy sources. With alternative energy sources available today, we have an opportunity to position ourselves for a net zero energy consumption and do this in an "environmentally friendly" manner. Another is to address the security risk benefits associated with alternative energy solutions. Specifically, utilize alternative energy sources on NFS lands in a manner that will not only reduce our current demand on traditional energy sources, but allow for "decentralizing" the current electrical grid, a potential target of terrorism.

Legal and Regulatory

There are relatively few policy barriers standing in the way of the Forest Service achieving net zero energy use. The most important policy steps for the agency to take now are to increase the agency's emphasis on solar, wind, geothermal, and hydro; and develop national and regional strategic plans with measurable goals, methods and performance measures that allow flexibility to take advantage of local conditions and promote partnerships.

Social Values and Conflict

Forest Service proposals have many times been controversial. Much of the controversy has revolved around values-based conflicts over how the National Forests should be managed and how specific management actions are perceived to affect forest resources or values that the opposition hold dear. Efforts to develop renewable energy infrastructure on USFS administrative units may provoke NIMBY opposition. Open, collaborative planning could defuse this reaction. Large utilities are better positioned to serve FS units efforts to develop alternative energy service. Smaller utilities are less able to provide energy services outside their traditional portfolio, though this is changing. Increasing conservation actions and alternative energy developments, even though broadly supported in concept, may be resisted by employees, possibly because of conflict with the traditional mission. Strategies are described to improve support and foster a greater likelihood for success both internally and externally.

Team Recommendations

Each section of the following report includes a more detailed set of recommendations for the topics discussed. The following recommendations are more strategic in nature and believed by the team to be critical to making progress toward *Net Zero*.

Fuel the Passion

- ◊ Validate and encourage the ongoing local initiative, creativity, and passion of Forest Service employees throughout the agency in energy conservation and alternative energy development.
- ◊ Increase funding opportunities beyond appropriated funds for *Net Zero* efforts:

- ✓ Cost-shares with partners, utilities, other agencies, etc.
- ✓ Competitive grants
- ✓ Microgrants

Reduce Barriers

- ◊ Establish centers of excellence or similar entities where new technology, contracting, and other types of expertise are available to advise units seeking alternative energy strategies:
  - ✓ Increase awareness and application of procurement and contracting, partnerships, ESPC, UESC, and PPA instruments to expand effective use of energy conservation and alternative energy systems.
- ◊ Foster support for energy conservation behaviors and alternative energy in the agency workforce.

Leadership

- ◊ Diversify portfolio of renewables: look beyond biomass;
- ◊ Create and champion a national strategy;
  - ✓ Allow flexibility to take advantage of local situations
  - ✓ Align budget accountability and performance
  - ✓ Use partners to develop:
    - ▪ Network expertise with external partnerships: private sector, utilities, NGOs, other agencies.

Renewable Energy Resources Maps and DVD

The Forest Service manages 193,000,000 acres of public lands. Many of these lands possess resources that could provide the means for the agency to become a Net Zero energy consumer. The premise of the "Forest Service: *Off the Grid*" action learning project is many USFS units are located in regions of relatively abundant sources of renewable energy (solar, wind, geothermal) or actually manage National Forests that possess these resources (biomass, hydropower potential).

If local or regional Forest Service units were able to develop their locally advantageous renewable energy resource potential, conceivably, units that generate excess electrical energy could wheel their surplus back on the grid and offset other units that do not have that capability or have not yet developed it. Over time, the Forest Service could achieve Net Zero energy consumption. What is needed is a proactive strategy that mobilizes all the policy, administrative, budgetary processes, and human capital resources the agency controls to holistically execute a long term strategy throughout the agency

Off the Grid **DVD**

Established in 1905, the U.S. Forest Service manages 193 million acres of public lands in national forests and grasslands to provide the greatest amount of good for the greatest number of people. These public lands play a vital role in water resource availability, global climates, air quality, timber, and recreation.

The Forest Service employees over 30,000 men and women at 155 national forests, 20 national grasslands, 7 research stations, and various State and Private Forestry offices. In 2007, the Forest Service occupied more than 33 million square feet of space, spent nearly $29 million on utilities and water, and used more than 1.4 trillion BTUs of energy.

As global leaders in natural resource conservation, the Forest Service and its employees are taking a more proactive role in reducing our environmental footprint.

Photovoltaic solar energy is the most prominent alternative energy source in the Forest Service. Solar energy is perfect for recreational sites such as those found on the Tonto Basin Ranger District in Arizona. They have converted approximately 40 percent of their 500 electrified recreational sites to photovoltaic arrays, resulting in significant long-term utility savings.

The Missoula Development and Technology Center has installed five 65-Watt photovoltaic exterior lighting systems to provide light for their parking areas and ensuring the safety of their employees.

Several larger scale photovoltaic systems have been installed in various Forest Service locations such as this 2-Kilowatt array at the new Wind River work center on the Shoshone National Forest. The Madison Ranger Station in Ennis, Montana has installed a 4-Kilowatt photovoltaic array that, in turn, sparked a major shift in employee energy conservation philosophies resulting in a 40 percent reduction in their total electrical grid usage.

A shining example of what is possible with solar can be seen at the Schulman Grove Ancient Bristlecone Pine Forest Visitor Center in California. The visitor center employs an efficient building design along with energy conservation practices and photovoltaic arrays to make them one of the few Forest Service facilities that are completely off the electrical grid.

In many cases, solar power is either impractical or can not meet the entire demands of a particular site. Visitors to the Maroon Bells scenic recreation site on the Aspen Ranger District arrive by hybrid bus and enjoy the visitors' center and bathroom facilities that are powered entirely by a 1-Kilowatt photovoltaic array, as well as a 1-Kilowatt micro-hydrogenerating facility.

Another example of using hydropower to run an off-the-grid complex is the campus to the largest Forest Service District in the country: The Spotted Bear Ranger District in northwest Montana. The Spotted Bear Ranger Station is composed of about 40 buildings that make up the ranger station as well as local housing for the employees and volunteers. The power to this campus is provided by a unique 35-kilowatt hydrogenerating facility that is fed by a tributary to the Flathead River.

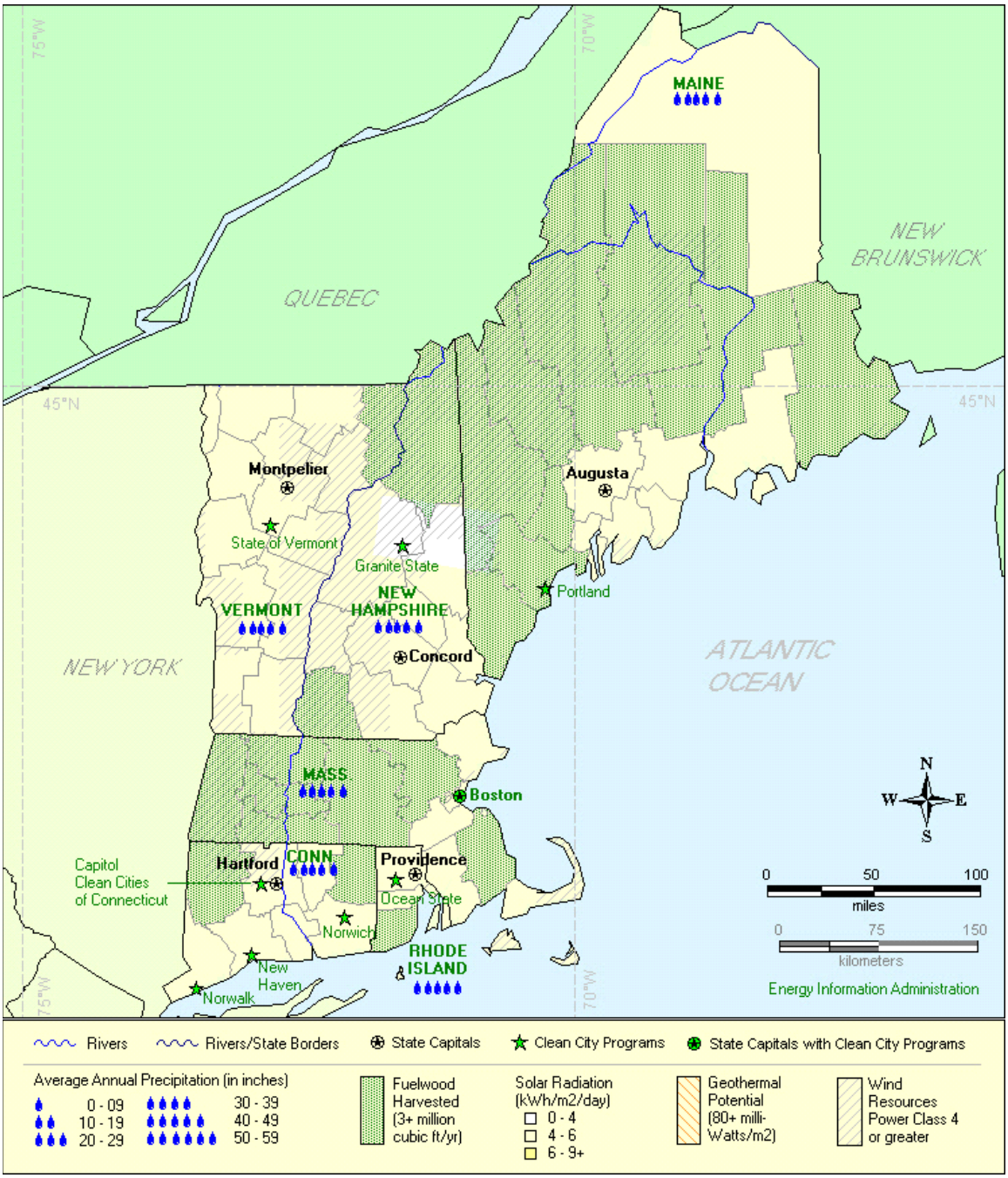
The Forest Service is beginning to explore advances in technology that are minimizing their environmental footprint such as this state-of-the-art geothermal heating and cooling system installed at the Eastern Sierra Interagency Visitor Center in Lone Pine, California. The geothermal heat pump at the visitors center is a closed loop series of 28 wells that are 300 feet deep to provide a consistent temperature at a considerable energy savings.

The Winn Ranger District on the Kisatchie National Forest in Louisiana is using woody biomass residues to produce 25-kilowatts of electricity. A joint venture between the National Forest System, Research, and State and Private Forestry, the system uses high temperatures to chemically convert the woody biomass to volatile gases. The gases are fed into a carburetor of a 6-cylinder engine which turns a generator and produces electricity. The generator produces enough electricity to run the Winn Ranger Station and provides a slight excess of electricity which is fed back onto the electricity grid, actually running the electric meter backwards.

As the Forest Service begins its journey into its 2nd hundred years, we must balance our continued stewardship of the land with their global environmental costs. The Forest Service and its dedicated employees will continue to evolve and adapt such that we not only meet our natural resource objectives but do so such that we are leaders in the global arena of conservation.

Renewable Resources Maps

The following pages include maps that describe the location and types of renewable energy resources throughout the United States. The source of these maps is the US Department of Energy, Energy Information Administration (August 2008).

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0 - 4
4 - 6
6 - 9+
Geothermal Potential (80+ milli-Watts/m2)
Wind Resources Power Class 4 or greater


