Section 3: *Where and How Should Energy Projects Be Sited?*

3.1: Background

*Evan F. Ray*

*Yale School of Forestry & Environmental Studies*

“Because landowners, policymakers, utilities and investors are scouring the countryside looking for places to install generating capacity, obtain biofuels, and construct new transmission corridors, we cannot simply continue to conduct land conservation business as usual”

— *Judy Anderson, Columbia Land Conservancy*  
(quoted in “The Next Frontier: Conservation and Renewable Energy” by Paul Doscher)

Given that development of additional energy-production infrastructure will happen, and will happen rapidly over the coming decade and beyond, conservation organizations will need to enter the fray over siting if they are to have any influence over the process. The prospect of this nationwide effort to boost domestic energy capacity is alarming to conservation organizations that have expended significant human and financial capital over the past decades identifying and preserving high value tracts.

The challenge moving forward is to work together with communities, developers, local municipalities, and government agencies to come up with a comprehensive triage approach to siting energy development. Conservation organizations have an opportunity to work with these stakeholders to reach their shared goals of preserving the aesthetic value and biological integrity of priority sites and corridors, while still promoting the responsible development of energy resources in a region.

This background paper offers information about some of the development and siting issues associated with various renewable energy projects, as well as natural gas production. It is not intended to be a comprehensive review but rather a summary of the major factors affecting the siting of energy projects and how those relate to the on-going efforts of conservation organizations.
Siting Energy Projects

Solar

There are two primary methods for producing useable power from solar energy. The first, and perhaps more common, method is via photovoltaic (PV) systems. These are the “solar panels” one sees on the roofs of buildings and in groupings, or “arrays.” Generation capacity can be very large, as with industrial facilities who choose to clad their roofs in PVs, or quite small, as with the homeowner who puts a single panel on their roof for supplemental supply for personal energy consumption. In PV systems, each panel operates independently of the others. As such, the orientation and positioning of the panels relative to each other is important only to the extent that it is more efficient to link them to a central transmission line if they are installed in close proximity to each other.

Solar Development on Public Lands in California and the Southwest

In 2009 the U.S. Secretary of the Interior, Ken Salazar, announced that he had given the go ahead for solar development suitability studies to take place on over 670,000 acres of public land in California and five states in the Southwest. The goal of the action was to expedite the development of commercial-scale solar installations on leased public lands as a part of President Obama’s desire to increase renewable energy generation capacity in the U.S.

By the end of 2010, the Bureau of Land Management (BLM) had fast-tracked 14 developments, nine of which had been signed-off on by Salazar himself, thus limiting the potential for appeals by the public. The projects have an average footprint of 4,300 acres.

Opposition to the federal actions and proposed developments are many, ranging from concerns over the resilience of sensitive desert ecosystems to the functional privatization of public lands. Of particular concern to some environmental groups is, in their view, the relative weakness of the “programmatic environmental impact assessment” (PEIS), which allows the Department of the Interior (DOI) to establish broad, rather than project specific, environmental standards for the development of industrial scale solar projects on public lands.

The second primary method of converting solar energy to usable power is via solar thermal concentrating systems. Solar thermal installations come in various shapes and sizes, but the largest installations – capable of providing utility scale power – use what are called “central tower” or “power tower” systems. These systems use an array of many mirrors to concentrate the sun’s energy on a single tower that, in brief, collects the energy that then generates steam to drive a conventional turbine, ultimately producing usable power. The benefit of these systems is that the steam-driven turbine is essentially the same mechanism that is used by coal-powered power plants, making the link between the generation facility and the transmission lines well known and reliable. Another popular solar thermal method uses what are called parabolic troughs. These are large arrays of curved mirrors that concentrate solar energy on a single, liquid-filled tube running above, and parallel to, the mirrors’ surfaces. The liquid in the tube heats, creating steam, which drives conventional turbines.

