# *Green vs. Green:*
# *The Political, Legal, and Administrative Pitfalls Facing Green Energy Production*

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*An Institutional Framework for Analyzing Conflicts between Green Goals and Green Regulations*

**Introduction**

Our purpose is to evaluate the political, legal, and regulatory environment facing large-scale green energy development in the United States. In particular, we focus on the environment for solar, wind, geothermal, biofuels and small to micro hydro energy development. There are many evaluations of the economics of green energy and we do not attempt to add to or evaluate those claims (see, for example, Fogarty, Tom and Robert Lamb, Investing in the Renewable Power Market: How to Profit from Energy Transformation 2012, Wiley). Economic claims aside, there are real barriers to entry for developing green energy. The most prominent of these barriers are the existing environmental laws and regulations. After extensive review of current environmental policies, including those promoting green energy development, we argue that in sum, environmental laws and regulations hamper the development of clean energy. In addition, the micro-goal of protecting individual areas, species, small-scale ecosystems and other local environmental aims often limits ability to achieve macro-goals like preventing global climate change or transitioning to large-scale green energy production. Statutes and regulations designed to protect environmental and cultural integrity from degradation directly conflict with other stated environmental ends.

We analyze political choices using the tools and assumptions of economics. The focus of that analysis is how individuals choose within the constraints of rules. We assume that citizens, legislators, bureaucrats, and interest group members have passions and interests they pursue through governmental processes. It is as if we view politics as a game and these various players in the game are the game pieces. Unlike a board game, however, these game pieces move on their own power. They sometimes group together to form alliances to accomplish their ends. Sometimes they sit back and watch others play.

This model of politics and the democratic process is a simple one. The players—voters, interest groups, politicians, and bureaucrats—attempt to accomplish their own ends through government. By assuming these players are self-interested, we do not assume that they are selfish. We are simply saying that they attempt to accomplish their own goals. Examination of the actual goals is where notions of selfishness and otherness can be discerned. We assume that many people have goals that are other-interested. Many want to save polar bears and prairie dogs, for example. Others care only for themselves. People attempt to achieve their goals even if those goals and actions conflict with those of others. Thus, our self-interest assumption is that people pursue their own goals, and that those goals can be broad or narrow.

This is essentially a common sense view of politics. We all know that most of the time people invest their scarce time in doing what they value the most. Conversely, they choose to not invest in actions that have little payoff for them. Of course, we do not always know what is best for us, but neither does anyone else. The decision environment is best characterized by varying degrees of uncertainty; that is, we only rarely know with confidence what will happen. We always choose in varying states of ignorance with respect to what nature and other rational, self-interested people are contemplating. But, people have invented ways of reducing uncertainty. We call those inventions rules and some rules are cultural, others are political implementations of cultural rules, and others are simply political.

The social order that emerges from socio-political rules reduces uncertainty and allows people to advance their interests. Such rules structure the behavior in the political game. Among those rules are constitutions that prescribe how subsequent policy choices and decision changes are to be made. Civic rights, property rights, contracts, etc., serve to better define who commands which resources and how they may be employed and transferred. The important point is that collective institutions are highly important matters with good and bad consequences for individual and joint welfare.

**Institutional Analysis and Policy Design**

Evaluating the political, legal, and regulatory environment for green energy requires choosing an analytical framework, a theory of policy development, implementation, and evaluation. There is, however, no overarching or unified theory of public policy. In fact, there are competing and even conflicting theories. The February, 2009 issue of *The Policy Studies Journal* (Vol. 37, issue 1), for example, contained what the editors called a "policy shootout" in which authors of ten papers competed to make the best pitch for their favored approaches to policy analysis. Many of the proffered approaches overlap and complement each other. Even so, it is quickly clear from reading the articles that the field is an eclectic one.