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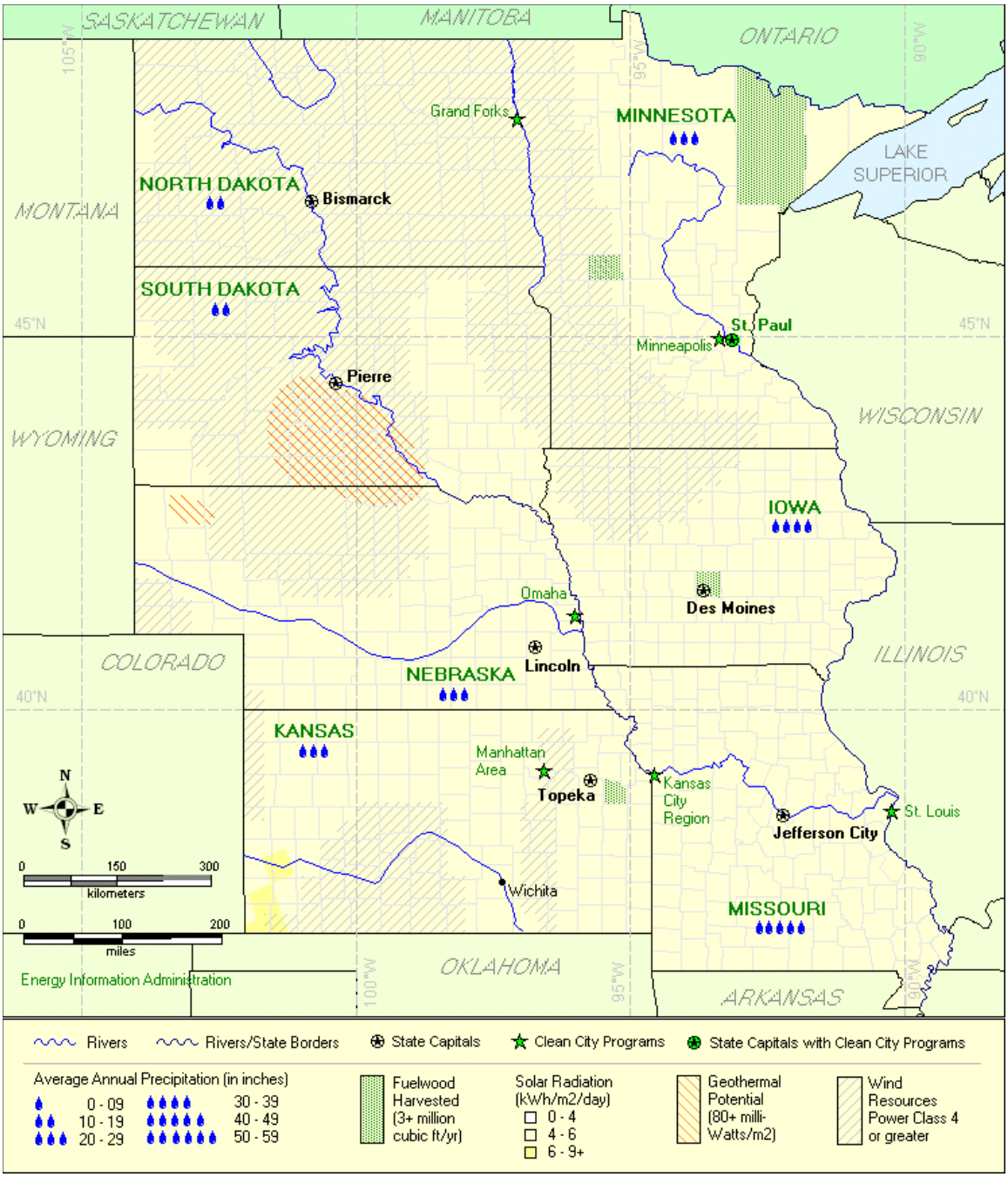
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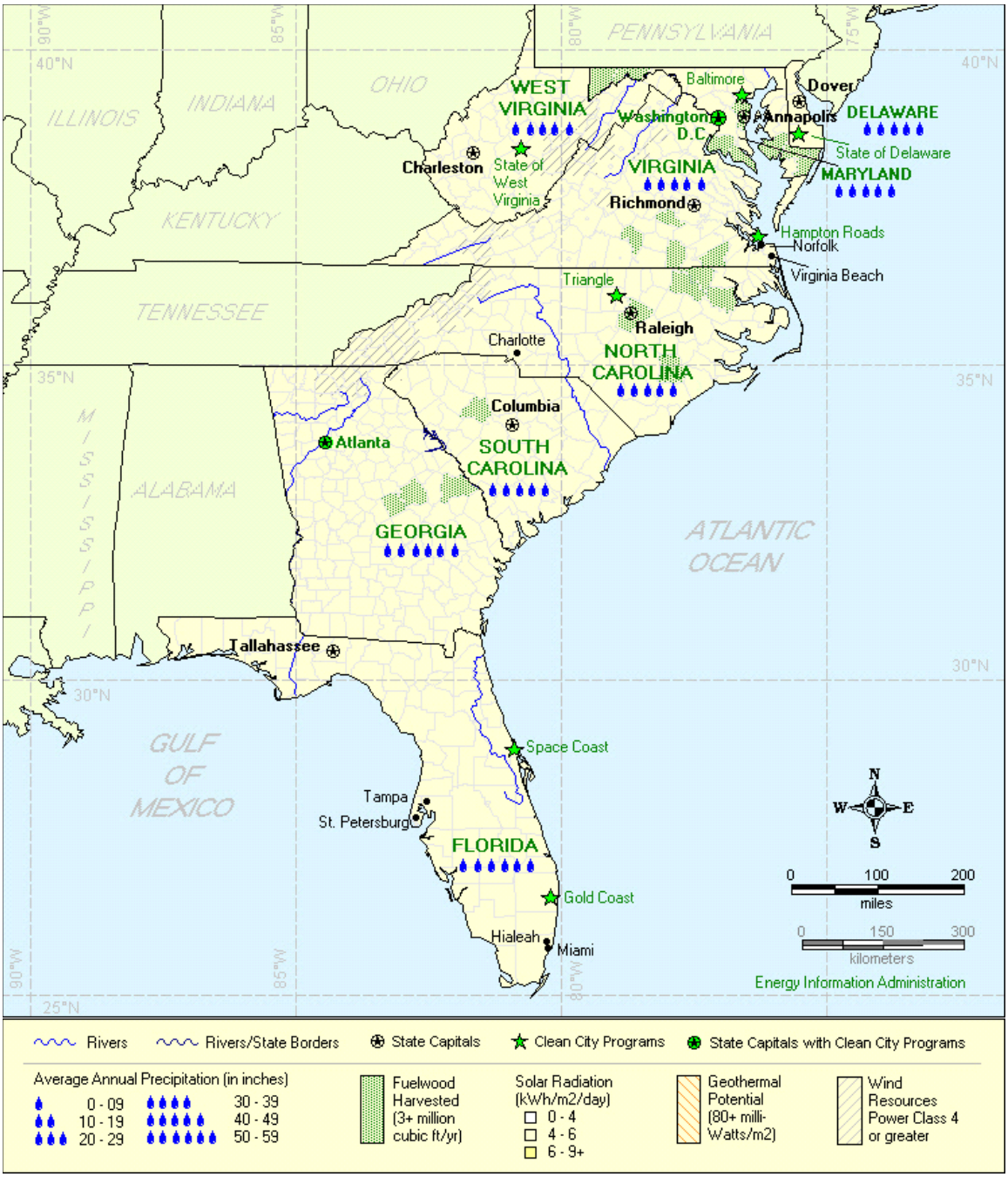
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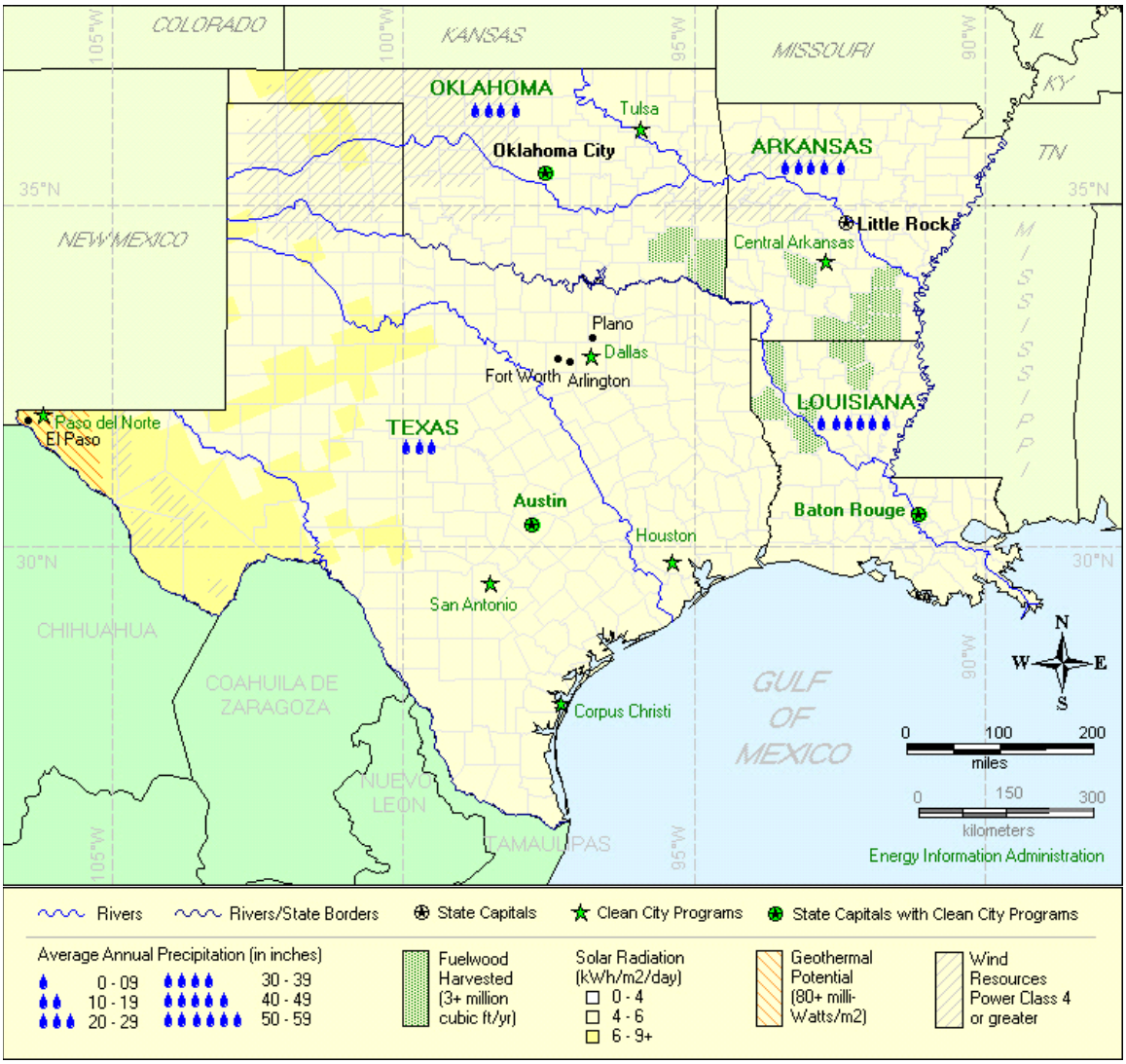
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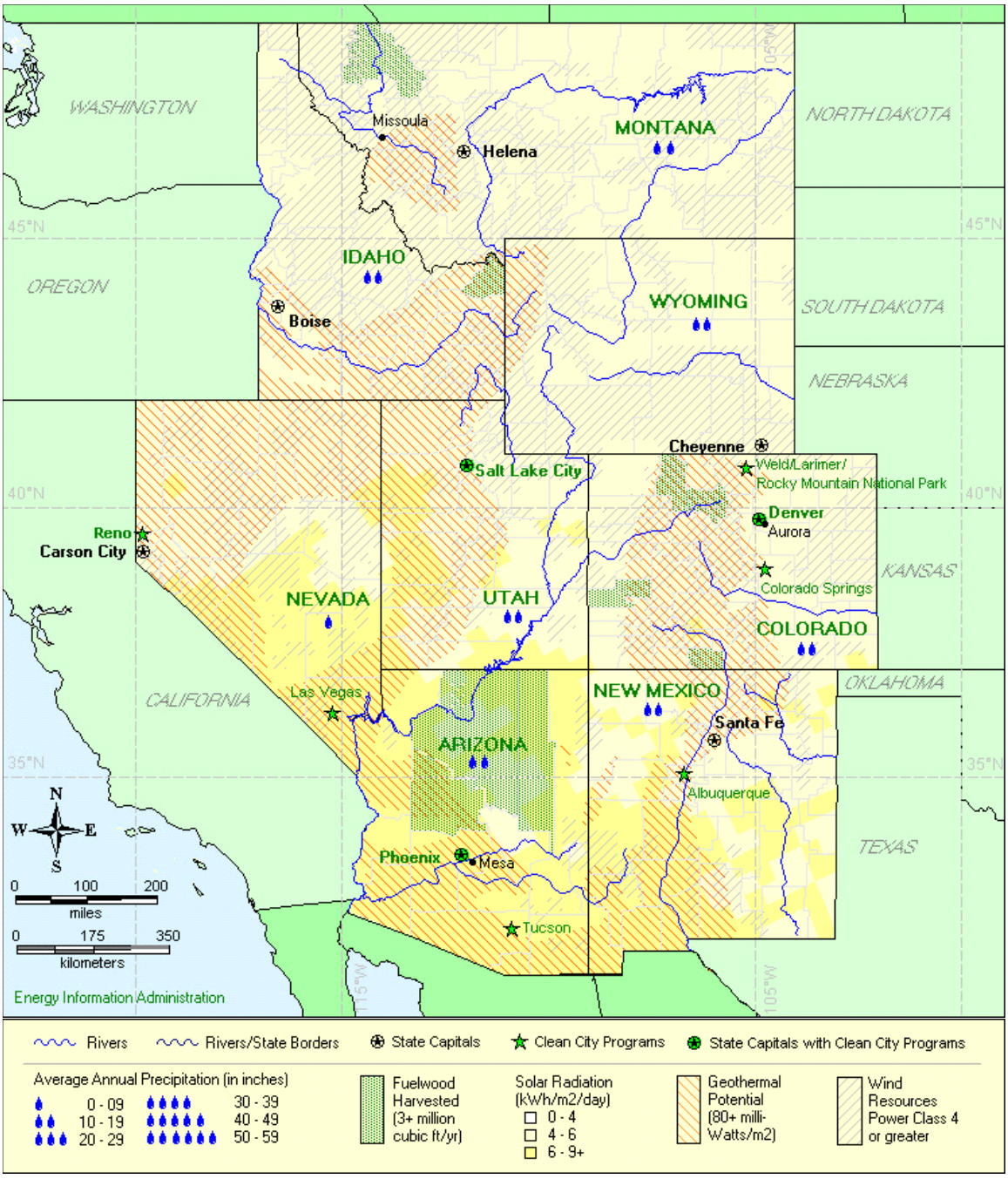
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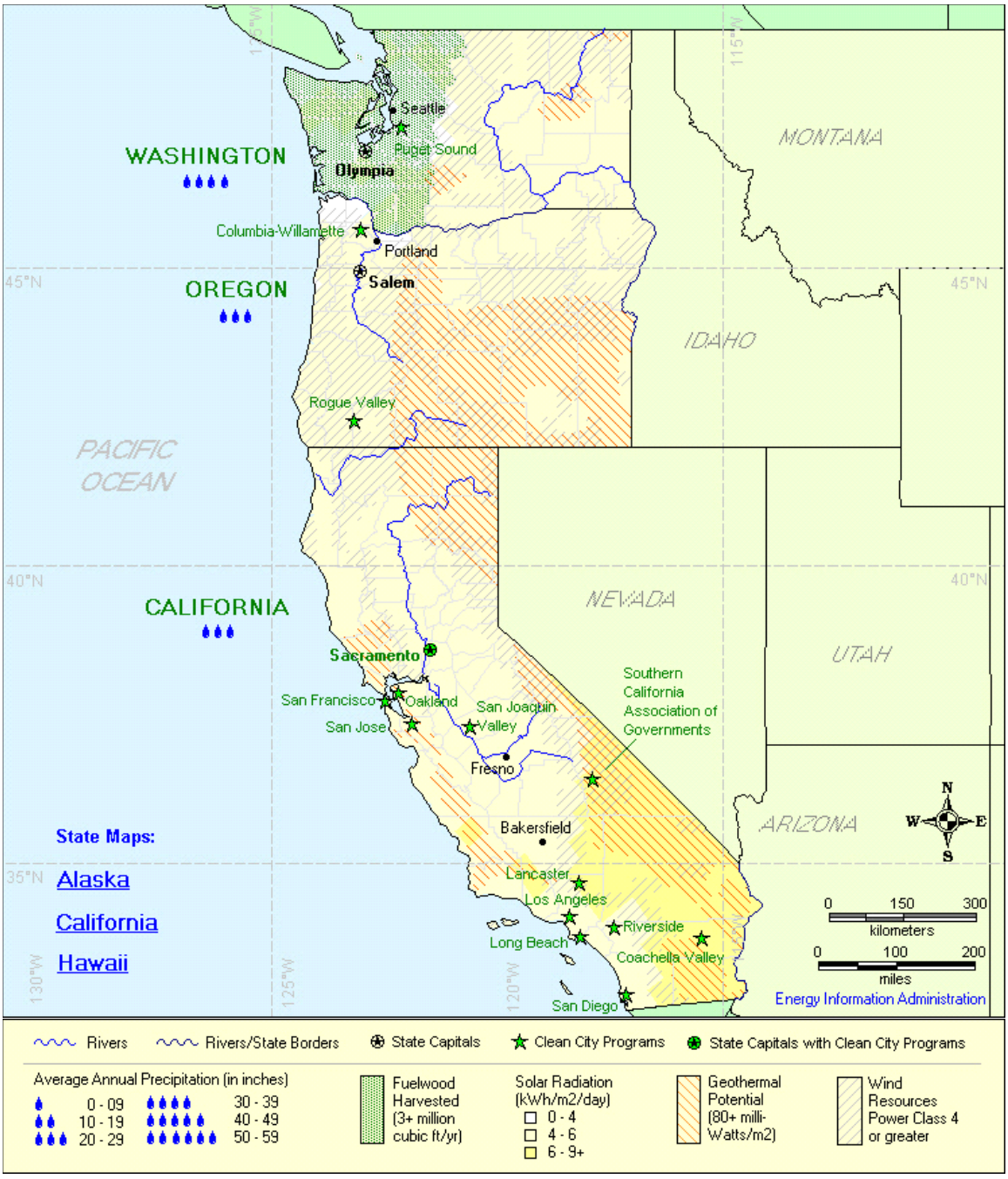
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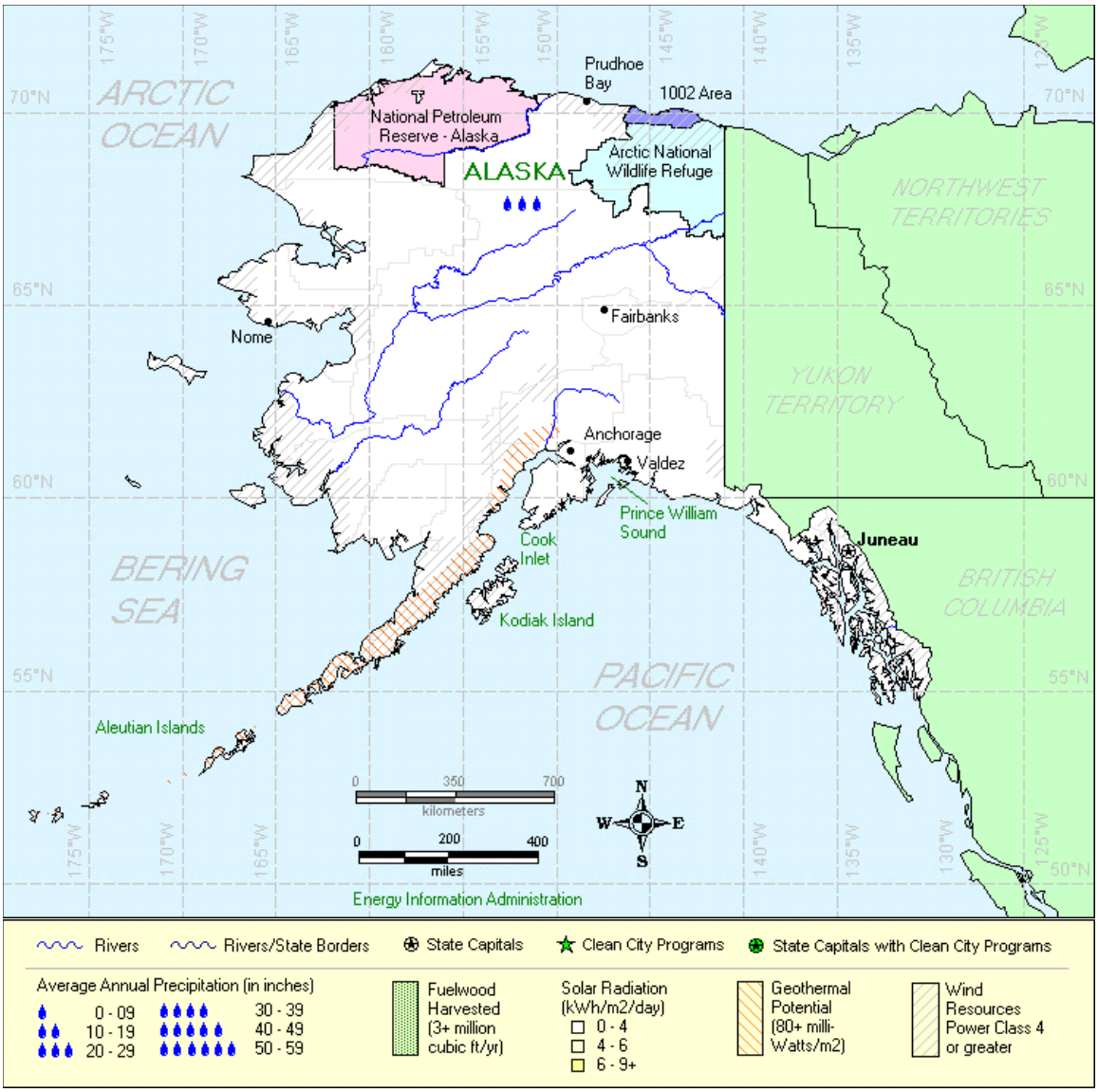
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Technology

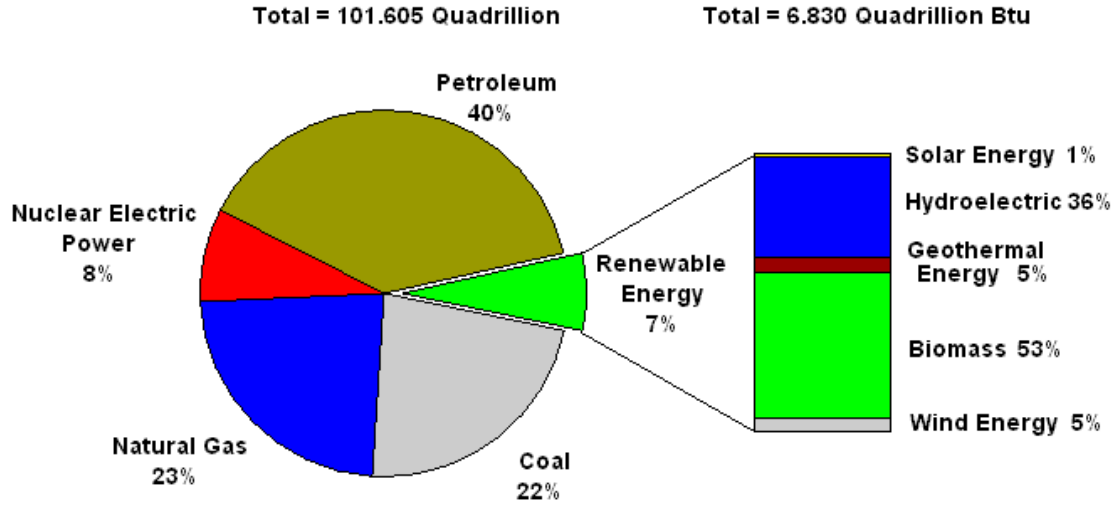
Sokjae Cho
Northern Research Station

This section of the report is not intended to provide extensive technical information. There are myriad sources of technical information regarding renewable energy. The amount and depth of such data would overwhelm the efforts of this team. Rather, the intent of this section is to highlight renewable energy technology that is available and practical for Forest Service use.

In order to achieve the goal of "net zero" energy consumption, we will look at how Forest Service locations can generate renewable energy on or near the facility vicinity. For the intent of this report, we will look at "distributed" power systems. These are "distributed because they are placed at or near the point of energy consumption, unlike traditional "centralized" systems, where electricity is generated at a remotely located, large-scale power plant and then transmitted down power lines to the consumer." [1]

In generating renewable energy, this section will address the following renewable energy technology and their application to Forest Service facilities; biomass, wind, solar, geothermal, and hydro. Attached at the end of this section is a resource map broken out regionally.

The following figures are provided to give a sense, or order of magnitude, of renewable energy nation wide and the amount of energy consumed by the Forest Service.



Quadrillion - 10^{15} = (1,000 billion)

Figure 1, National Energy Use, 2007

	Forest Service Energy/Water Cost, FY 2007			Forest Service Energy/Water Use, FY 2007			
Commodity Type	Revised NFC Data	Unallocated Purchase Card Data	Total	Revised NFC Data	Unallocated Purchase Card Data	Total	
Electricity	$17,637,101	$147,105	$17,784,206	211,124,884	1,522,828	212,647,712	Kilowatthours
Fuel Oil	$0	$3,267,108	$3,267,108	0	1,320,577	1,320,577	Gallons
Natural Gas	$3,020,803	$349,570	$3,370,373	317,744,018	30,962,802	348,706,820	Cubic Feet
LPG/Propane	$1,641,159	$31,202	$1,672,361	1,603,169	18,194	1,621,363	Gallons
Coal	$204	$27,609	$27,813	4	449	453	Short Tons
Facility Energy Total	$22,299,267	$3,822,594	$26,121,861	1,201	233	1,434	Billion Btu
	85.4%	14.6%	100.0%	83.8%	16.2%	100.0%	
Water	$1,668,143	$1,395,601	$3,063,744	407,217,514	594,885,414	1,002,102,928	Gallons
	54.4%	45.6%	100.0%	40.6%	59.4%	100.0%	

Figure 2, 2007 US Forest Service Energy Consumption

BIOMASS ENERGY

Bio-energy is energy produced from plants (from wood, wood wastes, agricultural products, agricultural wastes, landfill gases). There are different application technologies on the use of biomass. For Forest Service facilities, the main technology will be use of biopower; direct fired boiler, gasification system, and potentially methane gas from landfills. Use of biomass is considered carbon neutral, in that carbon released from biomass combustion is balanced by the carbon dioxide captured in its own

Wood Pellet Boiler – Murphy Lake Ranger District.

growth. [2]

The use of direct-fired system for thermal output is well known for its application for heating purposes. In fact there are several Forest Service locations incorporating this technology currently. This section will discuss two biomass technologies that are not well applied to current facilities but may have potential, gasification and landfill gas.

GASIFICATION SYSTEM

Gasification systems are designed to "convert carbon-containing materials into a synthesis gas product that can be used for energy production or as a building block for other chemical manufacturing processes". [3] In more detail, gasification is a "process that involves injecting air or oxygen, and a suitable raw fuel (e.g., coal, petroleum, petcoke, and biomass) into the gasifier under high temperature and pressure, where numerous chemical reactions occur that convert the feedstock into synthesis gas (or syngas), a mixture of carbon monoxide and hydrogen, while simultaneously generating steam from the excess heat generated by the chemical reaction". [4] Biomass (wood or other solid plant matter) is heated to very high temperatures (600-800 ^{o}C) [5] in a gasifier.


Gasification System - SRS & Winn R.D.

Biomass gasification system has the advantage of being used for both heat and another energy output, usually electricity. The Winn Ranger District in Louisiana and the Southern Research Station are jointly investigating the application of a 25 K watt gasification system. The system will produce electricity and heat. The system being used there produces H_2 (20%), CO (20%), $CH_{4\ (2\%)}$, CO2 (7%), and balance is N2 [6] with smaller quantities of other gases. There are technologies that can burn most types of biomass for conversion of combustible gases. In deed, the system being used for the Winn Ranger District was produced by a company called Community Power Corporation (CPC). The project team had the pleasure of visiting the manufacturing plant and witnessed a test burn of a gasification system running on expired military Meals Ready to Eat (MRE). The project team was informed, "as a rule of thumb, two pounds of biomass produces one KW of power". The application of such technology at Forest Service locations has potential. In addition, the gasification systems are now capable of producing bio diesel fuel. While the technology is relatively new, certainly the growth in this field will be promising.

METHANE GAS

Methane gas is a byproduct of biomass decay, a natural decay of biomass produces methane, which can be captured and used for power production. In landfills, wells can be drilled to release the methane from decaying organic matter. Then pipes from each well carry the methane to a central point, where it is filtered and cleaned before burning. This produces electricity and reduces the release of methane (a very potent greenhouse gas) into the atmosphere. [7] The use of this flammable gas from landfills has potential for many applications. They include heat, co-generation plants, and any application where fuel such as natural gas and propane are applied. Because landfill gas is about 50 percent methane, it can be used as a source of energy similar to natural gas (which is about 90% methane). [8] The burning of methane gas is more beneficial to climate change as the methane-rich fuels may have a higher global warming potential than carbon dioxide.[9]

Currently there are no examples of methane gas application in the Forest Service. The Department of Energy, through the Energy Savings Performance Contracting (ESPC), is applying this technology at other federal facilities.

BIOMASS FUEL

The Dept of Energy looks at biomass feedstock in two areas, Sustainable Feedstock Production and Feedstock Logistics. Sustainable feedstock production includes activities to the point they are ready to be harvested. Feedstock logistics includes activities necessary to move biomass to a bio-refinery. [10] However, this area is concentrated more of production of cellulosic ethanol, rather than for thermal or co-generation needs.