**Solar Resources and Existing Transmission Lines in the U.S. Southwest**

![Map of solar resources and transmission lines in the U.S. Southwest. Source: U.S. Department of Energy, National Renewable Energy Laboratory.](image)

Most solar thermal installations are much larger than PV installations as creating very large arrays can create desirable economies of scale. It is not uncommon, for example, for solar thermal installations to cover an area of roughly two square miles (SolarReserve, n.d.).

Obviously, siting such large installations can be difficult. Suitable areas to develop such a project are limited in number when all the necessary factors are taken into account – including access to sun, land, transmission lines, demand, financial incentives and related items. Not only must there be a consistent intensity of solar energy, there must also be sufficient
land on which to build the array and nearby transmission lines to transport the power to end users and feed the grid. The mix of available demand, prices, and incentives also needs to be sufficiently attractive to justify and support the investment.

**Wind**

Like solar, wind can be harnessed on various scales for both local or regional power needs. This section will focus on commercial scale wind projects, which typically range from 5 to several hundred megawatts (MW) and entail the installation of anywhere from just a few to hundreds of turbines.

A typical commercial wind-turbine, and its associated infrastructure, usually requires one acre of land for siting. The height of a typical industrial scale turbine reaches 200-300 feet above the ground, while each individual rotor blade is between 60 and 130 feet long. The specific flow of events for the approval and installation of any given wind project will vary greatly from city to city and state to state. What follows is an overview of the typical development model for a generic wind energy project (summarized from the AWEA Siting Handbook).

The first phase of development is to conduct a preliminary site characterization. This involves multiple steps. The first step is to source and analyze the wind resource. Meteorological towers ("met towers") are installed in proximity to the proposed turbine site to gather information on wind speed and duration. This process typically takes one to three years. Concurrently, the developer may make several site visits with engineers, who can evaluate constructability, and biologists, who can identify and evaluate any environmental constraints, such as migration pathways or endangered species habitat. It is at these early stages of project development that conservation organizations might also offer useful guidance and access to local knowledge and contacts.

If the first phase concludes that the proposed site is suitable for development, the developer will begin to work out the economics of the project. Each developer will have his or her own benchmarks and financial requirements. If the project is sited on land that the developer does not own outright, the landowner will be involved with these discussions. In the case of wind projects on community or municipal forests, broader constituencies will be involved.

Along with working on the economics of the project, the developer will conduct a more thorough environmental issues analysis and review of the regulatory approvals necessary for the specific project. Regulatory frameworks vary greatly by location. In some states, only one agency has jurisdiction over the siting and approval of wind projects. In others, states have crafted model wind ordinances that municipal governments can use as guidelines when reviewing proposed wind projects.

A critical element of the preliminary site characterization is to determine if existing transmission capacity will be sufficient to support the new facility or if additional transmission lines will need to be installed. The developer will work with the local independent system operator (ISO) and regional transmission operator (RTO) to conduct a transmission capacity analysis. One of the issues facing wind power in the U.S. is that the large wind resources in the center of the country are often far removed from major load and demand centers such as large cities.
Throughout these project development stages, the developer will be reaching out to and working with key stakeholders in the local community. Making sure that the community is on board with the project is often critical to the ultimate success or failure of the project.

If the preliminary site assessment is positive, the project can move forward. The first stage of implementing the project is to acquire land rights. Typically wind farms are on leased land. While the developer has been in contact with the relevant municipal, state, federal, or private land owner, this is the time when formal agreements are drawn-up and signed.

Finally, the developer will need to conduct a formal Environmental Impact Analysis, implement any required mitigation, and obtain all necessary approvals. Obviously these activities will be of great interest to conservation organizations. In some cases, they will oppose the issuance of any such approvals. In others, they might offer assistance in crafting acceptable ways forward.

**Hydroelectric**

The siting of hydroelectric generation facilities is obviously limited by the location of suitable water resources and the type of technology deployed. Traditional hydropower development is fraught with controversy since it requires the establishment of a reservoir, often displacing existing terrestrial ecosystems and, sometimes, human communities. The siting of a run-of-river turbine will have much less impact on local flora and fauna, but will still require
transmission facilities. The possibility of repowering existing dams is also being explored in many areas, but the push to remove old dams and reopen rivers is also gaining momentum.