We chose to apply the Institutional Analysis and Development (IAD) framework to policy analysis and design developed by Elinor Ostrom and her colleagues at the Workshop in Political Theory and Policy at Indiana University (Ostrom, 2011, 7-27; Ostrom, 2007, 21-64). The IAD framework is a policy analysis tool that provides a means of organizing information and data across different policy levels. It emphasizes organizations and interactions among the various actors in the policy arena (Ostrom calls it an "action arena") that interact. The IAD emphasizes what we believe to be the most fundamental aspect of policy formation-- the institutions within which policy processes take place. We use "institution" in the way used by Ostrom (1996) and Douglass North (1990). An institution, according to them, is "a widely understood rule, norm or strategy that creates incentives for behavior in repetitive situations" (Polski & Ostrom, 1999). Institutions can be laws, policies, customs or formal and informal procedures. They may be visible, as in the case of a particular law, or they may be invisible, existing in the minds of each member of a community. They coordinate actions because they create expectations about how others will act in a particular policy or collective choice arena.

Both Ostrom and North stress that institutions and organizations are different analytical concepts. Institutions are rules. Organizations are structures. Institutions may be the product of conscious human

choices such as a law, regulation, or court decision, or they may be the product of the unconscious accretion of rules of thumb or experiences. Institutions that are the product of human actions but not of conscious design can be as formal as the common law and as informal as the rules determining whether offense or defense calls fouls in a pick-up basketball game. Whereas organizations are visible, institutions can be rather invisible, especially to outsiders. A city council is a visible organization, for example. But the customary rights, sanctions, and norms shared in a community are often invisible in the sense that they are not written down anywhere. They develop through time and exist in the minds of the community members.

Social order emerges because socio-political institutions and organizations reduce uncertainty and allow people to advance their interests. They structure the behavior in the political game. Political organizations create policy arenas within which rules are decided. Among those rules are constitutions that prescribe how subsequent policy choices and decision changes are to be made. Civic rights, property rights, contracts, etc., serve to better define who commands which resources and how they may be employed and transferred (Kiser & Ostrom 1982, 208). Kiser and Ostrom identified three levels of political institutions: procedural, collective choice and constitutional. The procedural level consists of rules that direct how individuals act. The collective action level is the set of rules determining how to make procedural rules. That is, it consists of legislative procedures. The constitutional level defines and limits the kinds of legislation that may be adopted. Our focus is on the collective action and procedural rules. Specifically, we consider local, state, and national legislation and the effects of that legislation once it is converted into procedures and regulations.

In our analysis, we examine both institutions and organizations. We identify formal and informal organizations and attempt to discover and evaluate institutions that exist within and across those institutions. Our analysis, we believe, provides an organized means of better understanding the patterns of interactions that result in green goals conflicting with green policies.

**Analytical Concepts**

*Institutions and Organizations*

Policy processes are messy, or more formally, they have a great deal of complexity. They operate within different levels of institutions and across organizations. They may be created by interactions that are games within games as protagonists and antagonists bargain, threaten, cooperate, or demonize. Often, groups that cooperate at one level are in opposition with each other at another level. A major reason for that complexity in the United States is that our organizational context is federalism, a system in which political power, or sovereignty, is divided among the national, state, and local governments. Distinct as well as overlapping areas of rights to govern reside in each level of our federal system. Power at each of these levels is often separated between judicial, executive, and legislative authorities. In many counties and municipalities however, the executive and legislative powers are not separated. Instead, they are combined in the county or city council. Separating power within levels of government is not required in a federal system but it is a key feature of American federalism. Local political power is not restricted to cities or counties as it is also exercised by special taxing districts such as mosquito abatement or water conservation districts, associations of government and even the most rapidly increasing form of local government—homeowners' associations. All told, there are more than 80,000 different governments in the United States.

Sometimes jurisdiction between several these levels of government overlaps and sometimes it does not. The federal government can pass a law to protect endangered species that cannot be ignored by other state and local governments. Those governments can, however, establish rules more restrictive than those from the national government. California for example, has a statewide Endangered Species Act that is more powerful than the national one. Conversely, because zoning authority resides with state and local authorities, a local homeowner association may choose to establish rules prohibiting solar panels from being seen from the road. Just as the association can banish basketball hoops to the

backyard, it can banish solar panels to the backside of a roof, regardless of the national government's desire to promote solar energy.