Traditionally, the burning of biomass has been clean wood chips. In addition to wood chips, there are options of burning cordwood and processed pellets. There are benefits and costs associated with these types of fuels. For each type of fuel, there are variances; moisture content, ash content, particulates from combustion, transportation and storage, feeding of fuel, and maintenance of the system. These variances impact initial design and installation costs as well as long term operation and maintenance costs. This life cycle costing is a factor in selection and use of biomass energy. The complexity (excluding issues of environmental impact, regulatory issues, and social issues – to be addressed elsewhere in this report) in terms of technical and costs stem from the following variables:

Types of facility,
Transportation distant,
Occupation and use,
Size of facility (amount of energy being consumed),
Geographic location (less/more heating or cooling load),
Quality of fuel,
Additional labor burden (for operation and maintenance of biomass boiler),
And life cycle costing.

What about the unique position of the Forest Service and its access to natural resources? Specifically, the National Forest System conducts extensive fuel reduction and forest thinning efforts. With readily accessible biomass fuels from National Forests, could the FS produce its own fuel pellets? Some advantages of this possibility are that, quality of fuel is controlled, the cost (after plant construction) would be reduced, and fuel supply can be managed. Clearly there are cost, environmental, regulatory, and social aspects to address in Forest Service going into the business of producing wood pellets. However, there are also advantages for Forest Service producing wood pellets. Woody biomass would be better utilized from forest thinning than going to burn pile, the fuel would directly benefit Forest Service facilities in helping to heat them, the pellets would burn more efficiently, more cleanly, with less ash content, and storing/handling would be more efficient. This possibility is certainly worth further investigation.

Examples of biomass application in the Forest Service:

- ◊ Murphy Lake Ranger District, MT.
  - o Using pellet fed biomass boiler. Heating 3,000 SF office space.
- ◊ Winn Ranger District, LA.
  - o In partnership with Southern Research Station. Gasification system to provide heating and electric power.

WIND ENERGY

Wind energy has been around for very long time. Reflect back to the windmills that grind our grains and pump our wells, or powered the earliest of sail boats. Wind turbines harness the wind to generate electricity. The United States currently generates more than 10,000 megawatts (MW) of electricity from the wind, which is enough to power 2.5 million average American homes. [11] With the increase production of commercial wind farms, wind energy is one of the lowest-priced renewable energy technologies available today, costing between 4 and 6 cents per kilowatt-hour [12], depending upon the project financing and other variables. However, the technology still requires a higher initial investment than fossil-fueled generators. [13] Wind energy is a truly a clean renewable energy. It is zero emission energy. One major pitfall with wind is that it is not a constant source and it is geographically applicable energy. However, wind energy seems to be a relatively abundant source in the locations where FS has presence (see resource maps).

In application to the Forest Service, current technology of large wind turbine is not a favorable one. These large turbines generate sizeable energy, from 100 kilowatts to as large as several megawatts. [14] Some pitfalls of these types of wind turbines include visual impact and adverse impact to certain birds and bats. Rather, small wind power has potential for application to Forest Service locations. Small wind is typically defines as “small turbines, below 100 kilowatts, are

used for homes, telecommunications dishes, or water pumping." [15] According to the American Wind Energy Association, "These turbines, which are defined as 100 kilowatts in capacity and below, have seen their market grow significantly and the industry has set ambitious growth targets continuing at 18-20% through 2010". [16]

HORIZONTAL TURBINES

The turbines typically used in commercial wind farms tend to be very large (with blade diameters ranging 65 to 130') structures. They tend to have towers that are 100 feet (30 meters) or more aboveground, they can take advantage of the faster and less turbulent wind. [17] The blade seem to rotate slowly, but because of their large size, high blade tip speed is realized. Working on the same principle of an aircraft wing, the blades are actually wing foils causing pressure differential between the surfaces of the blade (foil). Wind speed, height of the tower, pitch of the blades all play into the performance of the horizontal wind turbines. The size and speed of the blades can be a hazard to certain birds and bats. The size of the wind turbines also leads to visual impact issues.

VERTICAL TURBINES

The vertical axis wind turbines (VAWT) are configured differently from the horizontal counterparts. The "blades" are configured on a vertical axis, meaning that wind can be from any direction. The VAWT tend be to smaller in size and closer to the ground – a drawback as the wind speeds tend to be less. However, one manufacturer, Tangerine Alternative Power (its product is under consideration for use in R2), notes products that will produce power with winds as low as 4 mph. [18] The VAWT tends to be less efficient than the horizontal turbines. The vertical configuration tends to produce more drag on its "blades" than their horizontal counterparts. Its static structure tends to be less of a visual impact as well as less impact to wildlife. This technology may be most suitable for Forest Service locations. Smaller in size and less air and ground space needed, it may be well suited to meet electric loads at many of our Ranger District and Research Station lab locations

Examples of wind energy use in forest service:

- ◊ R2 –future plan for vertical axis wind turbines. Potentially up to seven locations with power generation between 1 KW and 5 KW.
  Pictured - Approx 5' tall x 14" wide
- ◊ R2, Yampa RD, Yampa CO, Medicine Bow-Routt NFs

Computer rendering of proposed vertical wind turbine at the Yampa R.D. office

GEOTHERMAL ENERGY

Geothermal power is the use of thermal energy from below the surface of the earth. As of 2006, geothermal power supplies 0.343% of the US energy. [19] Geothermal power is reliable and abundant in the US, reducing our dependency on foreign oil. Generally, in the U.S., most geothermal reservoirs are located in the western states, Alaska, and Hawaii. Commercial power plants are generating large amounts of energy in applying varying technologies, including Dry steam plants: use geothermal steam to turn turbines.

* Flash steam plants: uses high-pressure hot water. Flashing steam from lowering the pressure is used to drive turbines.

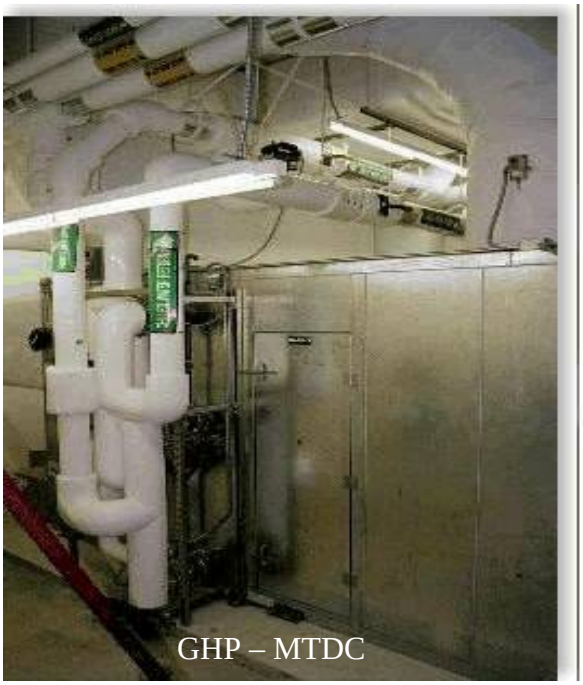
* Binary-cycle plants: heat exchange between hot geothermal water and a secondary fluid. The secondary fluid flashes to steam from the heat exchange and it drives turbines.

There two types of application that may be well suited for Forest Service, Direct Use and Geothermal Heat Pump.

Direct Use utilizes heated fluid from geothermal source and directly applies that thermal energy to residential or commercial use. The geothermal source tends to be low to moderate

temperature, ranging 68°–302°F (20°–150°C). [20] The geothermal fluid, after initial use, may be used again for other thermal (heat exchange) applications. The potential application for direct use is high, especially for western US states. It is unknown if Forest Service is using such technology.

Geothermal Heat Pumps (GHPs) uses the constant temperature near the earth's surface for heating and cooling applications. A constant temperature of 50 and 60°F (10 and 16°C) [21] is maintained nearly everywhere. Similar to air cooled or water cooled evaporative HVAC systems, the constant temperature of the underground piping is utilized for heating and/or cooling applications. A common type of geothermal heat pump is a closed loop system (open system will use ground source water). Piping is routed below grade and returned. With constant temperature of the earth, the amount of work needed by the cooling/heating system is reduced as compared to traditional cooling system. This translates to a smaller sized system to perform the work, resulting in less energy expended to achieve same effect. This reduced energy consumption also equates to reduced carbon emissions. In comparing a geothermal system to an air source system, the Dept of Energy noted, "Even though the installation price of a geothermal system can be several times that of an air-source system of the same heating and cooling capacity, the additional costs are returned to you in energy savings in 5–10 years." [22] The application of GHP is local (at or near the facility) and generally small scale. GHP is not dependent on geographic areas with high underground geothermal activity. Generally durable and dependable, they are popular with residential application.


GHP – MTDC

Some advantages of geothermal (GHP) energy:

- ◊ Clean, zero emission energy.
- ◊ No marked environmental impact
- ◊ Sustainable energy
- ◊ Reliable source regardless of weather, time of day, and other limiting factors that impact other renewable energy such as wind or solar.

Some disadvantages of geothermal energy:

- ◊ Specific technology geothermal energy could impact stability of surrounding land (Enhanced geothermal systems – injection of water underground)
- ◊ Large capital investment to build commercial geothermal plants
- ◊ There could be cultural issues with Native Americans.
- ◊ Depending on type of geothermal energy, geographic location can be an issue.

Examples of geothermal energy in forest service:

- ◊ Missoula Technology Development Center, MT.
- ◊ Ground Source Heat Pump providing cooling for the office.
- ◊ Savannah River Forestry Sciences Laboratory, SRS
- ◊ Ground Source Heat Pump for cooling/heating needs

SOLAR

The use of solar energy has many benefits, including being clean and renewable. Most people are familiar with photovoltaic (PV) panels mounted on roofs or arrays in field. The use of solar for the Forest Service has potential, but there are some barriers. They include cost, low efficiency, space, not well suited for certain geographic areas, developing technology, and source is not constant. In applying solar technology to FS, there are several types of application that may be suited for FS facilities, including passive solar, photovoltaic (PV), and solar hot water.

Passive Solar

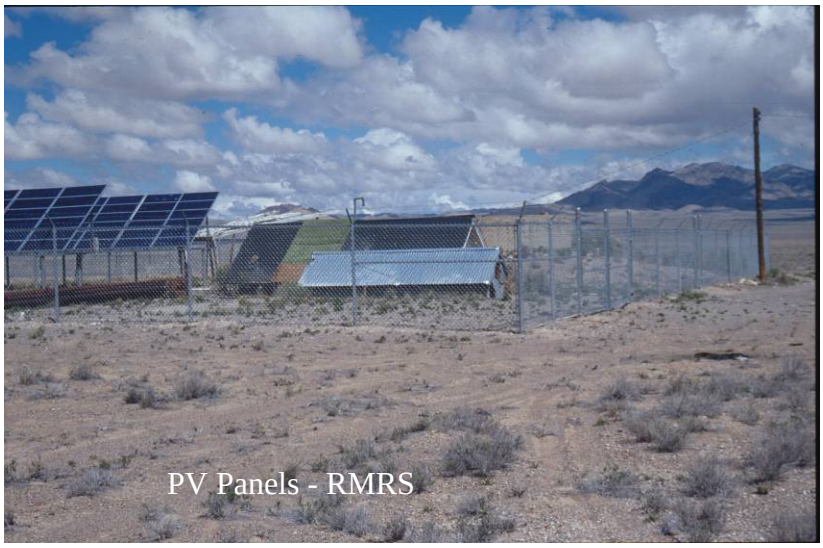
In a passive solar use, no mechanical means are employed to transfer energy. Structures are designed to maximize solar energy through large windows, orientation, and mass that retains and slowly releases heat. Incorporating passive solar designs can reduce heating bills. The application of passive solar energy is occurring through the Federal Government and the Forest Service.

PV Panels – SO/Ranger District, OH

Most recently, Forest Service mandated that new construction and new leases shall meet LEED (Leadership in Environmental and Energy Design) certification. This compliance with LEED certification will ensure passive solar will be incorporated in some degree.

Photovoltaic (PV)

PV is the conversion of direct sunlight to electricity (the process of knocking off electrons). "The energy of the absorbed light is transferred to electrons in the atoms of the PV cell. With their newfound energy, these electrons escape from their normal positions in the atoms of the semiconductor PV material and become part of the electrical flow, or current, in an electrical circuit." [23] PV technology can be fixed panels (set to optimum angle) and tracking, which permits panels to track the sun. Currently the efficiency of PV is relatively low. A typical commercial PV cell has an efficiency of 15%. [24] This is one large reason why so many PV panels are required to generate sizable amount of energy. In addition to efficiency, a typical PV cell produces about one or two watts of power. [25] In addition to the efficiency, availability of source is not constant. Dependent on the weather and time of day, a PV system will need a power storage and backup system if the system is to be "off the grid". There are opportunities for application to Forest Service. Cost and power generation can be a limiting factor, but size and amount of power can be varied (depending on # of panels used) and often there are utility rebates to help offset costs. The rebate is an important part of utilizing PV panels as the cost to install is significant, often beyond a reasonable payback period for most utility markets. The payback period is dependent on three factors; the conversion efficiency of the system, the amount of illumination the system receives, and the manufacturing technology. [26] There are some examples of small PV applications in the Forest Service.



PV Panels - RMRS

Solar Hot Water

Solar hot water heaters use the sun to heat water. Most common type is the flat plate heater. In active solar water heaters, water is pumped through a pipe through the solar collectors. Passive solar water heaters use gravity and changes is water pressure and temperature to move water. This type of solar energy can be applied to most Forest Service location.

Concentrating Solar Power (CSP)
CSP is the use of mirror configurations to convert the sun's energy into high-temperature heat. The heat then converts liquid to steam, and then uses the steam to drive a generator. This technology is applicable more to the commercial sector.
Examples of solar energy in Forest Service:

- ◊ Ennis Ranger District, MT. For electric load.
- ◊ Desert Experimental Range, RMRS. For powering equipment.
- ◊ SO/Ranger District, OH. For electric load.

HYDROPOWER

Hydro power is the capturing of water's potential and kinetic energy to drive mechanical blades or turbine. Hydro power is clean and efficient. According to one industry association, "hydropower turbines are capable of converting more than 90% of available energy into electricity, which is more efficient than any other form of generation (the best fossil fuel power plant is only about 50% efficient)." [27] Commercial hydro power is widely available in the west and can be purchased through the commercial utility market. Types of hydro energy range from hydro-electric dams, ocean currents, waves, and tides. Potential application for Forest Service may be mini and micro hydro power.

Small hydro is when the power generation is generally under 10 megawatts (MW) of power. Mini Hydro is when the power generation is generally under 1 MW or 1,000 kW of power. Micro Hydro is generally up to 100 kW of power. The use of micro and mini hydro power technology seem to be more widely applied to international use, especially in developing countries. The application of mini and micro hydro to Forest Service location has strong potential. The system requires access to flowing water. The amount of water flow, in gallons per minute and "head", the amount of pressure and drop of water, will dictate how much power can be produced.

There are clear advantages and disadvantages to a micro hydro system. In addition to the more obvious ones such as it is renewable and clean, some less obvious pros and cons include:

Advantages: [28]

- ◊ Efficient energy source. It only takes a small amount of flow (as little as two gallons per minute) or a drop as low as two feet to generate electricity with micro hydro. Electricity can be delivered as far as a mile away to the location where it is being used.
- ◊ Reliable electricity source.
- ◊ Cost effective. Building a small-scale hydro-power system can cost from $1,000 - $20,000, depending on site electricity requirements and location. Maintenance fees are relatively small in comparison to other technologies.

Disadvantages: [29]

- ◊ Suitable site required.
- ◊ Energy expansion not possible.
- ◊ Low-power in the summer months. In many locations stream size will fluctuate seasonally. During the summer months there will likely be less flow and therefore less power output.
- ◊ Environmental impact. The ecological impact of small-scale hydro is minimal; however the low-level environmental effects must be taken into consideration before construction begins. Stream water will be diverted away from a portion of the stream, and proper caution must be exercised to ensure there will be no damaging impact on the local ecology or civil infrastructure.

Example of micro hydro in Forest Service:

- ◊ Spotted Bear Ranger District, MT

ECONOMICS

With all renewable energy technology, high initial costs make their application a difficult one. Many local utilities offer rebates and there are tax rebates that help offset these costs. For Forest Service, and other federal agencies, acquiring capital investment funds to implement renewable energy is difficult. There are competing needs in maintenance, in deferred maintenance, and new facilities to support the mission of the agency. There is one federal program out there that could be a valuable tool. The Dept of Energy's Federal Energy Management Program (FEMP) has a contracting vehicle available to federal agencies. The program, Energy Savings Performance Contracting (ESPC), is a means to fund capital projects that reduce energy usage. In this program, a private vendor provides the upfront-cost needed for the design and construction of capital improvements. The energy service contractor (ESCO) incurs the cost of implementing energy conservation measures (ECM) and is paid from the energy, water, wastewater and operations savings resulting from these ECMs. The following figure outlines how the financing work.

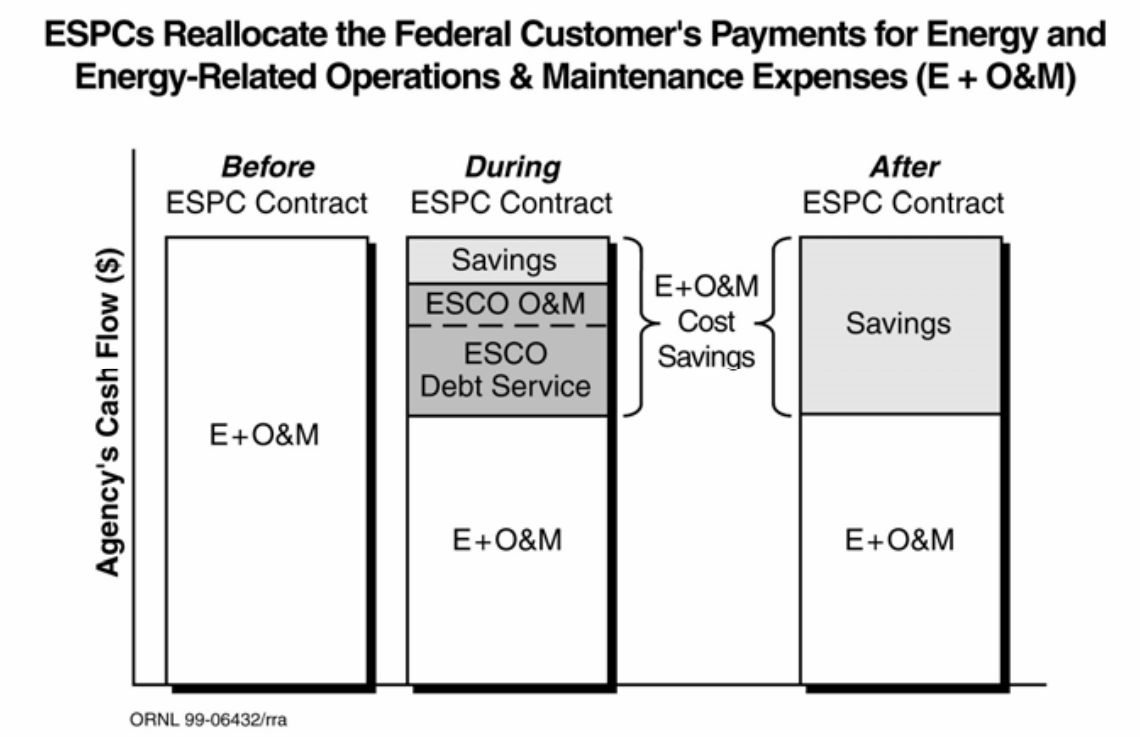


FIGURE 3

- ◊ Some ESPC facts: [30]
- ◊ In use by the Private Sector since early 80's
- ◊ 1st Federal ESPCs in 1995
- ◊ Over 400 Federal projects since then
- ◊ $5.2 Billion in Savings - $1.9 Billion Investment
- ◊ 19 Agencies in 46 States
- ◊ Contract term cannot exceed 25 years

Currently the Forest Service is utilizing ESPC in R2, R4, and FPL. R3 is in the investigative stage. NRS is nearing the completion of investigating the potential application of ESPC for NRS, NA, and select forests in R9.

One characteristic point of ESPC is that it works best for larger projects. Ideal for large federal complexes, such as military bases, ESPC may be a challenge to implement in an environment like Forest Service, with smaller facilities dispersed over wide areas. Even after locations are "bundled" to create a larger project, the finances may still be a challenge for the ESCO.

In the following section, there will be further discussion on the financial considerations of renewable energy.