The harnessing of tidal energy is a relatively new field of energy generation and one with unique ecological challenges. The manipulation of natural tides for energy generation creates some negative consequences not only for aquatic species, but also for shorebirds and other species that live at the ocean’s edge.

SeaGen is the world’s first commercial scale tidal energy production facility. Located in the Strangford Narrows, a small strait separating Strangford and Portaferry in Northern Ireland, the facility opened in 2008 and generates 1.2 MW daily providing power for roughly 1500 homes. Developed by Marine Current Turbines (MCT) of Bristol, UK, the system is driven by two large, windmill-like turbines that spin at low revolutions during both the flow and ebb of the tide.

The project is licensed for five years, after which the results of a comprehensive environmental review will be used to determine the appropriateness of continued operation. At the announcement of the project, some concern was raised about possible detrimental effects to marine life, especially to the many common seals that live and breed in the area. MCT claims that the relatively slow rotation speeds of the rotors – no more than 10 to 15 revolutions per minute – pose little threat to marine life.

To date the project has been very successful and popular, operating as planned with minimal environmental impacts. In May of 2011 MCT received the EnergyOcean International 2011 Technology Pioneer Award for its demonstration of the commercial viability of large-scale tidal energy generation.

For more information see: Marine Current Turbines, www.marineturbines.com; and Sea Generation Ltd, www.seageneration.co.uk.

The regulation of hydroelectric generation facilities is multi-layered and often complex. Any project that intends to interconnect with existing interstate power grids is subject to Federal Energy Regulatory Commission (FERC) approval in addition to any applicable state and local regulations. Tidal and wave power facilities, whether interconnected or not, are also subject to regulation by the U.S. Army Corps of Engineers. A few states have signed memorandums of understanding (MOUs) with FERC to streamline project review processes by coordinating review procedures and timelines. These MOUs serve the mutual interest...
of the state and federal regulators, as well as developers and supporters of such projects, by improving the efficiency of the administrative process.

**Natural Gas**

Given the scale of shale gas formations in the U.S., natural gas is poised to play a much larger role in providing power to many regions of the country. Indeed, the amount of technically recoverable shale gas resources in the U.S. is surpassed only by China (U.S. EIA, 2011). Increased production, pipeline, and terminal facilities will be proposed for development in the coming years, each potentially creating new environmental concerns for local communities and the larger U.S.

The method of extracting natural gas known as hydraulic fracturing, or “hydrofracking,” is of particular concern. Hydrofracking is the practice of pumping a mixture of water, chemicals, and sand at very high pressure into a well to create cracks in the shale formations that then allow gas to be released.

The infrastructure necessary for hydrofracking operations include one or several well-pads, a supply of the water/chemical/sand mix required for fracturing, and appropriate access road(s). Total land impacted by well-site ranges from 3-5 acres (Citizen’s Campaign for the Environment, 2011).

The water/chemical mixture used for hydrofracking is often a proprietary mix of substances, some of which may be harmful to human and environmental health – especially if released into drinking water. There have been numerous reports of headaches, dirty or discolored water, and even flammable faucets from homeowners living near hydrofracking facilities (Fox, 2010).

In addition to the potential for subsurface water contamination, other environmental concerns include: 1) impacts from drill pad construction, which can cause forest fragmentation and consequent impacts on local flora and fauna; 2) the heavy use of fresh water resources, impacting local and regional hydrology and water supply; 3) surface water contamination due to inadvertent spills and/or poor well construction; 4) poor management of waste fluids; 5) poor regulation of the extraction processes; and 6) the emission of hazardous substances from standing waste water pools, pumping stations, transport trucks, and other elements of the extraction process (Mejias, 2011).

The U.S. has extensive shale gas reserves (see U.S. EIA map, below) with some of the largest deposits in the Marcellus formation underlying much of the Northeast. Efforts to tap these deposits are currently underway and have the support of the Obama administration, which views natural gas as not only a relatively clean source of domestic energy, when compared to coal, but also a way to entice the existing fossil fuel lobby to make the first step – albeit somewhat of a half step – towards embracing cleaner and renewable sources of energy.