**The Democratic Process**

We analyze political choices using the tools and assumptions of economics. The focus of that analysis is how individuals choose within the constraints of rules. Thus, instead of studying just the structure of bureaucracy, we also study how that structure affects the individual bureaucrat. Congress is a large, complex institution that is best understood, we believe, by studying the individual members and how they act within the formal and informal rules of Congress. Likewise, when we study interest groups, we consider the individuals in those groups. We evaluate individual benefits and costs from participating with the group. We assume that citizens, legislators, bureaucrats, and interest group members have passions and interests that they pursue through governmental processes. It is as if we view politics as a game and these various players in the game as the game pieces. Unlike a board game however, these game pieces move on their own power. They sometimes group together to form alliances to accomplish their ends. Sometimes, they sit back and watch others play.

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invest their scarce time in doing what they value the most. Conversely, they choose to not invest in actions that have little payoff for them. Of course, we do not always know what is best for us but neither does anyone else. All decision environments, including policy arenas, are characterized by varying degrees of uncertainty; that is, we only rarely know with confidence what will happen. This is especially true in policy decision environments. We must choose to participate, or not, in varying states of ignorance with respect to what other rational, self-interested people are contemplating. We noted above that Kiser and Ostrom identified three levels of political institutions: constitutional, collective choice, procedural; we also noted that our analysis is at the collective choice and procedural levels. We assume that at the collective action level (Congress, legislatures, councils and boards), many players in the collective action game will attempt to have laws passed that are consistent with their own goals. Further, we expect that they will also attempt to influence the content of procedural-level rules and regulations and will work to ensure that procedural rules are followed. Citizens pursuing their private desires quickly learn that organized groups have more influence on laws and regulation setting than do individuals. They often, therefore, organize into interest groups where they can pursue their goals.

Individuals and groups lobby to have their interests reflected in the structure and outcomes of laws, rules, and regulations. Much lobbying is what economists call "'rent-seeking," which is more than just seeking favors. It is attempting to collect benefits, both physical and emotional (what economists call 'rents') from capital the actors do not own. The standard term used to describe them is "rent-seekers." Rent-seeking literature identifies outcomes from lobbying that are quite the opposite of that predicted by James Madison in Federalist 10. In that essay, Madison argued that the federal design provided by the proposed constitution would control the excesses of factions. He defined factions as "a number of citizens, whether amounting to a majority or a minority of the whole, who are united and actuated by some common impulse of passion or of interest, adverse to the rights of other citizens or to the permanent and aggregate interests of the community." Madison was especially concerned about

majorities taking advantage of minorities and believed that with their new form of government, they were creating a political marketplace in which majority factions would compete with and control each others' excesses. It is possible to interpret Madison's analysis as concluding that the political game played under the rules of federalism was in some ways, an exchange or gains-from-trade game.

In Federalist 10, Madison anticipateed situations in which majorities exploit minorities; he did not anticipate minorities useing the political system to exploit majorities. The rent seeking literature takes up that analysis by viewing political games as wealth-reducing activities. In these games, the amounts of wealth the players spend attempting to gain rents are, in total, more than the value of the rents gained. As we explain in detail below, they are locked tragedy of the commons. By seeking their own interests, they often make others worse off. Attempts to stop the Cape Wind project (Chapter 4) may, for example, be a form of rent seeking. If the opponents are successful in blocking the project, one likely result is that more carbon-based energy will be used than if the project were built. Rent seekers attempting to get a regulation adopted can harm other interests, as is the case of protecting the Indiana bat under the Endangered Species Act, which in effect, makes some excellent wind power sites unavailable.

Group members seldom see the costs of their actions but they do see the benefits. Prairie dog proponents rejoice at saving prairie dog colonies but they often do not pay the costs of formerly productive agricultural lands being rendered unproductive. Mandating that a city increase the amount of wind power it uses but also enacting laws that prohibit siting wind power anywhere near the city means that wind generation facilities have to be located elsewhere, usually in rural areas in other states. Thus, the city's politicians and citizens get the benefits of wind energy and the environmental and social production costs are exported to other places. A city council or state legislature can adopt a solar or wind energy mandate without considering the costs of transmitting the energy. They do not have to consider the costs to a rural area of having hundreds of windmills or hundreds of acres of solar

facilities, whose energy production is exported elsewhere. Likewise, groups opposing siting a wind farm on their favorite viewshed do not have to consider the costs of not reducing the amount of carbon-based energy.