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FOREST SERVICE – *OFF THE GRID*

Financial Considerations for Moving USFS Facilities to Renewable Energy

Carmine Lockwood,
Grand Mesa-Uncompahgre-Gunnison National Forests

Introduction

The Forest Service has long been recognized as a conservation leader in natural resource management, and appropriately, should demonstrate leadership in moving the nation to energy self-sufficiency, with renewable energy sources playing a significant role. National Forest System Lands contain plentiful renewable energy sources and opportunities for development that could be tapped for meeting renewable energy mandates for federal facilities and benefiting the country as a whole.

A cursory look at economic feasibility factors related to moving FS facilities to renewable energy reveals that the concept of getting all facilities "off-the-grid" is a naive and impractical. There are several reasons for this, including severe shortage of appropriated funding; the small and isolated nature of many of our buildings, the high percentage of leased facilities, and the inability of contractors or partners to develop profitable retro-fits for many facilities. Fortunately, great progress can be made in moving facilities to renewable energy through the use of available creative contracting and partnership mechanisms. The potential is large; by taking the "net-zero" philosophy, the agency could provide the resources and installations that would produce more renewable energy than total energy it consumes. Beyond that, it could satisfy the renewable energy mandates for the entire USDA, and other federal agencies or departments.

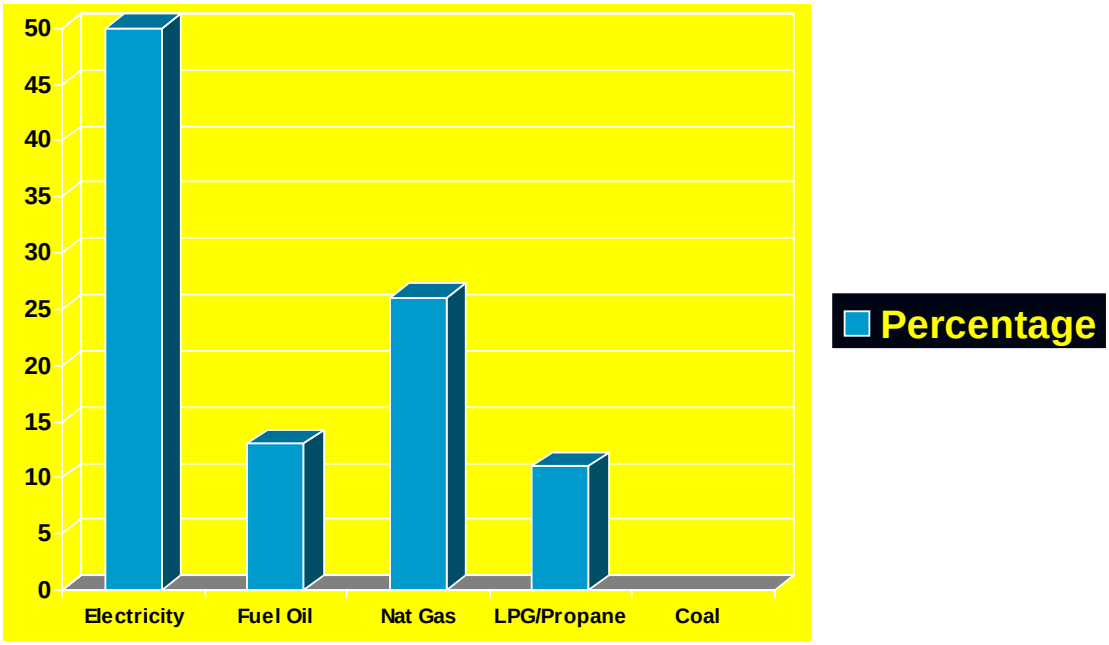
Forest Service Energy Usage

The 2007 calculation of the agencies 2003 base year (for EPAct mandates) shows that the agency has 33.6 million gross square feet of administrative facility space. That figure leads to a relatively small percentage of USDA use and a extremely small percentage of total federal government use.

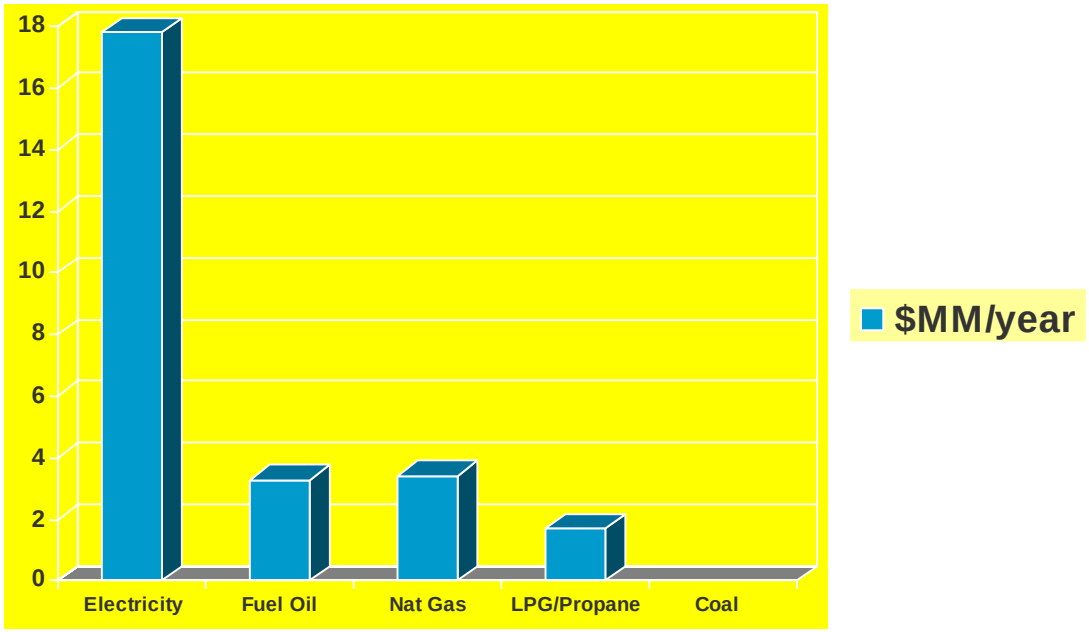
- ◊ 1,434 Billion BTUs
- ◊ 33% of USDA
- ◊ 0.326% of Federal Government
- ◊ 0.00142% of United States
- ◊ Comparable to 15,600 typical households

--based on data from Forest Service 2007,
Energy Information Administration 2005

Energy Consumption by Type



FS Energy Cost by Type ($26.1 million total)



Renewable Energy Certificates/Credits (RECs)

The interplay of renewable energy credits/certificates (RECs) substantially affects the economic desirability and feasibility of many renewable energy projects. For example, most large photovoltaic installations would not be feasible without their REC contribution to a local utility renewable portfolio standard (RPS), or to meet federal policy mandate.

Key points:

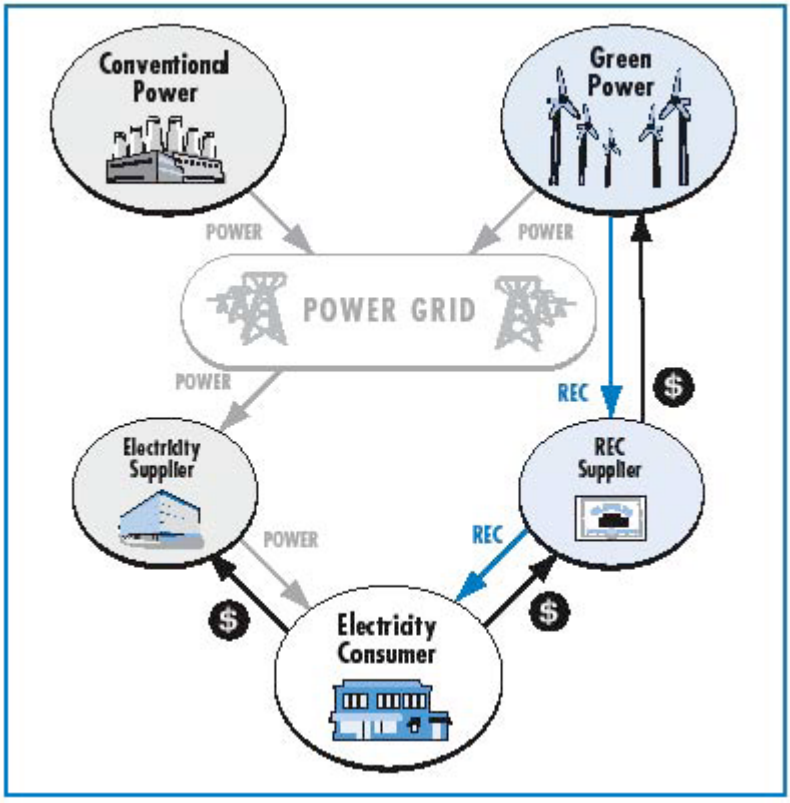
- ◊ RECs help track progress toward legal mandates
- ◊ 7.5% Renewable by 2013 (EPAct 2005)
- ◊ We get them by:
- ◊ Purchasing from utility companies
- ◊ Self-generating, applying on-site, or reallocating
- ◊ We get double credit for renewable installations located on National Forest System Lands (NFSL) or owned administrative sites
- ◊ RECs are critical to the feasibility of many renewable projects

RECs, also known tradable renewable certificates, or green tags, have become an important element of the market for renewable electricity. RECs represent the environmental and other attributes of electricity generated from renewable resources. These attributes may be unbundled and sold separately from the physical electricity.

RECs (and other renewable power purchase options) enable a site to realize the benefits of renewable energy in the near-term without having to deal with the finances and time needed to install an on-site renewable energy system. On-site renewable systems require investment, but provide renewable energy to the site over their lifetime of up to 25 years. RECs are available to any site and may be purchased from renewable generation sources located anywhere in the country. Thus, RECs are a viable option for any location, but are especially useful for sites located in states without a competitive electricity market and/or when the local utility does not offer a green pricing program. Federal agency purchases of RECs were a significant contributor to the Executive Order 13123 federal renewable energy goal, and are planned as one of several means to meet the Energy Policy Act of 2005 renewable energy goal.

REC prices vary, depending on factors such as renewable resource type and location. States with renewable portfolio standard (RPS) requirements typically have higher REC prices due to increased demand. Federal agencies may purchase RECs through either the Defense Energy Support Center or the General Services Administration (GSA). Both have significant experience purchasing RECs. The Western Area Power Administration has a new federal renewable program that is primarily available to agencies in their service territory, encompassing most of the western United States.

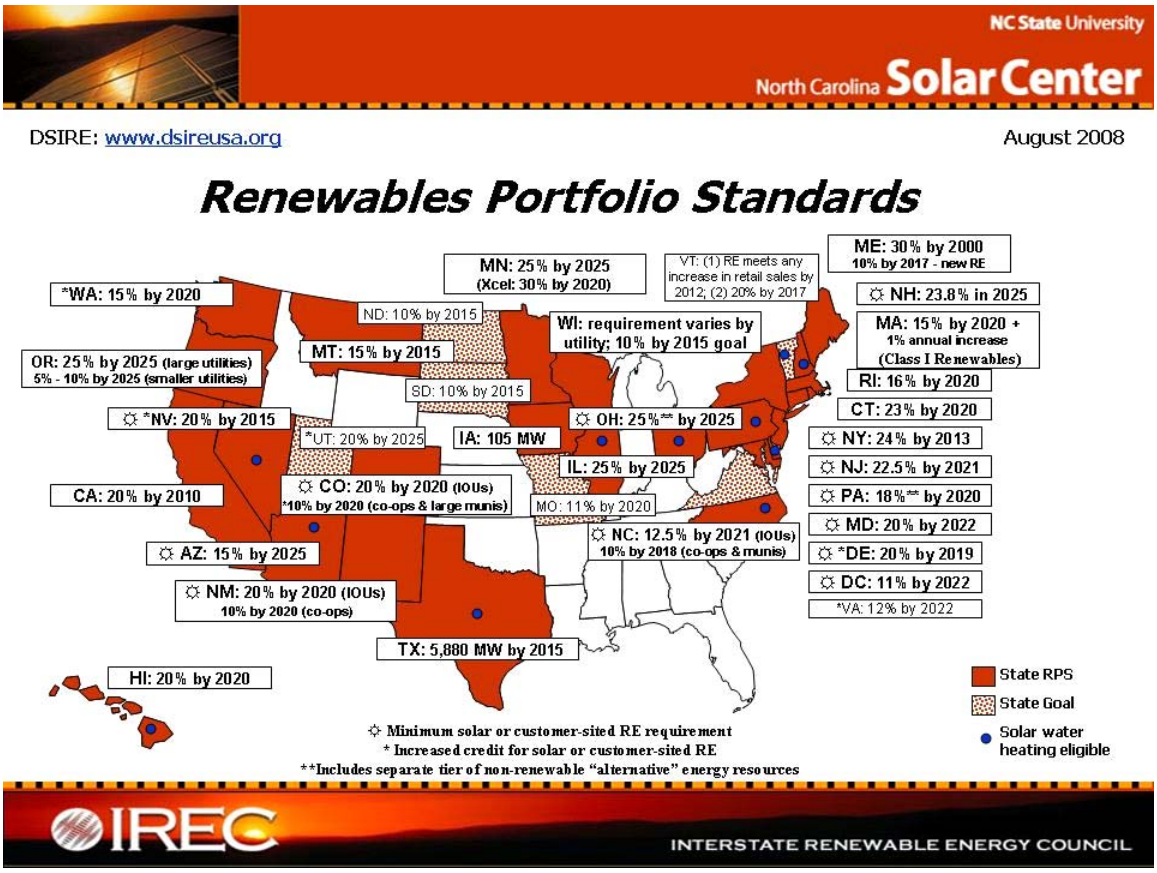
There are several verification and certification programs for RECs and other renewable products that are helpful in providing some assurance that a supplier's claims are accurate and that the product meets minimum standards for quality. Federal agencies are encouraged to include an annual verification audit requirement in their REC purchases.



Renewable Portfolio Standards

The type of program used most frequently by the States is an RPS requiring that some specified percentage of electricity supply be provided by qualifying renewable energy sources (see map below). Most State RPS programs were initiated when privately owned electric utilities were being deregulated, in order to ensure their continued investment in renewables.

Because features of RPS programs and existing electricity supplies differ from state to state, the percentage of renewable energy specified in a given State's RPS does not reveal the actual amount of new renewable energy capacity required. Most of the programs include output from existing capacity; generation supplied from other States; credit trading; and conventional hydroelectric power. Key differences among the States include their definitions of qualifying renewables, alternatives to new renewable capacity, approaches to cost recovery, opt-out provisions, and enforcement mechanisms.



Traditional Methods for Financing Renewable Energy

Financing renewable energy retrofits for Forest Service facilities with appropriated dollars is one option that brings significant tradeoffs. Availability of these funds (Cost Pool (09), Facilities Improvement & Maintenance, CMCM, QMQM), is extremely limited and competition for them intense. Based on the financial analysis of buildings almanac reports (08/01/2008) in the corporate data warehouse (CDW in I-web), the agency is currently carrying deferred maintenance of $582 million, capital improvement needs of $86 million, and annual maintenance of $67 million, for a combined need of over $735 million. The agency is not making much progress in reducing the backlog. Each of those categories has risen, 106, 70, and 47 percent, respectively, since 2000. Total "critical" deferred maintenance is calculated at $114 million, with non-critical at $429 million. Renewable energy retrofits are competing with basic investments to ensure the health, safety, and occupational functioning of facilities. Certainly, when a building gets to the front of the line for improvement or replacement, renewable energy infrastructure can be incorporated into design options, generally more cost-effectively than with retrofits.

Internally, there is tremendous competition for facilities dollars. Forests are being forced to expend resource project dollars to cover emergency facility repairs because there are no facilities or quarters funds available. Externally, the public has their own view as to how investments

should be made, and administrative facilities are likely not at the top of their list. For example, the deferred maintenance estimate for recreation facilities is approximately $178 million nationally. Locally, forests have experienced strong public controversy and outcry over plans to decommission campgrounds and other facilities in need of repair. New PV panels on, or wind turbines near, a ranger district office that is in the process of decommissioning numerous campgrounds probably would not be well received by the public.

Traditional financing methods have their advantages, including: maximum agency control over priority improvements and how they get done; minimal risk – only that associated with typical procurement/contracting; and no finance charges or additional mark-up.

The disadvantages of traditional methods far outweigh advantages, and include:
extreme shortage of required funding, huge amounts of deferred maintenance; very slow rate of accomplishment; and internal and external conflicts on priorities. Note of optimism, occasionally there are micro-grants or partnership dollars available to augment small scale renewable energy installations at individual Forest service facilities.

R1 Example of Traditionally Financed Project

Recently, two photovoltaic panels were installed on the Madison Ranger Station of the Beaverhead-Deerlodge National Forest. Each panel provides two kilowatts of power and cost approximately $15,000 each to install, with an additional $4000 worth of emergency battery back-up. The first PV array was actually funded through a partnership effort with the Greater Yellowstone Coordinating Committee, who provided $4000 in seed money. In response to the enthusiasm, the local utility company contributed $19,000. The second panel was funded through appropriated facilities dollars. The panels provide 12 percent of the office's energy use, saving $750/year at current rates.

Madison Ranger Station PV installation

Alternative Methods for Financing Renewable Energy

"Maximizing energy efficiency and renewable energy is the domestic epicenter in the War on Terror and it is imperative that we maximize the partnerships between the public and private sectors in new and creative ways with a sense of seriousness, national purpose and the urgency the situation merits."
—Alexander A. Karsner, Assistant Secretary for Energy, Efficiency and Renewable Energy

Alternative financing isn't just an "alternative" anymore—it's an essential tool for meeting our federal energy goals. (Federal Energy Management Program website)

Given the dismal outlook for financing renewable energy facility retrofits using traditional appropriated funds, the Forest Service must turn to alternative funding methods if meaningful large scale progress is to be made.

Fortunately, there are a number of contracting and partnership mechanisms available to federal agencies to assist in making substantial progress in converting to or adding renewable energy sources. These include:

- ◊ Energy Savings Performance Contacts (ESPCs)
- ◊ Utility Energy Service Contracts (UESCs)
- ◊ Power Purchase Agreements (PPAs)
- ◊ Other partnerships (corporate, permittee, grants)

Energy Saving Performance Contracts

Energy Savings Performance Contracting (ESPC) is an innovative procurement approach in which savings are captured from the energy and O&M budgets (and guaranteed) for reinvestment to improve the facilities' energy efficiency and provide infrastructure improvements.

An ESPC is a contracting vehicle that allows agencies to accomplish energy projects for their facilities without up-front capital costs and without special Congressional appropriations to pay for the improvements.

An ESPC project is a partnership between the customer and an energy services company (ESCO). The ESCO conducts a comprehensive energy audit and identifies improvements that will save energy at the facility. In consultation with the agency customer, the ESCO designs and constructs a project that meets the agency's needs and arranges financing to pay for it. The ESCO guarantees that the improvements will generate savings sufficient to pay for the project over the term of the contract. After the contract ends, all additional cost savings accrue to the agency. Contract terms up to 25 years are allowed.

Super ESPCs are indefinite-delivery, indefinite-quantity (IDIQ) contracts established by DOE to make ESPCs as practical and cost-effective a tool as possible for agencies to use. These "umbrella" contracts were competitively awarded to ESCOs who demonstrated their capabilities

to provide energy projects to federal customers. The general terms and conditions are established in the IDIQ contracts, and agencies implement projects by awarding delivery orders to the Super ESPC ESCOs. Agencies can implement a Super ESPC project in far less time than it takes to develop a stand-alone ESPC project.

With an ESPC, the ESCo designs, purchases, and installs energy conservation measures. A means to use utility savings to pay project costs. The government buys a "basket" of savings at a fixed price, guaranteed. The basket is detailed by energy conservation measures (ECMs), but the guarantee is for the total. The government pays for savings as they accrue.

Cost Elements of ESPCs are markedly different than traditional procurement or federal contracts because the high proportion of their cost in financing and mark-up. These factors relate primarily to the excessive risk being assumed by the ESCO in guaranteeing the performance of the ECMs they install.

- ◊ Project Development (3%)
  - o Energy surveys, proposal development, etc.
- ◊ Energy Conservation Measures (41%)
  - o Direct costs for design, installation/construction
- ◊ Energy Service Company Markup (25-30%)
  - o Indirect costs and profit
- ◊ Financing Costs (35%)
  - o Interest rate
  - o Finance procurement price
- ◊ Performance-period services (31%)

The key advantages of using an ESPC, include: little up-front capital cost, no special appropriations; simplified procurement by using a single contract to cover multiple facilities across numerous locations; and, guaranteed project cost, savings, and equipment performance. Chief disadvantages: ESPCs may not be a good fit for <u>most</u> Forest Service facilities which are generally small, scattered, and often remote; ESPCs are not applicable to leased facilities which make up 13% of our total gross square footage; ESCO needs to operate at a large economic scale, generally over $1,000,000, which also tends to disqualify certain geographic areas or sites; ESCO—not agency--decides what to include because they're assuming risk; we pay a premium for financing (35%) and high mark-up (25-30%).