The vast known resources of shale gas deposits in the U.S., coupled with the Obama administration’s enthusiasm for the resource, likely means that natural gas and hydrofracking will continue to be an issue for the foreseeable future. Developers in many states, and especially in potentially high-value areas like the central and northern Appalachians, are actively seeking leases from private landowners, often for attractive sums.
Traditional Conflicts with Conservation Organizations

Conservation, at its very core, is about protection – protection of ecosystem function, biodiversity, landscapes, and ways of life. The development of energy production facilities often threatens the integrity of these core conservation values by making semi-permanent and significant changes to the environments in which the facilities operate.

The largest – and perhaps most obvious – conflicts between the development of energy production sites and conservation goals are both the immediate environmental impacts of project installation, and the long term effects on wildlife habitat caused by the physical permanence of the production facilities. Wind projects provide a useful example, with concerns over propeller-induced bird deaths and regional impacts to migratory patterns serving as prominent issues.

Other concerns focus on the fact that lands with very high conservation value often have the potential to produce the greatest amount of energy from renewable sources. Wind projects and commercial scale solar projects frequently face this challenge. In many cases, the negative impacts caused by the additional infrastructure needed to bring the renewable energy to consumers are seen by conservationists as outweighing the benefits of increased renewable generating capacity. In other words, the value of the conserved landscape under threat is greater than the value the conservation organization might bring to society by helping to site additional renewable energy facilities.
Opportunities to Move Forward

Addressing these and other concerns in a productive manner will require thoughtful exchanges between various stakeholders with competing goals and passions. Fortunately, a number of efforts are already underway and offer real time models for learning how to make these connections. For example, the American Wind and Wildlife Institute (AWWI), whose mission is “to facilitate timely and responsible development of wind energy, while protecting wildlife and wildlife habitat,” is working closely with wind developers to promote and assist with the siting of wind generation facilities. AWWI, in collaboration with The Nature Conservancy, has recently published an interactive siting tool that allows developers and the public alike to view wind resources mapped against habitat ranges for various wildlife species.

Being clear about the reasons for the conservation of a certain parcel becomes very important when thinking about how to move forward with development on or near lands with high conservation value. Existing developed or working lands, for example, are likely more suitable candidates for wind or solar installations. Someone will invariably be upset by any efforts to develop near high conservation lands. By identifying the specific aspects of that landscape that are most valuable to either energy production or habitats, developers and conservation organizations might more easily reach agreements that serve key conservation goals, while also meeting regional and national energy needs.

Careful crafting of the specific language used in conservation easements is a good way to stage opportunities for development to happen where it should. Conservation organizations are increasingly supporting economic activity on encumbered lands through the use of working lands easements. Enabling this mixed use of the land maintains the character of the site while promoting local economic activity and sustaining a working landscape. Farmers, for example, often welcome the opportunity to place wind turbines on their lands as a source of supplemental income.

Conservation organizations and developers might also consider urging Congress to provide new tax incentives specifically targeting renewable energy production on sites with donated conservation easements. As Paul Doscher writes, “Whether Congress will change the enabling legislation that creates tax incentives for conservation easement donations to include renewable energy generation is the multi-million dollar question. If this were to occur…it would create a new world for land trusts” (Doscher, 2010).

Discussion Questions

• How can conservation organizations help developers or government agencies site energy production facilities on lands that have lower conservation value?
• Can better siting and improved mitigation efforts offset the impacts of development on or near high conservation value lands?
• Can energy projects and production sites be made compatible with land conservation?
• If tradeoffs have to be made between energy development and land conservation, how should they best be made?
Organizations Doing Interesting Work

**American Wind and Wildlife Institute** is working actively with developers to help promote and site wind power generation facilities. See [http://wind.tnc.org/awwi/](http://wind.tnc.org/awwi/).