Divorcing costs from benefits is what happens in the familiar setting of a group dining together and agreeing to split the bill. The situation even has a name—*the unscrupulous diner's dilemma.* If the bill is being split evenly, the selfish diner will order an exceptional dinner in the belief that her/his fellows will order normally. But, if everyone orders more in the expectation that others will help pay the cost, they each end up with a far higher bill individually and severally than if they had agreed at the outset to each pay their own portion of the bill. If friends are willing to do this to each other face-to-face sitting around a table, think how much more interests in the policy arena might be willing to do it to anonymous others.

The unscrupulous diner's dilemma was illustrated in an environmental context by biologist Garrett Hardin in his 1968 article, "The Tragedy of the Commons." He focused the attention of the environmental movement on incentives and human action. In that essay and others (e.g. 1977 & 1982), Hardin showed that analyzing most environmental issues, from overcrowding in national parks to overgrazing commonly owned property, requires an understanding of who controls access to a resource, who gets the benefits from using it and who pays the costs. Hardin said the answers to those questions lead to basic policy principles for encouraging preservation.

In this classic article, Hardin claimed that many of our environmental problems are caused by a system of open access to a commonly owned environment. He summarized conventional wisdom about common property[1] as follows, "Ruin is the destination toward which all men rush, each pursuing his own best interest in a society which believes in the freedom of the commons. Freedom in a commons brings ruin to all" (Hardin, 1968, 1244). Hardin's article became one of the most cited environmental articles ever published and his call for "mutual coercion, mutually agreed upon" was the intellectual

justification for decades of environmental legislation in the United States.

Hardin used a pasture as an example of how the commons can produce tragedy. As long as grazing on the commonly owned pasture is below carrying capacity, a herdsman may add another cow without negatively affecting the amount of grazing available for other cows. But once carrying capacity is reached,[2] adding the additional cow has negative consequences for all users of the common pasture. The rational herdsman faced with adding the extra cow calculates his share of the benefits (100%) and his share of the cost (1/n herdsmen) and adds the cow. And another. As do all other herdsmen. Each may care for what is common but can do nothing about it since one person exercising restraint only assures himself a smaller herd, not a stable, preserved commons. Thus, the commons is a paradox—an individual acting in his self-interest makes himself and everyone worse off in the long run but an individual acting in the group interest cannot stop the inevitable ruin.

A misunderstanding about the tragedy of the commons is the claim that the core problem is lack of conscience. If people simply developed a conservation ethic, were less greedy, less inculcated with western values and more caring of the community, the common claim is that the tragedy would not happen. Hardin rejected appeals to conscience out of hand; "To make such an appeal is to set up a selective incentive system that works toward the elimination of conscience from the race" (Hardin 1968, p. 1245). Further, to conjure up conscience "in the absence of substantial sanctions, are we not trying to browbeat a free man in the commons into acting against his own interests" (Hardin, 1968, p. 1245)? He claims, with much justification in evolutionary biology, economics, and political science, that successful policies are those that do not require people to act against their self-interest. Appeals to conscience may work in the short run but self-interest means such policies are not sustainable.

Hardin claimed the core problem to be lack of responsibility as defined by philosopher Charles Frankel. "Responsibility is the product of definite social arrangements. ... A decision is considered responsible when the man or group that makes it has to answer for it to those who are directly or

indirectly affected by it"," (Hardin, 1968, p. 1244) he said. Frankelian responsibility exists, then, when people taking an action must pay the costs of that action. Since costs also imply benefits, the other side of the responsibility coin is that the person taking the action also receives the benefits of that action.

On the commons, individuals have the authority to add an extra cow and each gains the benefits of his actions. But, the costs of each herder's actions are spread among all other users of the commons. *Any action on a commons is intrinsically irresponsible because costs are socialized and benefits are privatized.* Without the corrective feedback provided in a system establishing Frankelian responsibility, destructive actions are encouraged and, Hardin says, inevitable.