<u>ESPC Examples</u>

Region 2 Energy Saving Performance Contract (Phase 1)

The Rocky Mountain region has been leading the agency in use of ESPCs. The ESCO serving R2 is Energy Systems Group, LLC, out of Newburgh, Indiana. A summary of the final proposal for the initial phase (May 7, 2008 submittal), includes:

- ◊ $1,438,102 in Energy Conservation Measures
- ◊ 10.35% Reduction in Electricity Consumption
- ◊ Renewable Energy Projects on 11 Nat'l Forests
- ◊ 4.5% Renewable Energy Usage Credit
- ◊ 1,020 Tons/Year GHG Reduction

The Rocky Mountain Region chose augment the financing of ECMs for the first phase with $489,000 of appropriated dollars. This served to "buy down" the finance costs, and ensure that every forest was given a renewable energy project of some type. The final proposal submitted to the region included the following renewable ECMs:

- ◊ Vertical axis wind turbines (30-40 foot towers, 1-5 kw) on six national forests
- ◊ Photovoltaic power arrays on four sites
- ◊ Wood-fueled furnace to displace propane usage at a tree nursery

The projected initial annual savings from the total ESPC (including all non-renewable ECM retrofits) package is calculated at $20,000 to $23,000, with 15 year cumulative savings of $360, 000 to $416,000, depending on option selected.

Spearfish ESPC Biomass Proposal-- "Renewable Energy from Healthy Forests"

This proposed R2 ECM is featured in this repot because it is likely the most bold and significant move to renewable energy being considered by the agency at this time. This proposal is directly on track with the Chief's emphasis and strategy for biomass utilization, as well as green house gas reductions. The project has made it into the second phase of project development and review. The ultimate disposition of this project will likely be viewed as a bellwether of how serious the agency and public are in their determination to move forward with renewable energy projects and to address forest health/fuels issues at significant temporal and geographic scales.

The plant would be located in Spearfish, South Dakota and its primary feedstock would be biomass from the Black Hills National Forest. The designer/builder/operator is an ESCO named Energy Systems Group, LLC. Specifications include a steam boiler, steam turbine generator, condenser, cooling tower, and electrostatic precipitator, with multi clones fuel-handling equipment. The capital cost would be $43,000,000, with annual revenues of $13,402,800 from power and steam sales, and a potential estimated payment of $4,000,000 back to the Black Hills National Forest to support healthy forest projects. (March 2008 White Paper, Energy Systems Group, LLC).

- ◊ 10 Megawatt Biomass Plant
- ◊ 78,840 Megawatt-hours of RECs produced
- ◊ 50-mile radius working area
- ◊ 5000 acres/year treated
- ◊ 200,000 tons/year of wood/fuel processed

Two of these plants would satisfy the total Forest Service EPact requirement for electricity from renewable sources. Five of these plants would satisfy total USDA requirement.

Plant Objectives:

1. Generate the renewable power needs of the entire USFS at multiple woody biomass fueled plants located on NFS lands.

2. Fund the Healthy Forest Initiative, through the combined proceeds of the plant through sale of power from the plant, and internal sale/allocation of RECs throughout the USFS.

Plant Benefits:

1. Long-Term supply of renewable power.

2. Beneficial use for forest's excess biomass (fuels reduction).

3. Financially supports goals related to the National Fire Plan, Healthy Forest Initiative, and general landscape-scale, sustainable ecosystem management.

Energy Systems Group has identified two other potential locations for this type of project for National Forests in Idaho and Colorado.

The biomass plant would function exactly like all other utility power plants, with the fuel type as the only distinction. Most utility power plants use coal, natural gas, and oil instead of wood to fuel the steam boilers. The technology that this plant uses to generate electricity is standard equipment that has been used and successfully demonstrated for decades.

The fuel, in the form of wood waste, tree branches, and other scraps, would originate from harvested local timber crops, Forest Service stewardship contracts, and sawmills. The electricity that the generator produces would then flows through transmission wires that link the Biomass Plant at interconnection points to the South Dakota Power electric grid.

The air emissions generated from the burning of the wood, would flow through an electrostatic precipitator, which collects dust particles and other particulates. In the wood products industry, the dry electrostatic precipitator, which was preceded by multi clones, is now normally considered the best available control technology for wood-fired boiler emissions.

Region 3 Energy Saving Performance Contract (Phase 1)

The Southwestern Region is in the first phase of its Super ESPC development, with an initial proposal submitted in July 2008. Their ESCO is Honeywell, Federal Government Team, of Cumming, Georgia.

- ◊ Provide the turnkey implementation of $984,000 in self-funding facility infrastructure improvements;
- ◊ Achieve EPACT 2005 / EO 13423 Goals
  - o 11% reduction in electricity
  - o 6.4% reduction in natural gas
  - o 6% reduction in propane
- ◊ Improve comfort and HVAC system efficiency and reliability; and
- ◊ Reduce environmental emissions by: 564 tons/yr CO2; 1 ton/yr NOx; and 5 tons/yr SOx – that's the environmental equivalent of removing 113 cars from the road.

The renewable energy components include photovoltaic lighting systems for 50 restroom facilities, wood burning stove (forest biomass fed) to supplement natural gas heating on a Cibola National Forest warehouse, solar domestic water heating, and 100-plus photovoltaic panels to supply half the load on the new Verde Ranger District Office.

Region 4 Energy Saving Performance Contract (Phase 1)

The ESCO for R4 is also Energy Systems Group, LLC; their initial proposal was submitted in July 2008. Intermountain Region used 10,061 Megawatt-hours of electricity in 2003. The base proposal identifies self funding projects that reduce this by 1,363.7 Megawatt-hours which is a 13.55% reduction in power consumption. This would be significant progress towards the region's goals, with zero impact on Forest or Regional budgets.

The base proposal includes onsite renewable energy (biomass heating) that will produce a minimum of 48 Mega-watt hours (0.48%) of Equivalent Renewable Electricity. However, this energy is generated on Federal Land, so it counts double towards this goal. Therefore, at no additional expense, the Region will get credit for 0.96% renewable energy usage.

As an option not included in the base economics, we have also identified two approaches for using Biomass Heating at the Lucky Peak Nursery located in the Boise National Forest. These solutions are provided under a separate cover for discussion with the Regional Office, the Boise NF and the Lucky Peak Nursery site staff.

The first, a large scale, industrial wood boiler will produce the electrical equivalent of 791.1 Mega-watt hours (7.86%) or 15.72% towards renewable energy goals. The second approach, multiple wood furnaces, is significantly less expensive, but less robust in design. It will produce

the electrical equivalent of 474.7 Mega-watt hours (4.72%) or 9.44% towards renewable energy goals.

The overall financial impact of the base package of self funding projects is:
Base Project (all Forests combined) construction cost $ 877,009; 15 year Savings $ 1,283,467.

The base project conserves 1,363.7 Megawatt-hours of electricity annually, and reduces greenhouse gas emissions by:

- ◊ 614.8 tons/year of CO2
- ◊ 13.58 lbs/year of CH4
- ◊ 20.45 lbs/year of NO2

Utility Energy Services Contracts

"The Utility Energy Services Contract seems to be a logical and economic solution to the agency's national crisis of aging/inefficient structures, and can become a favorite tool in our box to become a national model of renewable energy production." (Tim Dedrick, Civil Engineer, Lassen National Forest, developer of R5 UESC model agreement with Southern California Edison)

One of the best ways for Federal agencies to implement efficiency and renewable energy projects is through partnerships with their franchised or serving utilities. Federal agencies often enter into utility energy service contracts (UESCs) to implement energy improvements at their facilities (FEMP website).

With a UESC, the utility typically arranges financing to cover the capital costs of the project. Then the utility is repaid over the contract term from the cost savings generated by the energy efficiency measures. With this arrangement, agencies can implement energy improvements with no initial capital investment; the net cost to the Federal agency is minimal, and the agency saves time and resources by using the one-stop shopping provided by the utility.

The Energy Policy Act of 1992 authorizes and encourages Federal agencies to participate in utility energy efficiency programs offered by electric and gas utilities and by other program administrators (e.g., state agencies). These programs range from equipment rebates (i.e., utility incentives) to delivery of a complete turnkey project. Federal legislation and numerous legal opinions demonstrate that agencies have full authority to enter into utility energy service contracts as well as take advantage of utility incentive programs.

More than 45 electric and gas utilities have provided project financing for energy and water efficiency upgrades at Federal facilities, investing more than $600 million through utility energy services contracts since 1995. The Edison Electric Institute has committed to encouraging $2 billion in private investment funding by 2010 for life-cycle, cost-effective Federal facility improvement projects. In fiscal year 2000, $157 million in private-sector investments generated

$35 million in savings at Federal facilities. These projects are now paying for themselves from a share of the cost savings resulting from efficiency improvements.

The Pacific Southwest Region, owing to the commitment of some key employees who are passionate about energy efficiency, has taken the agency lead in developing and utilizing UESCs. A model "master agreement" was developed between Southern California Edison and the Forest Service which covers approximately 35 percent of the region's facilities. Recently, a second agreement, covering an additional 40 percent of the region, was executed with Pacific Gas & Electric. According to one of the principle negotiators, the biggest challenge in getting the agreement finalized was incorporation of language to demonstrate compliance with Federal Acquisition Regulations. These agreements have the potential to yield huge savings in energy costs and GHG emissions.

Power Purchase Agreements

On-Site Renewable Energy Projects with Innovative Private Financing (excerpts from Chandra Shah, NREL)

Several federal agencies are in the process of developing on-site photovoltaic (PV) projects utilizing an innovative business model that could be the solution. Under this model, a private entity finances the PV equipment and installation, and provides O&M for the term of the contract. The PV system is privately owned and the federal site purchases the electricity through a long-term power purchase agreement (PPA). While the project examples in this article involve PV systems, this contractual arrangement could also be used for other types of renewable projects.

This is an attractive business model for several reasons. The primary benefit is that a private entity is eligible for various tax and other incentives that may not be available to a federal agency. In addition, the site does not have to provide up-front capital for the system. Finally, the long-term electricity contract helps federal agencies stabilize a portion of their electricity costs – an important benefit given energy market volatility.

FEMP is exploring the possibility of utilizing Western as the contracting agent for other on-site renewable projects at federal sites within Western's service territory (see http://www.wapa.gov/regions/default.htm). The short-term focus will be on the California market due to the attractive PV incentives that allow the site to retain the RECs.

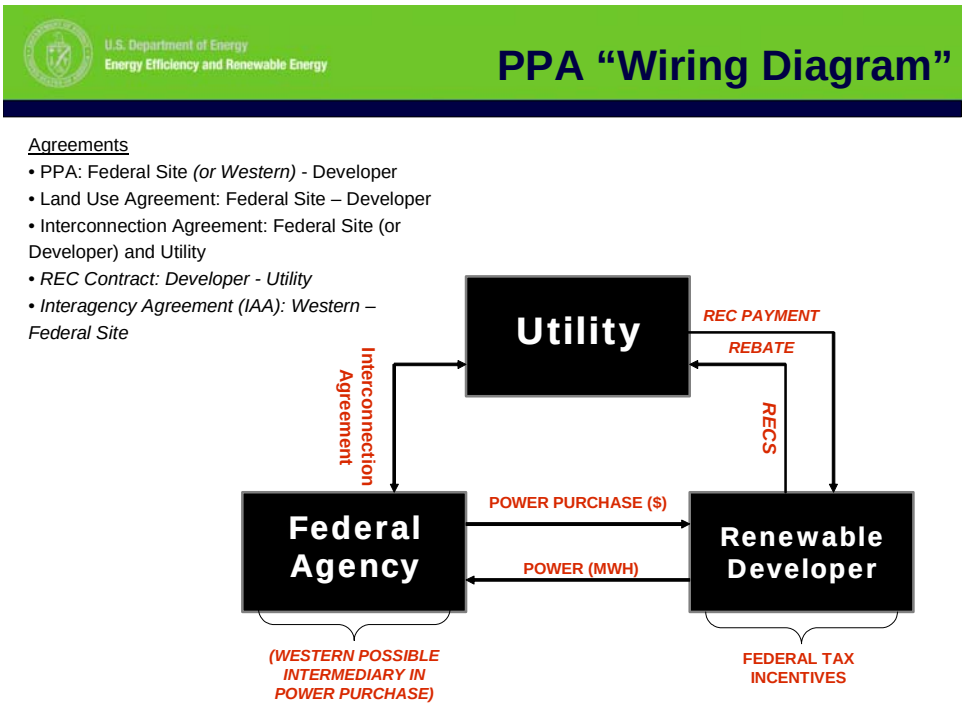
Cost-effective renewable opportunities depend upon a number of factors, including the utility rate and rate structure, available incentives, and whether there is a solar set-aside as part of the state renewable portfolio standard (thus creating a solar REC market). A site will need to consult with their serving utility to determine if the PPA model is allowable. While a federal agency can also utilize appropriations, when available, to develop a renewable project; third party financing

will facilitate the widespread development of renewable energy throughout the Federal government.

Within this framework, a private entity installs, owns, operates and maintains customer-sited (behind the meter) renewable equipment. The agency purchases electricity through power purchase agreement (PPA). PPAs can also be done within an ESPC or UESC – called an "Energy Services Agreement (ESA)." Key advantages include:

- ◊ Private entity eligible for tax incentives (note that federal investment tax credit reverts from 30% to 10% at end of year – extensions being considered in Congress)
- ◊ No agency up-front capital required
- ◊ RE developer provides O&M
- ◊ Contract directly with RE developer - minimizes overhead/profit costs
- ◊ Minimal risk to government

Potential challenges may relate to: limited federal sector experience with this new process; development of land use agreement – lease, easement, license, other; contract length limitations likely (agency authorities vary); development of site access, environmental, safety, and security provisions; and, NEPA requirements



Federal agencies interested in developing an on-site renewable project utilizing this innovative business model should contact Chandra Shah at 303-384-7557 or chandra_shah@nrel.gov

PPA Example: Fort Carson PV Project

- ◊ 2 MW, 3200 MWh in first year (~2% of Ft. Carson's load)
- ◊ Fixed, non-escalating energy rate
- ◊ Western Area Power Administration is contracting agent
- ◊ 17 year contract, with 3 year option
- ◊ No cost lease (using 10 USC 2667 lease authority)
- ◊ Developer sells RECs to Xcel Energy for RPS solar set-aside (20 year contract)
- ◊ Ground-mounted, fixed system covering 12 acre former landfill
- ◊ First Solar thin film, 25 year warranty

(Fort Carson PV installation)

Creative Partnership Agreements

One any given site, unique circumstances or partnership relationships may exist that can inspire or facilitate the opportunity to develop and implement renewable energy applications. Circumstances may relate to proximity of potentially tapped resources, such as streams for micro-hydro generation or abundance of reliable wind. Relationships may include cooperative permittees or local benefactors with personal interests in seeing renewable energy projects done. One recent example has come to the fore on the White River National Forest in Region 2.

Snowmass Ski Area Wind Proposed Wind Energy Partnership

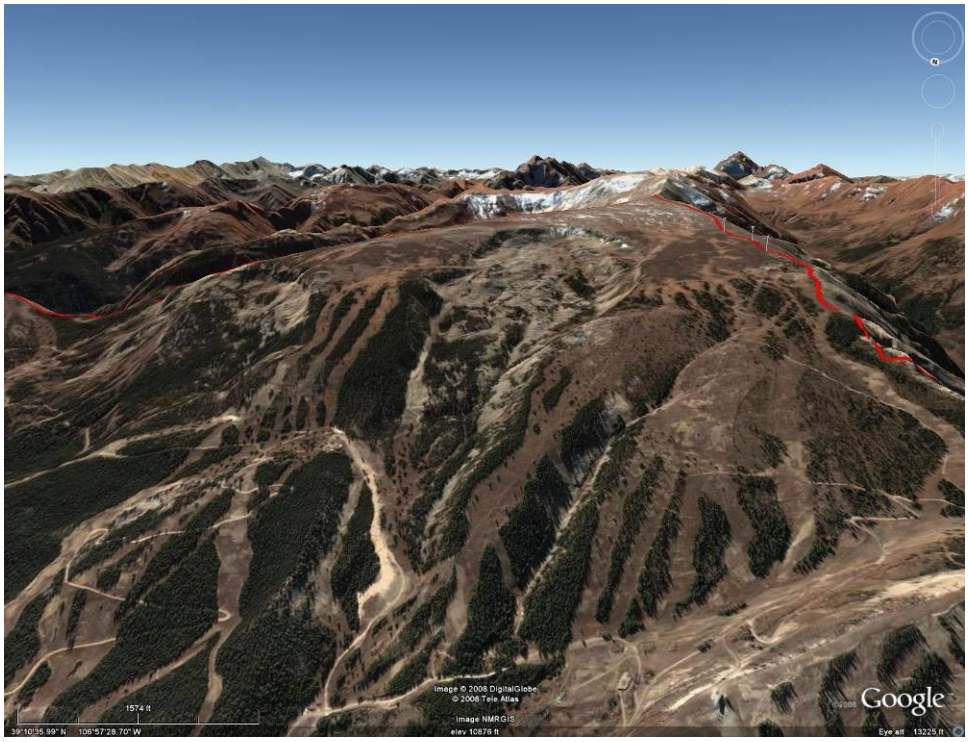
The White River National Forest and Aspen Skiing Company are partnering to study and hopefully construct, a 3-turbine, 5.1 megawatt, wind energy project above "the Cirque" terrain of the Snowmass Ski Area. A study tower has been installed this summer to confirm the annual reliability of the wind patterns. If completed the, project would power two-thirds of the company's total energy needs, including four mountain operations and base facilities (administrative and guest accommodations). Currently, the company boasts of using green power, but it buys wind credits from Xcel Energy, rather than hosting actual turbines. "It's the real deal," said Auden Schendler, executive director of sustainability for the company, "We're always in what's real instead of offsets and credits."

The prominent ridges of ski areas are often good potential wind power sites because of their exposure and proximity to existing roads and power transmission lines. The project would be financed by the Forest Service permittee (Aspen Skiing Company), and specifications would include:

- ◊ Three 1.7 MW Turbines, 65 meter hub height, 70 meter rotor diameter
- ◊ 9,786 megawatts/year renewable energy credit
- ◊ $ 23,600,000 Net Present Value
- ◊ 8,535 tons/yr GHG reduced

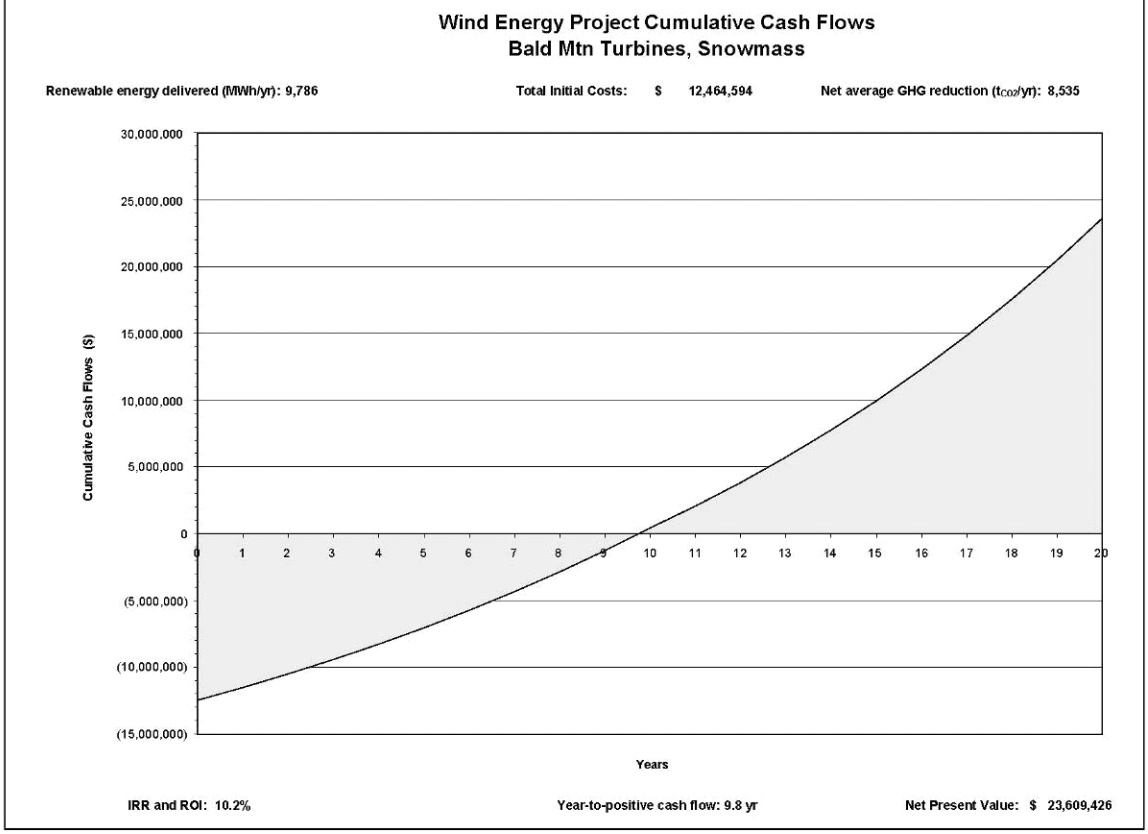
Thus far, outreach to community stakeholders, including several environmental organizations, has shown support for the project, despite the close proximity of the turbine sites to the Maroon Bells/Snowmass Wilderness boundary.