**The Wilderness Society** is working with developers in western states to help minimize environmental impacts of numerous “fast-tracked” renewable energy projects – specifically solar installations – slated for construction in relatively sensitive areas. See [http://wilderness.org/content/shaping-renewable-energy-how-we-can-minimize-environmental-impacts](http://wilderness.org/content/shaping-renewable-energy-how-we-can-minimize-environmental-impacts).

**Land Trust Alliance** is working with conservation organizations across the nation to make sure encumbered properties are known and thus might be avoided during the development of energy production facilities. See [www.landtrustalliance.org/policy/emerging-issues/energy-development/energy-development](http://www.landtrustalliance.org/policy/emerging-issues/energy-development/energy-development).

**Protected Areas Database of the United States (PAD-US) Partnership** is working to catalogue protected lands across the nation to help planners and developers craft better decisions about local, regional, and national development stratifies. See [www.protectedlands.net](http://www.protectedlands.net).

Useful Readings / Works Cited


### 3.2: Examples, sources of information and other key points from the discussion

Some of the examples, sources of information and key points from the discussion included the following:

- Since conservation is not the only goal of development projects, there will always be tradeoffs – that will be difficult, but necessary to make.
- There is huge political momentum behind the development of shale gas and oil, as well as wind and solar, projects in the U.S. – they will continue to expand.

**Colorado’s Regulation of New Shale Gas Development**

In 2007, Colorado adopted new legislation broadening the goals of the regulatory framework for oil and gas development – calling for “balanced and responsible development” reflecting a range of factors including “wildlife and environment.” This window of opportunity for change was occasioned by leadership from the top by a new governor, a boom in the drilling of new wells, and an alliance among previously wary parties as ranchers and hunters – seeing unprecedented industrialization of agricultural and natural landscapes – found common cause with conservationists and environmentalists. Among the key themes of the resulting regulatory framework are flexibility; collaboration; incorporation of externalities; inclusivity; and some new market mechanisms. The regulations also combine landscape scale planning with application of the “mitigation hierarchy”: avoid, minimize, restore, and offset. The overall goal is to vary the degree of protection for any particular development with the degree of ecological sensitivity in the area, with the hope of having no impacts or even improved conditions through restoration and mitigation. Considerable amounts of baseline data have been collected on wildlife and their habitats. The resulting maps are used to assess the suitability of
particular sites for development and to determine the protections needed. For instance, “General Operating Requirements” apply a base level of environmental and wildlife protections that must be observed in any oil or gas drilling operations throughout the state. In “Sensitive Wildlife Habitats” a higher level of protection is required which may include reductions in the amount of surface disruption allowed and/or seasonal restrictions on development activities. The highest level of protection is applied to certain “Restricted Surface Occupancy” areas such as quality riparian areas, sage grouse leks, and raptor nests, where all oil and gas development is prohibited except under extraordinary circumstances. Incentives for landscape level assessments are also included to help address the cumulative effects of multiple individual wells across a basin. While industry groups initially filed suit challenging the new regulations, the suit was dropped not long ago – as industry became more familiar with the rules and found that they helped build their “social license to operate” in the state.

For more information see: “Final Statement of Basis and Purpose” at http://cogcc.state.co.us/.

• While farmers tend to like renewable energy projects, second home owners tend not to – creating neighbor vs neighbor conflicts in areas considering such projects.

• Zone-based approaches are attractive to project developers – if they are available up front. More, well-characterized “go zones” would be a major boost to project efforts. Programmatic environmental impact statements for solar projects on federal lands are being developed as a potential component of the response to this need.