The idea of the commons is a core concept for understanding problems faced in creating green energy. Assuming that green energy makes everyone better off by reducing carbon consumption, it is clear that no one can be excluded from the benefits. But the provision dimension is another story. Green energy facilities need to be placed somewhere but they can be excluded from many, if not most, locations. The strategy for locals is to say they are in favor of green energy but the facilities need to be located elsewhere. The producers of green energy, thus, are restricted from accessing available sites, which reduces the amount of green energy production. Returning to Hardin's story of the common pasture, producing green energy makes society better off. But, we all have an incentive to disallow production facilities in our favorite part of the pasture. In this new story, we are not adding more cows to the commons, thus creating a tragedy through destruction. Instead, we are systematically reducing the amount of pasture available for energy production. Protecting the pasture from energy production facilities makes everyone else worse off. In such cases, small, local interests harm the general interest.

Another analytical tool consistent with and often used in conjunction with the tragedy of the commons story is 'externalities'. When people take actions that create costs for a second person without that person's permission or sometimes knowledge, they are producing what are known as negative externalities. Conversely, there are positive externalities. A family adopting a stretch of

highway and keeping it clean makes everyone else better off. Their actions have positive spillover effects on others. When someone fouls the air or a stream, they are producing negative externalities.

In the context of Hardin's common pasture, adding an extra cow once the pasture has reached carrying capacity produces a negative externality. The person adding the cow gains all the benefits from adding the cow and the costs of his or her actions spill over onto all other users. The costs of adding the cow are socialized and the benefits are privatized. Socialized costs and privatized benefits mean that the person adding the cow gets a 'free-ride' at others' expense. They are free riders.

An excellent treatment of the free rider problem and its implications for group action was provided by Mancur Olson in his 1965 book, *The Logic of Collective Action: Public Goods and the Theory of Groups.* Olson and Hardin wrote about the same general issues, how individuals acting in their short-term self-interest can produce outcomes that make the group worse off. Hardin wrote about individual action in a commons and Olsen wrote about individual action (or non-action) in achieving group goals. Olson explained that the problem of groups achieving their goals comes down to the free rider problem. Everyone in the group may share a common goal but when everyone in the group gets the benefits of achieving the goal, whether they contribute to obtaining it or not, there is a strong incentive to let others work toward the goal. Or, in other words, they are incentivized to free ride.

Olson illustrated the point made by welfare economists about situations having two distinct characteristics—non-exclusive provision and non-rivalrous consumption. Non-exclusive provision means that once a benefit is provided for one member of the group, it is provided for all. That is, individuals cannot be prohibited from the benefits. Non-rivalrous consumption means that one person's consumption does not affect other peoples' consumption. Standard examples of such situations are police protection, GPS signals, flood control, and national defense. Something characterized by non-exclusive provision and non-rivalrous consumption is known as a public good. With private goods, on the other hand, usually the owner enjoys private goods, and that person's consumption means others

cannot consume it. Oranges, cell phones, and automobiles are just a few from the myriad of examples.

Private goods are easily provided in markets because there are willing buyers who can only get the benefits of the private good by purchasing it. The problem with public goods is that when the benefits of something (a project or getting a new law or regulation adopted, for example) are non-exclusive and where consumption is non-rivalrous, successful group action is unlikely. If everyone thinks that way, no one produces a public good voluntarily. Public goods are, therefore, less easily provided than are private goods. The incentives are all wrong: since people obtain the benefits of a public good without paying for it, if it gets provided, there is a powerful incentive to offer nothing or little in exchange.

Consider the problem of getting people to voluntarily pay higher prices for switching their energy consumption away from fossil-based sources to greener ones. Such a switch produces a public good—lower carbon production. Everyone shares the benefits of making the switch, even those continuing to use energy produced from coal. The costs are paid by those willing to pay the higher price. Consider the problem facing a wind energy entrepreneur who hopes people will willingly pay him to produce low-carbon energy. If he tries to sell subscriptions to his service, he will find that although many people claim they want the energy they consume to be greener, few are willing to pay the higher price. Something that people want in the abstract—greener energy—fails to be produced because those same people are not willing to pay for it. Of course, if they can get others to pay for it, they are all in favor.

We note that although public goods and commons problems are similar, there is an important distinction. In the commons, consumption is rivalrous, whereas it is non-rivalrous for public goods. The distinction is important when considering policies for overcoming the free rider problem in each case. In a commons, causing people to become responsible for the externality they produce can change their behavior. For public goods, private incentives such as subsidies or other benefits can encourage a

sufficient amount of people to contribute so that public goods are produced.