Issues remaining for the project include land us permitting, ownership of renewable energy credits, and NEPA compliance. This project has the potential to be precedent setting for Forest Service permitted ski areas. [Jiminy Peak Ski Area in Massachusetts has a 1.5 megawatt turbine]. As with the Spearfish biomass proposal, it will be a "put-up, or-shut-up" moment for how willing the public is to accept some environmental impact on public lands, to achieve renewable energy production and energy self-sufficiency in this country.



RETScreen® Financial Summary - Wind Energy Project

Cumulative Cash Flows Graph



Evolving Financial Picture

The planning and financing environment for renewable energy projects is rapidly changing. This report will be obsolete the day it is delivered to Senior Leader Class administrators. Political, social, and economic factors include:

- ◊ Looming federal legislation on carbon tax, or cap and trade
- ◊ State legal / regulatory frameworks on tax credits or renewable portfolio standards
- ◊ Evolution of Forest Service Strategic Plan objectives and measures to elevate priority of renewable energy installation or resource development
- ◊ Global politics and conflict that may upset or strain world oil supply

All of these factors will likely act to mandate or foster (i.e., subsidize) a more conducive economic climate for renewable energy retrofitting of agency facilities, and developing national forest renewable energy resources to meet the country's needs.

Strategic Recommendations for Financing Alternative Energy

Encourage use of contracting and partnership funding mechanisms

Despite what is likely to be a more economically friendly climate in the future, there will never be enough appropriated dollars to meet the agency's deferred maintenance, capital investment, and annual maintenance needs. ESPCs, UESCs, PPAs, and other creative partnerships can likely go a long way in meeting the agency's renewable energy goals.

Go big to get maximum payoffs toward goals and mandates

Capitalize on the wealth of renewable energy resources and development opportunities on National Forest System Lands to meet Forest Service, USDA, and all federal government goals for renewable energy contributions. The Forest Services manages lands that are more than capable of meeting renewable energy mandates, without compromising other basic multiple resource values and uses. Through propagation of projects such as the Spearfish Biomass Plant, Snowmass Wind Turbines, and many others, the Forest Service truly could be the conservation leader in renewable energy application and generation for the federal government. "Off-the-grid" is a cliché that has little application to federal renewable goals. "Beyond net-zero" is perhaps a catch phrase that could be more inspiring and realistic in moving the agency past its goals in this arena.

Contributors to this Section

What progress the Forest Service has made in moving its facilities to renewable energy is largely attributable to the hard and dedication of a few key champions who harbor a strong passion for this effort. This intensity was apparent in the following individuals who provided the bulk of the source information used above:

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Main source of general technical information on financing federal renewable energy projects: Federal Energy Management Program websites--

http://www1.eere.energy.gov/femp/

http://www1.eere.energy.gov/femp/newsevents/fempfocus_article.cfm/news_id=11218

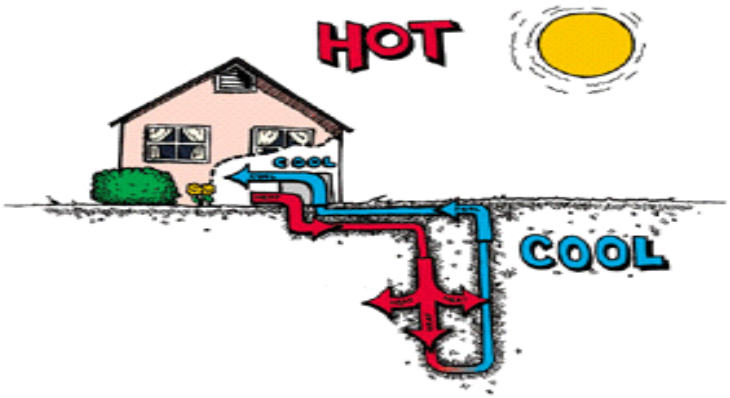
Environmental Impacts and Security Issues

Steve Ruppert
LE&I, Region 8

Environmental Impacts

The very high price of being a "civilized nation" is now being paid by our environment. With all of the comforts and technology now expected and demanded it is unrealistic to believe that humanity, as we know ourselves, can do without those amenities. We have created a huge environmental impact on our world, and yet our very national security depends on maintaining the advancements that have been made. It is now our responsibility to minimize the damage done, and find better, more eco-friendly ways to sustain our way of life. The immediate focus is reducing the U.S. Forest Service demand on traditional energy sources. With alternative energy sources, we can better position ourselves for a net zero energy consumption. One dimension of this process is to consider the additional environmental impact of the available alternative energy solutions primarily geothermal, wind, hydropower, solar, and biomass. Another concern to address is the security risk and benefits associated with those solutions.

Going Green is at the forefront of discussions nationwide both in the public and private sectors. A look at where we've been may hold the key to where we need to go. "In the United States in 1994, electric utilities accounted for 35 percent of the carbon dioxide emissions from fossil energy consumption and almost 10 percent of the total, 66 percent of the nitrous oxide emissions from stationary sources, 70 percent of the U.S. sulfur dioxide emissions (the main cause of acidic precipitation), 33 percent of our nitrogen oxide emissions (which induce formation of ground-level ozone), and 20 percent of the anthropogenic releases of gases linked to the atmospheric greenhouse effect." [1] We shift our focus to more environmentally friendly alternatives.



Geothermal energy which accounts for 0.25% of the annual world-wide energy consumption [2] is a viable energy option with minimal environmental impacts compared to conventional energy sources. Some environmental considerations with this energy option include land use, noise pollution, chemical pollution, ground subsidence, scenery spoliation, drying out of hot springs and destruction of geyser activity.

Land use typically is 1-8 acres/MW (megawatt), comparatively less than nuclear (requiring 5-10 acres/MW) or coal (19 acres/MW). [3] Noise pollution is typically a result of the construction phase and not of significant concern thereafter. Depending on the system used, chemical pollution may or may not be of significant concern. Closed-loop, a more expensive system, contains gas and fluid emissions and injects them back into the ground. Open-loop "can generate large amounts of solid wastes as well as noxious fumes. Metals, minerals, and gases leach out into the geothermal steam or hot chemical released when geothermal fields are tapped for commercial production can be hazardous or objectionable to people living and working nearby." [4]

Destruction of geyser activity, ground subsidence, and scenery spoliation can be the result of changing water levels where geothermal energy is used. "Destruction of rare geyser activity as a result of changing the water levels has proven to be an environmental liability. Electricity generation from geothermal resources has ended the eruptions from the second-and third-largest geyser fields in the 50 States. By 1987, the Beowawe Geyser Field in central Nevada and the Steamboat Springs geyser field, located several miles south of Reno, Nevada, no longer supported geyser activity." [5] Ground subsidence occurs when the "geothermal fluids are drawn from a reservoir at a rate greater than the natural inflow into the reservoir. This net outflow causes rock formations at the site to compact leading to ground subsidence at the surface. Ground subsidence can affect the stability of pipelines, drains, and well casings It can also cause the formation of ponds and cracks in the ground and, if the site is close to a populated area, it can lead to instability of buildings." [6] Another option to consider is the implementation of wind energy.

As of December 31, 2006, 36 states have wind-energy projects that provide about 1% of the U.S. electricity. "According to current projections for use of wind energy in 2020, use of the technology could reduce the energy sector's emissions of carbon dioxide by about 4.5% in 2020."[7] The environmental impact of wind turbines is minimal and local. They include land-use conflicts, noise, visual aesthetics, threats to wildlife, and erosion.

Land-use conflicts result primarily in forested areas where it may mean clearing trees and cutting roads unless heavy logging in the area has already occurred. [8] Noise created by wind turbines is primarily related to early designs. "Aerodynamic noise has been reduced by changing the thickness of the blades' trailing edges and by making machines "upwind" rather than "downwind"...a wind turbine 300 meters away is no noisier than the reading room of a library." [9] There is no evidence that wind turbines promote or deter tourism. However, the aesthetic impacts could affect property value in an area where one might wish to "experience life in a remote and relatively untouched area." [10] The threat to wildlife is the most controversial environmental impact. The 125-foot turbine blades kill both birds and bats. "Out of a total of perhaps 1 billion birds killed annually as a result of human structures, vehicles and activities, somewhere between 20,000 and 37,000 died in 2003 as a result of collisions with wind-energy facilities." [11] Efforts to address this issue include careful site selection considering migration patterns. Proper installation can prevent erosion, but it can be a concern in desert habitats, for example, where hard-packed soil is disturbed; or in mountainous ridgeline habitats primarily in the Eastern United States. [12] A third, but perhaps the least viable alternative is hydropower.

"Hydropower accounts for 98% of renewable energy in the United States. Wind, solar, and other sources account for the other 2%." [13] As stated by the Union of Concerned Scientists, "The impact of large dams is so great that there is almost no chance that any more will be built in the United States." [14] Due to the variations in hydroelectric projects, the environmental impacts are similar with some location specific attributes. Some of the impacts cause changes to the ecosystem which include the creation of reservoirs leading to stratification, supersaturation, changing water levels, greenhouse gas emission, silt sedimentation and erosion. Another impact involves changing habitat conditions affecting fish and wildlife. Reservoirs are created as water storage areas. This generally disrupts the natural river flow. In reservoir areas, stratification occurs when the surface temperature of water absorbs more heat from the sun and the colder, denser water sinks to the bottom. This colder water is oxygen-depleted, and when released, the downstream habitats change. [15]

Supersaturation occurs when water spills over a dam. This turbulent activity traps air in the water causing "lethal gas bubble disease" in some fish. [16] "A few recent studies of large reservoirs created behind hydro dams have suggested that decaying vegetation, submerged by flooding, may give off quantities of greenhouse gases equivalent to those from other sources of electricity." [17] Sedimentation issues are two-fold; the collection of sediments behind the dam

can create “nutrient loading” which reduces the oxygen level and also depletes needed nutrition down-stream. Erosion occurs as a result of the changing water levels and a lack of streamside vegetation. [18]

Fish migration and wildlife habitats are affected by hydropower systems. Fish lifts and ladders aid in migration. However, “when fish are trucked or barged around the dams, they may experience increased stress and disease and decreased homing instincts.” [19] Wildlife habits are temporarily or permanently lost when hydroelectric projects are built. Lost vegetation habitats for birds and mammals force them to move to higher ground where predators are more prevalent. [20] Moving back into more feasible alternatives, consideration is given to solar power.

Solar power has the least environmental impact of the proposed options. In addition, it produces fewer pollutants than conventional fossil fuel technologies. [21] As reported by the Northeast Sustainable Energy Association, “electricity produced from photovoltaic cells does not result in air or water pollution, deplete natural resources, or endanger animal or human health.” [22] Though the electricity itself does not present much environmental impact, other aspects of solar power do. These include the toxic chemicals used in production, production and transportation emissions, potential toxic fume hazard to firemen, disposal of materials when panel use has ended, and land use for utility-scale solar power plants.

Science Daily reports that “manufacture of photovoltaic cells requires potentially toxic metals such as lead, mercury and cadmium and produces carbon dioxide, which contributes to global warming. Vasilis M. Fthenakis and colleagues gathered air pollution emissions data from 13 solar cell manufacturers in Europe and the United States from 2004-2006. The solar cells include four major commercial types: multicrystalline silicon, monocrystalline silicon, ribbon silicon, and thin-film cadmium telluride. The researchers found that producing electricity from solar cells reduces air pollutants by about 90 percent in comparison to using conventional fossil fuel technologies.” [23]

The main issues, environmental, health, and safety, occur during manufacturing, installation and disposal of the product. “Materials used in some solar systems can create health and safety hazards for workers and anyone else coming into contact with them. In particular, the manufacturing of photovoltaic cells often requires hazardous materials such as arsenic and

cadmium. Even relatively inert silicon, a major material used in solar cells, can be hazardous to workers if it is breathed in as dust. Workers involved in manufacturing photovoltaic modules and components must consequently be protected from exposure to these materials. There is additional-probably very small- danger that hazardous fumes released from photovoltaic modules attached to burning homes or buildings could injure fire fighters." [24]

Due to the toxic chemical used in making photovoltaic panels, "disposal at the end of their useful life is another potential environmental issue. Now, only a small volume of PV panels is disposed of each year, so this is currently a minor issue. But the industry is already looking ahead toward recycling methods for future PV panels." [25]

"The large amount of land required for utility-scale solar power plants – approximately one square kilometer for every 20-60 megawatts (MW) generated – poses an additional problem, especially where wildlife protection is a concern. Solar-thermal plants (like most conventional power plants) also require cooling water, which may be costly or scarce in desert areas." [26] The final energy alternative to be examined is the use of biomass.

The pulse of the Forest Service comes from the management of the forests. Biomass is an energy alternative that is of considerable interest. An immediate observation would be the potential reduction of forest fire fuels left in logging and other forest areas. There are, however, environmental impacts that need to be considered including habit reduction, air pollution, land use and others.

"To many people, the most familiar forms of renewable energy are the wind and the sun. But biomass (plant material and animal waste) supplies almost 15 times as much energy in the United States as wind and solar power combined—and has the potential to supply much more. Forest wastes are the largest source of heat and electricity now, since lumber, pulp, and paper mills use them to power their factories. One large source of wood waste is tree tops and branches normally left behind in the forest after timber-harvesting operations. Some of these

must be left behind to recycle necessary nutrients to the forest and to provide habitat for birds and mammals, but some could be collected for energy production."[27]

"Biomass power, derived from the burning of plant matter, raises more serious environmental issues than any other renewable resource except hydropower. Combustion of biomass and biomass-derived fuels produces air pollution; beyond this, there are concerns about the impacts of using land to grow energy crops. How serious these impacts are will depend on how carefully the resource is managed. The picture is further complicated because there is no single biomass technology, but rather a wide variety of production and conversion methods, each with different environmental impacts." [28] The Bioenergy Feedstock Information Network lists the following environmental impacts that may occur if unmanaged natural forests or forests managed for low intensity uses are removed and replaced with short-rotation biomass plantations. They include:

1. Increased erosion and reduction of water quality as a result of forest harvesting;
2. Increased rates of runoff and decreased water-holding capacity;
3. Increased chemical pollution from fertilizers and pesticides;
4. Degradation of soil quality and productivity; and
5. Reduction of biodiversity through alteration of forest structure, creation of tree monocultures, and use of non-native tree species which local wildlife are unable to use.

Their report continues, "Forestry codes and plantation management procedures currently being developed and implemented around the world generally prohibit the conversion of natural forest to forestry plantations. Many of the natural forests occur on relatively poor soils, and destruction of natural forests is now recognized to have environmental costs in terms of biodiversity, environmental quality, and economic sustainability that far outweigh short-term economic gains from forest clearing." [29]

The Food and Agriculture Organization of the United Nations have narrowed their findings of environmental impacts. Two include site productivity and biodiversity. They state, "A commonly-expressed environmental concern about harvesting biomass for energy is that soil nutrients, organic matter and moisture-holding capacity may be depleted by intensive harvesting methods. Protection of soil relies on careful harvesting practices to reduce physical soil disturbance and compaction or removal of organic matter layers on the soil surface. Where roads and extraction tracks disturb organic layers, there is a need to manage water flows and runoff to reduce contamination of streams and waterbodies by soil and silt. Soil compaction, which reduces the extent and time of root growth, can be minimized by operating when soils are dry or frozen and by avoiding repeated passes of heavy equipment." [30]

Biodiversity conservation emphasizes protection of critical habitats and balance of vegetation structure, growth stages and forest ecosystems over time. The FAO also highlights the danger to wildlife habitats due to harvesting practices. They further indicate, "Experience in biomass production has shown that a normal utilization of residues after forest operations has little

negative impact on biodiversity, while the use of forest residues is environmentally beneficial because it replaces fossil fuels as an energy source." [31]

In conclusion, the environmental footprint we are currently leaving on our planet cannot be erased, but through alternative energy resources we may be able to displace and reduce some of the impact currently experienced. There is no "perfect" energy alternative. Solar, wind, water, geothermal and biomass do, however, offer less environmentally damaging options than that of fossil fuels of which we are so dependent upon now. Due to the complex environmental structure and the vast variety of landscape across this nation, consideration must be given to all renewable energy sources as some may not be viable in certain areas. The decentralization of our energy efforts will have a direct effect on the United States' national security as well.

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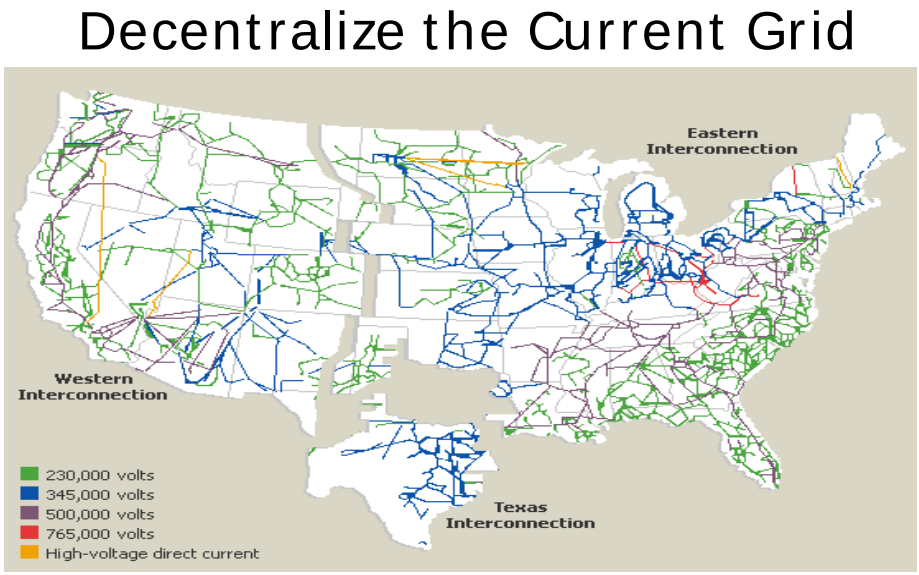
Security Issues

Security threats, in regards to alternative energy sources, are only limited to the imagination of terrorist and environmental activists/vandals focused on a particular damaging mission. "Fossil fuels—coal, oil and natural gas—are increasingly expensive and consumed in ever-increasing amounts. Oil and gas imports from foreign sources raise concerns over long-term energy security." [1] When considering the alternative energy sources of geothermal, solar power, wind turbines, and biomass, the inevitability of local vandalism or damage done by natural forces greatly outweighs that of an organized outside terrorist threat. For all practical purposes, decentralization of our energy resources provides the most sustainable alternative with minimal national security risk.



Geothermal alternatives for Forest Service office application have the least threat of vandalism due to the nature of the design. The units are installed indoors and are protected from "wear and tear from rain, snow, ice, debris, extreme temperatures or vandalism." [2] Limited components of the unit are exposed and could be damaged from inside the building but the likelihood is greatly diminished. This resource is available locally reducing current importing and transportation costs of fuel and maintaining the security of the supply. [3] Geothermal units have few mechanical parts; therefore, the units are very durable, highly reliable and low maintenance. [4] The highly durable pipes used in this type of heating system generally carry 25- to 50- year warranties contributing to their sustainability. "While many parts of the country experience seasonal temperature extremes – from scorching heat in the summer to sub-zero cold in the

winter – a few feet below the earth's surface the ground remains at a relatively constant temperature." [5] This benefit, in addition to the retrofit ability to existing properties, makes this energy alternative quite appealing.

GEOTHERMAL SECURITY CONSIDERATIONS:

- ✓ Industrial size geothermal facilities would need to be designated as secure sites, off-limit to the public. This may include on-site security personnel, fencing, and sensory-type monitoring.
- ✓ Office size geothermal units would require no additional security other than a locked door on the mechanical room with access only for authorized personnel.