Wind Energy Overlay Zones in Klickitat County, Washington

In the spring of 2005, Klickitat County, located in southern Washington along the Columbia River, established the nation’s first Energy Overlay Zone (EOZ) with an ordinance aimed to expedite wind energy siting and development throughout the county. Covering over 1,000 square miles – two thirds of Klickitat County – the EOZ is a mapping tool showing wind developers where they are welcome to pursue potential projects. Prior to establishing the EOZ, Klickitat County assessed the potential for wind development in the region by conducting wind energy and avian studies, economic impact statements, reviewing land uses, and consulting local residents. Wind energy development in the EOZ is automatically approved at the county level eliminating the need for site-specific zoning applications, approvals, and further environmental assessments. The EOZ abates the costs and risks associated with wind energy siting, making Klickitat County an attractive region for wind energy development. Moreover, by conducting a rigorous environmental assessment of the entire County, eliminating areas of major avian flyways, and requiring that developers monitor impacts on bird and wildlife populations, Klickitat County’s EOZ ordinance alleviated many of the environmental concerns associated with
wind energy siting, and influenced environmental organizations such as the Audubon Society to say “yes” to wind energy in Washington State.

For more information see: http://www.klickitatcounty.org/business/default.asp?fCategoryIDSelected=1118909864.

• There appears to be a dearth of data on projections of how changing weather and seasonal conditions are likely to affect habitats and wildlife. This will create problems as baselines change and regulatory zones may or may not.

• Developers do not know the best places to mitigate, and many environmentalists fear mitigation. More attention needs to be given to how best to ensure mitigation provides the expected benefits over time in a manner that will enable its use by project developers.

• Given the limits of available data, a robust system for “learning as we go” will be necessary in this arena – including iterative processes for combining renewable energy development with net benefits to regional conservation goals. Dynamic offsets – floating special management zones on working landscapes – may offer some help in responding to these needs.

Wildlife Restoration in the Jonah Natural Gas Field in Wyoming

The Jonah Natural Gas Field in southwest Wyoming is not only one of the nation’s largest energy development areas, with drilling wells and infrastructure covering over 30,000 acres, but also one of the most diverse wildlife habitat regions in the lower 48 states. In 2007, The Wyoming Chapter of The Nature Conservancy developed a model encouraging the energy industry and land managers to think more proactively about conservation on the Jonah Gas Field. Through this model, which merges the goals of energy development and biodiversity preservation, The Nature Conservancy created a map and study showing critical wildlife and plant habitat, landscape quality, future development risks, and best management practices for various species in the region. With map and study in hand, the Jonah Interagency Reclamation and Mitigation Office (JIO), a office that manages a $24 million mitigation account, has the tools necessary to make sound decisions both pre and post drilling regarding habitat acquisition, restoration, and management.

For more information see: http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/wyoming/howwework/energy-by-design-in-wyoming.xml.
• Landscape level pooling of mitigation funding might be a good way to help identify, procure, and maintain conservation priorities on a regional basis.

• Both site specific (impacts of turbines/solar collectors) and regional (roads, transmission lines, viewsheds) impacts are important to consider.

• Given the hurdles faced by renewable energy projects, conservation organizations are going to have to take them on as something they support in order for them to be built, or shale, gas, oil, and other sources of energy will fill the vacuum. Among the hurdles are trying to fit renewable energy projects into regulatory regimes built for fossil fuel fired generators to which the fuel could be brought, often close to cities. Renewable energy facilities have to be built at the fuel sources and then the power brought to the load – often across long distances unless small, distributed sources are used. The expectation of many is that support from conservation organizations is likely to speed up the permitting process.

> “Renewable energy has become iconic…and icons fall hard.”
> — Arthur Haubenstock, BrightSource Energy

• Really practical discussions on the details of how conservation groups might best become involved in these efforts are needed - maybe the Land Trust Alliance, or other similar conservation organizations would host some among its members. Among the topics that could be covered are: why (goals); strategy (when, values); and tactics (PR, legal processes, etc.).

• Experience from the siting of wind projects in Vermont suggests that such projects proceed most rapidly if: there is honest engagement by the developer with the local communities affected; attention is paid to the scale of government used to make decisions (local, regional, and state); and the overall features of the project connect with local values. Work remains to be done on mechanisms for sharing the tax revenues from such projects with all the towns affected, not just that in which the project is located.

• Increasing amounts of attention are being given to the links between energy and water, both from the efficiency (quantity) and quality points of view.