Solar power, in addition to geothermal power, is also a location-specific energy alternative. It would be virtually impossible for a mass threat of terrorism on this type of power. Local vandalism is the more imminent concern.

As reported in The Dickinson (North Dakota) Press, vandalism of a local coal company's solar panel and battery box was incurred from bullet holes and indentations incurring over $1,150 in damage. [6] In an unrelated incident in Idaho, the Bureau of Land Management incurred damage to their solar panels by vandals throwing rocks. This simple act "crippled the main Fire/Field Communications Site near Lucky Peak." The article further states, "This communications site is crucial to our Fire Dispatch Center which serves the entire Boise District area of almost 4 million acres of public land in southwestern Idaho." At the date of the article in August, 2007 it explained this was only the most recent vandalism to this site. It previously incurred damage to eleven solar panels at a replacement cost of $12,000. [7] Solar power should still be considered a viable option and some companies do offer a "vandalism proof" solar panel at additional cost. [8]

The Denver Federal Center in Lakewood, Colorado, recently installed a solar park embracing green technology. "The U.S. General Services Administration will build a one-megawatt system that will generate nearly 10 percent of the one square mile campus' peak electric demand. The power generated by this system is the equivalent to powering approximately 145 homes each year." The land use dedicated to this technology is six acres. Xcel Energy Vice President of Marketing, Fred Stoffel said, "The size of this project shows that solar power can be done on a

medium-sized level and that the government can set a tremendous example by leading the way." [9]

SOLAR POWER SECURITY CONSIDERATIONS:

- ✓ Industrial size solar facilities would need to be designated as secure sites, off-limit to the public. This may include on-site security personnel, fencing, and sensory-type monitoring.
- ✓ Office size solar units would require some additional security due to the external exposure. This may include fencing and sensory monitoring equipment. Detached solar units would need to be located in an area designated as off-limit to the public.

Wind energy is another viable option to decentralizing the nation's energy source. Advantage Labs, located in Minneapolis, MN, provide the following on-point information, "Wind turbines diversify our portfolio and reduce our dependence on foreign fossil fuel. Wind energy is homegrown electricity, and can help control spikes in fossil fuel cost. Distributed generation facilities, like many community wind projects, provide a safeguard against potential terrorist threats to power plants. A significant contribution to the worldwide energy mix can be made by small clusters of turbines or even single turbines, operated by local landowners and small businesses. Developing local sources of electricity means we import less fuel from other states, regions, and nations. It also means our energy dollars are plowed back into the local economy."[10] As with other alternative energy sources, wind energy is not infallible.

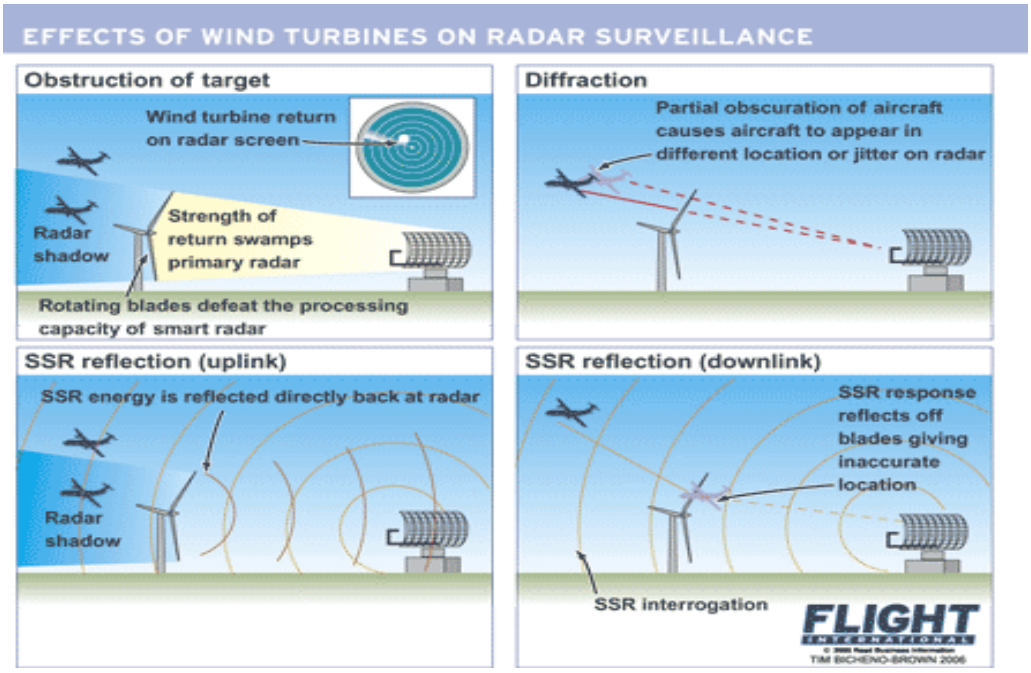
Wind turbines are designed to create power through the existence of normal wind conditions and can produce energy up to 30 years. "Most wind turbines are designed to withstand wind speeds up to 100 miles per hour (mph), but they can be damaged in extremely high winds during hurricanes or tornadoes, especially if objects are blown into the turbine. One advantage of tilt-up towers is that they can be lowered during hurricanes, reducing the likelihood of damage." [11] Another safety and economic concern is fire damage. One example occurred in Palm Springs, Florida. A windmill fire caused $750,000 in damage, spot fires and falling debris. [12] In another Florida fire near Garner, a wind turbine fire in the gear compartment caused two blades and other debris to fall to the ground. However, the damage was localized to the one wind turbine of the 148 turbines in the 80-square-mile Hancock County Wind Farm leaving others operational. "The turbines are all connected on different circuits so it is possible that four or five other turbines were taken out of service because of the fire," said Steve Stengel, a spokesman for Florida Power and Light. The cause of the fire was unknown. [13]

LM Glasfiber, a world-wide manufacturer of wind turbine products, states that "lightning strikes are a wind turbine's worst enemy. Without effective lightning protection, both the blades and turbine itself can be severely damaged by the powerful energy surges in lightning. A lightning strike on an unprotected blade can lead to temperature increases of up to 30,000 degrees C. and result in an explosive expansion of the air within the blade. This can cause damage to the blade

surface, delamination, cracking on both the leading and trailing edge, as well as melted glue. Lightning strikes can also cause hidden damage that over time will result in a significant reduction of the blade's service life." [14]

Vandalism, theft and liability of wind turbines must also be considered when evaluating this energy alternative. Mick Sagrillo, of Sagrillo Power & Light Co. provided the following information to the American Wind Energy Association. "While theft of an entire wind system seem implausible, there have been claims filed for individual components that have disappeared, both on the ground as well as atop the tower. Vandalism is probably the biggest concern for wind turbine owners. The most frequently filed vandalism claim involves guns being fired at turbine blades or generators. In either case, damage can be substantial. I have also repaired damage which has been traced to juveniles undoing guy cables which caused a guyed tower to come crashing down." He further covered liability coverage, "while claims in this area are extremely rare, the possibilities include such things as a blade flying off or a tower falling down, thereby causing damage to someone else's property. The second concern centers around personal injury or death. Again, this could happen if a blade flew off the wind system or if the tower fell down. However, it could also happen if someone fell from the tower, or someone was electrocuted while working on or nearby the system." [15]

Perhaps the most imminent security concern is actually created as wind farms are completed. Worldwide security concerns have been raised regarding the potential military radar interference wind farms produce.



"Wind turbines create a hole in radar coverage, so that even aircraft at higher altitudes cannot be detected," states British Minister of Defence Chris Breedon. Continuing he says, "This obscuration occurs regardless of the height of the aircraft, of the radar and of the turbine." [16] Considerable consideration must be given that these are not constructed within the line-of-sight of radar stations.

WIND POWER SECURITY CONSIDERATIONS:

- ✓ Wind turbine facilities would need to be designated as secure sites, off-limit to the public. This may include on-site security personnel, fencing, and sensory-type monitoring.
- ✓ To reduce the threat of vandalism (target shooting, etc), a quarter-mile buffer strip would need to be established around the perimeter.
- ✓ To decrease the impact of catastrophic fire, fire breaks would need to be established around the perimeter.
- ✓ Native grasses would need to be controlled through frequent mowing and trimming to decrease a fuel source for fire.

Decentralization is fundamental in securing our nation's energy needs. Considering the various energy alternatives, biomass is yet another "tool" in the energy "tool box." Forest biomass has been defined as "non-merchantable materials or pre-commercial thinning that are byproducts of preventative treatments, such as trees, wood, brush, thinning, chips, and slash, that are removed to reduce hazardous fuels, to reduce or contain disease or insect infestations, or to restore forest

health." [17] The North Carolina Division of the Society of American Foresters (SAF) supports policies that promote utilization of forest biomass that, to name a few:

- Restores healthy forests;
- Improves forest health and vigor;
- Improves the nation's energy security by providing an abundant, renewable fuel resource as a substitute for imported fossil fuels;
- Reduces the accumulation of hazardous fuels. [18]

The biomass resource, by its very nature, is exposed to the elements. Lightning strikes and resulting fires can eliminate a biomass source in minutes. There is virtually no way to protect this resource except by early fire spotting and response.

BIOMASS SECURITY CONSIDERATIONS:

- ✓ Ensure that biomass facilities are not vulnerable to vandalism or eco-terrorism intrusion;
- ✓ Take steps to protect the bio resource from arson;
- ✓ Continued patrols in dispersed areas where fires may be left unattended.

"No single solution can meet our society's future energy needs. The answer lies instead in a family of diverse energy technologies that share a common thread; they do not deplete our natural resources or destroy our environment. Renewable energy technologies tap into natural cycles and systems, turning the ever-present energy around us into usable forms. The movement of wind and water, the heat and light of the sun, heat in the ground, and the carbohydrates in plants all are natural energy sources that can supply our needs in a sustainable way. Because they are homegrown, renewable can also increase our energy security and create local jobs." [19] For all practical purposes, decentralization of our energy resources provides the most sustainable alternative with minimal national security risk.

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FOREST SERVICE – *OFF THE GRID*

Policy Considerations

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Why Use Renewable Energy?

In addition to all the numerous environmental, energy and economical reasons for using and generating renewable energy it is also federally mandated. This paper focuses on the policy angle of renewable energy generation in the Forest Service, what policies exist, what are the barriers to implementing existing policies and what policies and strategies may still be needed to move the Forest Service towards achieving net zero facility energy use.

Policy Overview

Federal Energy Policies

Through the years there have been a number of policies that address federal energy conservation including: the National Energy Conservation Policy Act (NECPA) of 1978, the Federal Energy Management Improvement Act of 1988, the Energy Policy Act of 1992 as well as numerous executive orders. This paper focuses primarily on the most recent acts and executive orders that build upon, amend, or replace the earlier acts and executive orders. The two acts and executive order that are most pertinent now are the Energy Policy Act of 2005 (EPACT), Executive Order (EO) 13423, and the Energy Independence and Security Act of 2007 (EISA). All three of these cover a broad array of energy and conservation related activities and the focus of this paper is on the titles related to energy conservation and renewable energy requirements for federal facilities. Appendix A contains more information on these Acts and Executive Orders but in summary the requirements relating to renewable energy are:

- Agencies are encouraged to implement renewable energy generation projects on agency property for agency use;
- Federal agencies must increase consumption of renewable energy with a target of no less then 7.5 percent of total energy consumption in FY 2013;
- Agencies must reduce the amount of energy consumed by federal facilities from 2003 levels by 30% in 2015;
- Renewable energy generated on federal lands or facilities can be counted twice, both as renewable energy generated and renewable energy used;
- The use of long term Energy Savings Performance Contracts (ESPCs) are encouraged;
- Agencies must develop tracking methods and report progress towards meeting the EO and Acts to OMB on a biannual basis. OMB must submit agency energy scorecards and reports to Congress.

The Council on Environmental Quality (CEQ) and US Department of Agriculture have developed memos, and regulations that further explain how agencies are expected to achieve the goals of these acts and EOs. The Department states that each USDA agency shall develop an energy management strategy which demonstrates the agency's plan for implementing the provisions and achieving the goals of the acts and EOs.

The Forest Service has developed a Climate Change Companion Document as part of the FS Strategic Plan for FY 2007-2012. Objective 2.3 is to help meet energy resource needs. This objective focuses primarily on biomass utilization and research but it also mentions the need for a nationwide renewable energy strategy. A Woody Biomass Utilization Strategy and Handbook have been published. These focus on improving the use of woody biomass in tandem with forest management activities on federal and private lands. The Pacific Northwest Region has developed a Business Plan to address energy resource needs with goals and desired conditions. It addresses woody biomass and hydropower as renewable energy sources but the focus of the report is primarily on providing the energy resources for public use though outside proposals, not agency consumption. The Eastern Region is also drafting a woody biomass strategy to tie in with the national strategy.

There are two reports that address Forest Service use of renewable energy in depth. The first report is the July 31, 2008 report *Moving Forward on a Pragmatic Approach to Climate Change – A Strategy for Implementing Sustainable Operations*. The other report is a draft and has not been authorized for distribution until finalized. It is the *OIG Audit Report on the Forest Service's Renewable Energy Program*.

There is extensive work in draft regarding renewable energy. The most pertinent to this effort is the draft Forest Service Manual direction on sustainable operations. This manual direction is nearing completion and the draft contains broad direction regarding who is responsible for meeting the Acts, Regulations and EOs, reporting requirements and methods for compliance. Other Forest Service or joint Forest Service efforts include: a Programmatic Geothermal EIS being prepared jointly by the BLM and Forest Service, rulemaking on siting hydropower facilities, and proposed wind energy directives. All of these will be helpful to the Forest Service when we pursue alternative energy development on NFS lands, however, the purpose of these policies is primarily to address applications from non-Forest Service entities for siting energy developments on NFS lands.

State Energy Policies:

Under the US Federal system of checks and balances, states maintain the largest share of legal authority for energy policy. As a result, each state has their unique energy policies and regulatory agencies. For example, in Minnesota, there are three state agencies that regulate utility services and renewable energy generation. This state system of energy regulation is so

complex that the Department of Energy and even energy-interest non-profit organizations devote entire web sites to identify state-by-state regulations and renewable energy incentive programs.

Other Federal and State Policies:

There are many other policies that can come into play when taking action to conserve energy and generate renewable energy on NFS lands and facilities. Environmental policies such as the National Environmental Policy Act (NEPA), National Historic Preservation Act, Endangered Species Act, state water quality standards, etc. are important considerations when siting renewable energy generating facilities or when removing woody biomass. Procurement and property regulations and policies such as the Federal Acquisition Regulation (FAR), Federal Property Management Regulations (FPMR) and Agriculture Acquisition Regulation (AGAR) are important when contracting with utilities and energy service companies, or when purchasing items for increased energy efficiency or energy generation.

Utility Companies:

Within each state there can be numerous utility companies, and depending on the state, also numerous Energy Service Companies (ESCOs) (companies that provide energy management services to energy consumers). Some of these utility companies and ESCOs are quite sophisticated and are receptive to non-utility generation of renewable energy. Others, generally smaller utilities, may not be. For example in many cases local utilities will not allow net-metering, which is the practice of putting electricity back into the grid when an amount in excess of what is being used by a facility is being generated.

What are the Policy Barriers to Achieving Net Zero?

There has been an increased emphasis in the past 10 years on encouraging energy conservation and renewable energy generation, so most of the policy changes that have occurred have addressed barriers that existed previously. Consequently there are not very many policy barriers to achieving net zero energy use for the Forest Service. However there are a few.

The EISA definition of biomass does not include biomass that comes off of federal lands. Therefore, biomass resulting from restoration work and other important management activities on NFS lands can not count as a renewable fuel for credit under the reporting requirements of EISA. The biomass can still be used to produce heat and electricity but the incentive does not exist for entities to pursue using biomass if they do not get credit for this renewable energy source when reporting to OMB and Congress.

When local utilities do not support net-metering, that can be a barrier to pursuing renewable energy development. Without net-metering, an entity has less incentive to develop larger scale renewable energy generation projects, because they will not be able to get credit for energy generated in excess of their immediate facility needs. This can be significant barrier to achieving

net zero facility energy consumption for the Forest Service when considering that larger energy generation projects tend to be more cost effective then small ones. This has been identified as a barrier for renewable energy projects and some states are introducing legislation that requires that all utilities allow net-metering to occur.

Environmental analysis policies such as NEPA and the ESA are often considered to be barriers to the development of renewable energy projects. It is not that these policies prohibit or discourage renewable energy generation, but the analysis required by the policies can be time-consuming, costly and the focal point for any controversy with the project. Energy generation using biomass is especially tied to these environmental analysis policies because environmental analyses are not only required when building the energy generation facility but also for every time biomass is removed from federal lands.

Some people who have experience implementing renewable energy and energy conservation projects on NFS facilities have found that the unique contracting and purchasing associated with energy conservation and renewable energy projects have resulted in problems with understanding how to mesh these needs with the requirements of the federal acquisition and property regulations (primarily FAR). This can be a significant problem when working with the UESCs and ESPCs because the contracting associated with these programs can be quite complex. However, it appears to be more a problem with contracting officers and representatives from both the agency and the utility company or ESCO understanding the unique needs associated with energy contracting and acquisition then any actual prohibitions contained within the FAR. This issue seems to have been recognized since Section 517 of the EISA directs DOE to create and administer a training program to educate federal contract negotiation and management personnel on how to negotiate energy efficiency contracts. It appears this training is geared toward DOE personnel; however, it illustrates that understanding how to negotiate these unique contracts may be a barrier until agency personnel have gained more experience and training.

Many utility companies offer rebates for implementing energy conservation measures. Currently, any rebates received from the energy companies must go back to the federal treasury. This decreases the incentive to the local units to pursue these energy conservation measures since the up-front investments can't be offset by the rebates.

Other Barriers

There are many other barriers to pursuing net zero in the Forest Service that are not addressed in this paper because they are addressed in other sections of the team report (e.g. technical, social and environmental issues). However, there are two other barriers that, while not directly related to any existing policies do not fall obviously anywhere else and shall be addressed in this paper.

Many Forest Service buildings are leased. Often the cost of utilities is combined with the cost for leasing the building resulting in one fixed price. This type of lease greatly reduces the

incentive for Forest Service employees to pursue energy savings measures since they do not get any monetary savings for their investment. The stipulation in USDA Regulation 5500-001 that says that the USDA energy reduction goals do not apply to USDA leased facilities where the landlord is responsible for paying the utility bills is a double edged sword for the Forest Service. It is helpful because the agency is not required to reduce energy use in facilities where we have no easy means to determine what historic use has been and few incentives to implement energy savings measures. On the other hand this policy does not help the Forest Service understand the full magnitude of our energy consumption nor does it provide incentive for the Forest Service to be truly net zero.

Another significant problem is data collection and reporting. The energy reduction goals associated with the EISA are based on reduction from 2003 energy use levels. However, the Forest Service does not have accurate information regarding what the energy use was in 2003. Nor do many local units have a complete understanding of what their current energy consumption is. The FY 2007 National Environmental Footprint Report addresses this issue and reports that considerable progress has been made in addressing these issues. However, time, effort and resources will continue to be needed to improve upon our data collection and reporting systems.

Recommendations

There is tremendous effort occurring nationwide to develop policies and initiatives to foster energy conservation and increase renewable energy generation. The recent legislation contained in the EPACT of 2005 and EISA of 2007 along with EO 13423 are filled with provisions that eliminate many policy barriers and improve incentives. There are also many advocacy groups in the private sector who are working behind-the-scenes on the creation of new federal incentives and policies to make it even easier to conserve energy. The result of all of this activity is that there are relatively few policy barriers facing the Forest Service in achieving net zero energy consumption. This is good news.

The agency has many dedicated and knowledgeable people who are already achieving success and addressing the remaining barriers. The July 31 2008 report *Moving Forward on a Pragmatic Approach to Climate Change – A Strategy for Implementing Sustainable Operations* contains numerous objectives and action items for sustainable agency leadership and achieving net zero. This paper focuses on recommendations that I think warrant emphasis and may duplicate or draw upon the objectives and action items contained in the *Moving Forward* and *Footprint* reports.

Expand emphasis on Solar, Wind, Geothermal and Hydro: The agency focus on renewable fuels has been primarily on biomass. This is because biomass is a byproduct of Forest Service management of NFS lands and increasing the use and markets for biomass will help achieve important public priorities such as removing hazardous fuels. However, as a federal agency the Forest Service is unique in that its facilities are distributed throughout the US on the lands that

have the highest potential for all of the other renewable energy resources as well. All of the renewable energy resources have unique technological, environmental and social challenges as pointed out in the other papers of this report. However, biomass has the unique challenge that the availability of the resource is dependent on the ability of the Forest Service to generate it. This ability is dependent on numerous factors including changing market conditions, transportation costs and the ability to successfully complete environmental analysis. Environmental analysis is not only required when developing the energy generation facility but it is required for every project that removes biomass from federal lands. This analysis can take years to complete and is subject to public appeals and litigation, causing the supply to be somewhat uncertain over the long term. Solar, geothermal, wind, and hydro generally require environmental analysis only once, prior to development of the energy collection facilities.

OIG Report: Take full advantage of and expand upon the recommendations contained in the OIG Audit Report on the Forest Service Renewable Energy Program. OIG audits often result in increased reporting and oversight by the Department of Agriculture. While this is an increased burden on the Forest Service it can also be an effective tool to ensure accomplishment of priority objectives. The recommendations most in line with the other recommendations in this paper are:

- Develop a National Strategic Plan for renewable energy with measurable goals, methods, and performance measures.
- Require Regions to develop Strategic Plans with measurable goals, methods, and performance measures.
- Designate a national renewable energy staff to oversee and coordinate the implementation of strategic plans.
- Assess the need to dedicate more staffing resources to the woody biomass renewable energy program and allocate available resources accordingly(with modification as described below).
- Modify existing computer tracking system to track the production from wind, solar hydroelectric and geothermal resources.
- Develop policies and guidelines in the FS handbook/manual to establish tracking and reporting procedures.

The OIG report mirrors the agencies priority on biomass generation as the primary renewable energy source for meeting agency requirements of the 2005 Energy Policy Act. However, in following with the recommendation in this paper to expand agency priorities to the other resources it follows that we also recommend that the additional staffing resources recommended by the OIG be for all renewable energy sources, not just biomass. This is an important distinction because of how these positions may be staffed. A biomass position is likely to be located in a State and Private or Forest Management staffs and it may not be easy for that person to expand their responsibility to the other renewable energy resources. However, if the position is created with the responsibility to promote and coordinate all renewable energy sources then

the knowledge, authorities and lines of communication needed to address all of these resources can be considered when determining how to staff the position.

Procurement and Contracting Capacity: The agency focus on energy conservation and renewable energy generation is relatively new and the incentives and authorities are changing rapidly. Therefore it is difficult for contracting officers, representatives and purchasers to understand the opportunities and requirements. This can be remedied by creating a center of excellence with personnel who have experience with energy related contracting and purchasing that can by used by any unit that is pursing energy projects. An alternate recommendation is to develop a training program CO and CORs on energy contract negotiation and purchasing.

Rebates and Leases: Continue and support the ongoing efforts to allow energy rebates to be retained by the Forest Service rather then returned to the treasure and also the efforts to negotiate leases that separate energy consumption costs from facility costs.

Flexible: The key to any policy or strategy that is developed is that it is flexible enough to take advantage of local conditions. Solar, biomass, wind, geothermal, and hydro resources are distributed in different places throughout the NFS (see Technology paper). There are vast differences in state and local utility regulations and the capacity of local utilities. And the partnership opportunities can be very different in different locations. For example in some locations there may be other federal lands or facilities that make a perfect partnership for sharing investments in renewable energy generation or for using the energy generated. In other locations there may be opportunities for partnering with private or state entities.

Promote partnerships: The technology and financial papers find that large scale renewable energy generation projects are more effective and efficient then investing in renewable energy generation at every Forest Service facility. The requirements for the Energy Acts and Executive Orders are for all federal agencies. In spite of all the incentives there are still many challenges to developing renewable energy facilities including money and staff time. One way to overcome these barriers is to share resources between partners. These partnerships could take many forms including sharing personnel in feasibility assessments and negotiations with the energy companies, joint capitol investments, sharing the energy generated from a facility or investing in the facility by buying renewable energy credits.

Summary

In summary, there are few policy barriers standing in the way of the Forest Service achieving net zero energy use. The most important policy steps for the agency to take now are to increase the agency's emphasis on solar, wind, geothermal, and hydro, while at the same time implementing the biomass strategy; develop national and regional strategic plans with measurable goals, methods and performance measures; improve tracking methods and requirements; and increase agency capacity in negotiating energy contracts and purchasing. It is very important that any

strategies developed allow flexibility to take advantage of local conditions and that they promote the use of partnerships.

Policy Considerations - Appendix A.

Existing Policies: additional information or policies not mentioned in the paper.

Energy Policy Act of 2005 (EPACT 2005) requires federal agencies to consume renewable energy in amounts no less than:

- 3 percent of the total annual electricity consumption in FY 2007 through 2009
- 5 percent of the total annual electricity consumption in FY 2010 through FY 2012
- 7.5 percent of the total annual electricity consumption in FY 2013 and thereafter.

It also provides for a bonus for renewable energy that is produced on federal facilities or federal lands which is equivalent to doubling the amount of credit received for the amount of renewable energy used or purchased.

Executive Order (E0) 13423 requires that agencies: ensure that (i) at least half of the statutorily required renewable energy consumed by the agency in a fiscal year comes from new renewable sources, and (ii) to the extent feasible, the agency implements renewable energy generation projects on agency property for agency use.

Energy Independence and Security Act (EISA) of 2007 establishes new energy reduction goals and accountability requirements including:

- Requires yearly reductions in the amount of energy consumed by federal facilities with an ultimate goal of a 30 percent reduction from 2003 levels by year 2015;
- Requires the use of a web-based tracking system for energy evaluation, implementation and follow-up;
- Directs each agency to compile and submit an annual report to OMB addressing compliance with the act;
- Directs OMB to submit an annual report and agency energy scorecards to Congress that include an evaluation of overall agency progress in meeting the provisions, goals and recommendations of the act ;
- Authorizes agencies to use appropriations and/or private financing, to comply with the energy reduction goals;
- Requires the use of Environmental Management Systems (EMS) as the primary management approach for addressing the environmental aspects of internal agency operations and activities, including energy functions;
- Promotes the use of long-term Energy Savings Performance Contracts (ESPCs) by amending the National Energy Conservation Policy Act of 1978 to: permanently authorize ESPCs; extend the definition of energy savings reduction to include increased use of an existing energy source by cogeneration or heat recovery; allow electrical or thermal energy generated by federal entities that is in excess of federal needs, to be sold or transferred to utilities or non-federal users: and permits agencies to retain the full amount of energy and water cost savings obtained from utility incentive programs.

It is important to note that the definition of biomass in the EISA does not include biomass that is generated from federal lands.

March 28 Memo from CEQ to Heads of Executive Branch Departments and Agencies: Implementation Instructions and Requirements for EO 13423 require agencies to apply the following overarching directives:

- Each agency shall, at all appropriate organizational levels, including agency, sub-agency, develop, implement, and maintain an EMS to be used to identify and address agency energy issues.
- Performance standards of senior agency officials shall include successful implementation of the EO;
- Each agency should employ incentive and award programs to reward exceptional individual and team performance in implementing the goals of the EO.

Existing USDA Policies

The Department of Agriculture has three policies that address renewable energy: Departmental Regulation 5500-001, USDA Guidance on Renewable Energy and the USDA Sustainable Buildings Implementation Plan.

Departmental Regulation 5500-001- USDA Facilities Energy and Water Conservation and Utilities Management:

- States that it is the USDA policy to meet or exceed the goals specified in applicable energy and water conservation laws.
- Requires each agency to develop an energy management strategy which demonstrates the agency's plan for implementing the provisions and achieving the goals of the acts and EOs.
- Requires annual progress of at least 10 percent toward completing energy and water audits.

It is important to note that the regulation does not apply to USDA leased facilities where the landlord is responsible for paying the utility bills.

The USDA Guidance on Renewable Energy provides USDA agencies with direction for complying with the EPACT and the USDA Regulation DR-5500-001. It provides an overview of renewable energy, and establishes requirements for USDA agencies to report their progress in complying with EACT.

The USDA Sustainable Buildings Implementation Plan renewable energy goal states that the USDA will increase the use of both on-grid and off-grid renewable energy generation systems.

Secretary's Memorandum 5500-002 – Implementing EO 13423 Strengthening Federal Environmental, Energy, and Transportation Management. This memo emphasizes the importance of internal USDA actions to meet the requirements.

Existing Forest Service Policies

February 15 2008 letter from Chief to NLT regarding Climate Change and 16 recommendations. This letter focuses on the bigger questions of how the agency will address climate change and doesn't directly address renewable energy as a goal. It does however include the woody biomass strategy as an action that will be completed.

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Social Values and Attitudes and their Influence on FS Net Zero Opportunities

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Introduction

Forest Service proposals have many times been controversial. Much of the controversy has revolved around values-based conflicts over how the National Forests should be managed and how specific management actions are perceived to affect forest resources or values that the opposition hold dear. This chapter looks at how proposals to achieve Net Zero energy consumption by increasing conservation actions and alternative energy improvements, even though broadly supported in concept, may be affected or opposed the public or even employees. It also looks at strategies to improve support and foster a greater likelihood for success both internally and externally.

NIMBYs, LULUs, and NOPEs – Local Community Values and Attitudes

While there is often general agreement and even enthusiastic support for alternative energy development in the abstract, specific proposals in specific locales can often spark conflict and opposition. This can occur even among persons or groups that are active promoters of alternative energy. The phenomenon of local opposition to new developments that threaten, or are perceived to threaten, locally valued features, has given rise to colorful acronyms: NIMBY (**N**ot **I**n **M**y **B**ack **Y**ard), LULU (**L**ocally **U**nwanted **L**and **U**se), and the more sweeping BANANA (**B**uild **A**bsolutely **N**othing **A**nywhere **N**ear **A**nything) and NOPE (**N**ot **O**n **P**lanet **E**arth). (1)

NIMBY is the most commonly used term. This can occur even when normally such a development would be would be supported, even strongly, were it to be located elsewhere. The personal social concern and commitment to alternative energy collides with the self-interest of personal preferences, property values, or aesthetics. In economic parlance, “personal utility” trumps perceived “public good”. This occurs when “benefits” are generalized and global but “costs” are viewed as specifically local. (2)

One of the more dramatic recent examples of this dichotomy was the 2001 proposal for a 130-turbine wind power development off the coast of Massachusetts in Nantucket Sound six miles south of Cape Cod. (3) Robert Kennedy, Jr., a well-known environmental activist and the more famous among Cape Cod residents who actively opposed the project on environmental grounds, declared, “…flashing lights to warn airplanes away from the turbines will steal the stars and nighttime views. The noise of the turbines will be audible onshore ... [and] the project will damage [the views]. Greenpeace actively supported the project. The conflict culminated in a

Greenpeace boat protesting against Kennedy's sailboat as he was participating in a protest against the project. The Greenpeace boat displayed a banner declaring, "Bobby, you're on the wrong boat." (4)

NIMBY is a fairly common occurrence when proposed developments are perceived to impact or threaten the character of a local community or neighborhood. Examples of such developments have included public facilities (prisons, airports), social service providers (mental health clinics, halfway houses), affordable housing (especially multifamily housing), commercial enterprises that conflict with local norms (liquor or pornography stores), energy developments, and industrial facilities. Opponents to such undesirable developments may actually support the development occurring elsewhere. (5)

Local Forest Service units have encountered local NIMBY reaction to various resource management proposals and projects near communities or population centers that do not have local support. Our NEPA process invites participation by the public and we often hear these concerns. NIMBY could also become a factor, though, where agency energy developments on administrative sites or offices are contemplated to reduce energy consumption or supplement non-renewable energy sources with local renewable facilities. Renewable energy development proposals on administrative sites within or near local communities should anticipate the potential for NIMBY inspired local opposition. In Susanville, CA, the local community converted a local residue burner from an inactive mill site to a medical waste burning facility. Public opposition developed and the facility was closed. (6)

Research on the NIMBY phenomena has posed some causes and factors that contribute to this perception. One explanation is that the public believes it has been essentially left out of the initial decision-making process. When considering alternative energy proposals that may stir NIMBY responses in the local community, a collaborative engagement with the public can help diffuse conflict and allay concern about the proposal. Local public involvement and trust are key factors in resolving conflict over NIMBY related issues. (7) This should align nicely with a proactive public engagement approach during the planning and design phase of any alternative energy proposal.

Utility Providers – Values and attitudes

Values and attitudes of utility providers are largely a function of the economic, regulatory, and competitive environment in which they operate. Large utility providers are better positioned to provide support and consultation for a broad array of energy conservation or alternative energy developments. Specific services and support are discussed elsewhere in this paper. Many investor-owned utilities (IOUs) and municipal utilities are actively advertising renewable energy services to consumers. Such utilities are better capitalized, staffed, and equipped to serve non-traditional energy alternatives. (8) Other electric utilities have not bought into renewable energy in a significant way. It's new or requires them to make changes. Some don't like external

entities (such as Forest Service offices) putting power back into the grid because it is a safety issue for their linemen. (9)

On the other hand, the smaller "mom-and-pop" type local energy providers, such as rural electrical cooperatives, which service some remote Forest Service locations are often less well positioned to respond with energy conservation or alternative energy options that are outside their traditional portfolio of energy services.

These types of smaller utilities have significant competitive challenges compared to the larger utilities. Cooperatives have lower profits, on average. They have substantially fewer customers and lower revenues per mile than larger utilities. They earn about 12% of what larger IOUs and municipal utilities earn per mile. Coops must maintain more excess capacity than large utilities because they have mostly residential customers and relatively fewer industrial customers, creating less flexibility for coops in serving high demand periods of residences. Industry can alter its demand more easily and consume electricity during off-peak hours. (10)

By law, cooperatives are established to provide least-cost service to customers, making them "cost minimizers" whereas larger utilities are "profit maximizers". A cooperative has to pass costs on to customers because the owners of the business are the customers themselves. Larger IOUs or municipals can absorb costs without changing the rate customers pay. Consequently, higher cost alternative energy options impact coops more than larger corporate utilities. (11)

Cooperatives may only have a single staff person responsible for renewable energy services, or a staff person whose secondary duties include providing service in alternative energy options. With recent legislation, state regulation, and the increase in energy costs, interest in rural economies for renewable energy alternatives, particularly site- specific wind developments, is increasing. Cooperatives interest in providing services for renewable energy opportunities may increase as these alternatives become more cost-competitive. (12)

Forest Service Leadership and Workforce Attitudes and Behavior

Perhaps the most significant influence on an effective transition to a net-zero energy consumption goal is employee and leadership participation and commitment. Interviews with Forest Service employees and leadership revealed an active interest throughout the agency for renewable energy and energy conservation. There are pockets of passionate interest and activity happening now in renewable energy within the agency. Many units have made significant efforts in "place-based" energy conservation practices and renewable energy investments. Many of these are described as "Success Shorts" in the Fiscal Year 2007 *National Environmental Footprint Report* (Draft). (13) The general view, though, is that it was unfocused and uneven, with ambivalent, even conflicting, messages (where they exist) throughout the agency leadership hierarchy on the importance of these efforts.

The establishment of Green Teams in 2007 throughout the agency fostered good progress on several fronts related to reducing the agency environmental footprint by energy saving, water conservation, recycling, and other "green" practices. This effort seems to have lost momentum, however, according to interviewees.

The significant role of employees and leadership cooperating in the common effort to move a large agency to Net Zero energy consumption can be corroborated through research studies and examples from outside the Forest Service. There are a number of common characteristics which presence or absence can impact motivation and make the difference between success and failure in reaching Net Zero. Some studies indicate that motivation to save energy *decreases* with:

- Coercion to save energy;
- Over-zealous or fringe conservation goals;
- A feeling the problem is too large;
- A belief that technology will save the day;
- An increase in the hassle factor or difficulty in saving energy;
- Belief that energy is a small and fixed cost;

Conversely, motivation to save energy *increases* with:

- Training and information on the financial and environmental consequences of energy consumption;
- Teamwork and peer pressure;
- Measurement and recognition of personal contributions;
- Belief the organization is genuinely interested in saving energy;
- Incentives for exceptional efforts, consequences for failure. (14)

Technology is important to moving to Net Zero energy goal but it alone cannot solve our energy problems. People play a significant role in achieving energy savings from technology. Where technology is in place to realize energy savings, organizational buy-in can powerfully increase its effectiveness. (15) In fact, without shared commitment by employees and leadership, energy efficiency can suffer, undermining any investment in energy saving infrastructure. This result, paradoxically, can foster even less workforce motivation to conserve.

The first step to shaping the collective motivation of the workforce is employee awareness. These can be promoted through employee awareness programs. These programs can provide employees with information on how energy resources are used in the workplace and how employees' actions can directly affect energy consumption.

For example, in one enterprise, an employee awareness program was aimed to achieve the following:

- ◊ promote the energy efficiency project within the workplace;
- ◊ encourage employee commitment and participation in the project; and

- ◊ promote the benefits of energy-saving technologies and practices in the workplace, at home and on the road.

The following proved effective in generating interest and enthusiasm for improved energy efficiency and additional savings: newsletters; fact sheets; e-mail messages; electronic signs; energy awareness days or weeks; stickers and buttons; videos and screen savers; and logos. (16)

In a second example, Raytheon discovered that up to two-thirds of its electricity use is due to the "plug load" from its 80,000 employees. The company launched a program entitled "Energy Conservation for a Competitive Advantage" in 2006. The program targeted "Total Employee Involvement" in the energy program. The program educated employees about the costs and environmental impact of daily energy use and underscored how energy conservation contributes to Raytheon's competitive advantage in the market place. Energy conservation was closely aligned with the corporate mission.

A network of "Energy Champions" was established to communicate with employees through media such as messages on computer screens, posters, stickers, memos, flyers, raffles, "meet and greet" events, and audit checklists. The company established visible leadership commitment to ensure that managers and employees clearly understood that energy conservation was a top priority of Raytheon leadership. The effort resulted in energy savings of approximately $9 million per year. (17)

In an example closer to home, the Ennis Ranger District in Montana installed solar panels on its office building. The panels alone were expected to yield a 5%-10% energy savings. However, the daily visibility of the panels to employees raised awareness of the goal to reduce energy use and the actual savings are estimated to be closer to 25% largely because employees became more conscientious in their energy saving behavior. (18)

The combination of infrastructure improvements and retrofits ***and*** employee awareness powerfully contributes to significant reductions in energy use. Training and awareness in the proper operation of energy consuming devices can produce dramatic energy savings of 15% or more. Organizations can make energy conservation easier by "rolling rocks off the trail" and promoting positive individual actions. One industrial plant saved $30,000 in the first year merely by affixing labels that showed which switches controlled what lights. (19)

Mission focus: conflict with energy conservation?

The Forest Service has a well-earned reputation as a "can-do" organization. Part of this reputation stems from the traditional mission focus that agency employees and units consistently exhibit. Energy use has been one of many means to the larger end of accomplishing the agency's work. It is often taken for granted and has been subordinate to the focus of "meeting targets".

We've necessarily consumed energy using field vehicles, travel, offices, computers, without giving it much thought.

As the Forest Service emphasizes energy savings and conservation measures, in response to EO 13423, could the mission become blurred? Could the incentives and rewards, or conversely, disincentives and penalties, promote emphasis on energy conservation at the expense of core mission work? At what point does the inconvenience or disruption of energy conservation behaviors impact the core mission? If you've ever rushed to a copier machine to photocopy handouts moments before your big meeting, only to find the copier turned off by a well-intended conservation-minded co-worker, you know the feeling.

Other potential barriers are trade offs involving scarce and normally insufficient facilities funding at the local units. There is a well-documented national backlog of agency facilities' maintenance and repair needs. It is difficult for local line officers to consider expensive investments in energy conservation infrastructure when safety and functional operational needs exist.

Still, making energy conservation part of normal business practices is critical to removing disincentives to save energy. More widespread use of ESPC and UESC instruments (discussed elsewhere in this report) can augment scarce appropriations to facilitate critical investments in energy conservation and renewables. Leadership intent should promote energy saving behavior as a function of normal business operations. As one interviewee put it, "You have 50 things on your plate. We're not asking you to do 51. We're asking you to do 50 things differently…" [i.e., in a way that conserves energy.] (20)

A lack of leadership or even leadership resistance to employee initiative in conservation behavior can be lethal to delivering effective progress. One employee commented on his supervisor's reaction to his investigation into a Utility Energy Services Contract (UESC) option for Forest facilities: "Are you still wasting your time on that?" That is clearly not the leadership message to promote energy conservation.

One local Forest Service project evidenced some resistance by employees because of concerns about intrusion into and impacts to work and the workplace. (21) Organizations can make it easier to practice energy saving behavior by reinforcing the right behaviors, involving employees, informing and educating on the benefits and importance of energy conservation, aligning conservation practices with the core mission, and showing affirmative leadership throughout the organization.

In conclusion, a more purposeful, proactive and consistent message on the agency's commitments and expectations for energy conservation and developing alternative energy infrastructure is needed. This requires structure and strategies, with leadership visibility, for the short and long term to build on the sustainable operations' and green teams' successes of the last few years. (22)

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