**The Action Arena**

The green energy game is played in the same institutional arena that traditional energy development operates in. Private interests, organized and unorganized opposition and strict legal requirements characterize that arena. Opponents to traditional energy projects discovered that the projects had to go through several political chokepoints before receiving authority to proceed. These chokepoints operate much like a firewall between a local network and the internet. Before any information can enter a local network, it must meet authentication tests, error detection tests, and rules regarding syntax and semantics before it can enter the local network. Political chokepoints work the same way. Before a project can move from proposal to actual development, it must meet the requirements established by federal legislation and regulation and, because we are in a federal system, it must also meet requirements established by state and local laws and regulations. Those proposing a project must authenticate that the proposed project will meet all applicable regulations. Because opponents are skilled at challenging a project, the proposal must not contain errors in its projections of impacts on local flora and fauna, groundwater, air, archeological sites, sacred Native American lands or geological formations. All this has to be done according to rules and procedures created by national, state, and local legislation and court interpretations of that legislation.

Firewalls stop any information that violates or does not meet its procedures; political chokepoints do the same for proposed energy projects. Challenges to fossil fuel projects come from a broad range of sources, well organized, and funded environmental groups to local garden clubs, for example. The concerns vary. Some are simply NIMBYism (Not In My Back Yard), cloaked as environmental concerns. Others raise serious questions about human and environmental health and welfare. The chokepoints allow groups to challenge project viability, environmental effects, and economic and cultural outcomes. In addition, chokepoints allow for challenges to procedures. Did the project need to

meet requirements of the National Environmental Protection Act (NEPA) for an Environmental Impact Statement (EIS) or was it justified in just doing an Environmental Assessment (EA)? Did it provide a realistic range of alternatives as required under NEPA? What about Clean Water Act (CWA) or Clean Air Act (CAA) requirements? Will endangered species be affected? Did the company file the needed paperwork on time and in the proper format? Are historical and cultural sites adequately protected as required under the Antiquities Act? Were Native American tribes consulted early in the process? If the project affects any stream, does the proposal meet requirements of the Army Corps of Engineers for mitigating wetland impacts? Even if the project gets past all the federal rules, does it meet the requirements of a state land use plan or local zoning rules? Can the project be challenged using common law nuisance requirements? The list can go on and on. The point is that there are many political chokepoints and they proliferate with each new local, state, and national law, the regulations that carry out the law and relevant court decisions.

Green energy projects must go through the same political chokepoints as traditional energy projects. Although nearly everyone favors developing alternative or "green" energy, they prefer that operations be located elsewhere. Local citizens and politicians often consider them unsightly, they may be fatal to local wildlife, legislators want to tax them to increase tax revenues, local communities want to charge impact fees to build local infrastructure, local environmental groups worry about environmental impacts and Native American Tribes are concerned with negative impacts on sites they consider sacred. Farmland preservationists worry that windmills or solar farms will destroy traditional farming. It quickly becomes clear that the constraints on alternative energy development are not just physical—long distances from transportation corridors, desert or mountainous terrain, necessary and available water supplies—but political.

The most obvious political chokepoint is the set of national environmental laws (we describe them and their requirements in some length in Chapter 3). These include the National Environmental

Protection Act (NEPA), the Endangered Species Act (ESA), the Clean Water Act (CWA) and the Clean Air Act (CAA). Each of these acts imposes restrictions that apply to any development. A solar farm that generates as much electricity as a natural gas well and power plant takes up thousands more acres and effectively destroys all vegetation under the collectors. Wind farms disturb thousands of acres and significantly affect viewsheds. Wind turbines have also been known to kill bats and some birds, including species that are endangered. Geothermal plants disturb 1-8 acres per megawatt (MW). Permits to disturb plant and animal life on public lands have to be granted through a drawn-out permitting process, often five years or more. At the very least, an Environmental Assessment (EA) has to be done and often an Environmental Impact Statement (EIS). Each of these involves studies, public hearings, other public input, revisions, and finally publication—all examples of political chokepoints

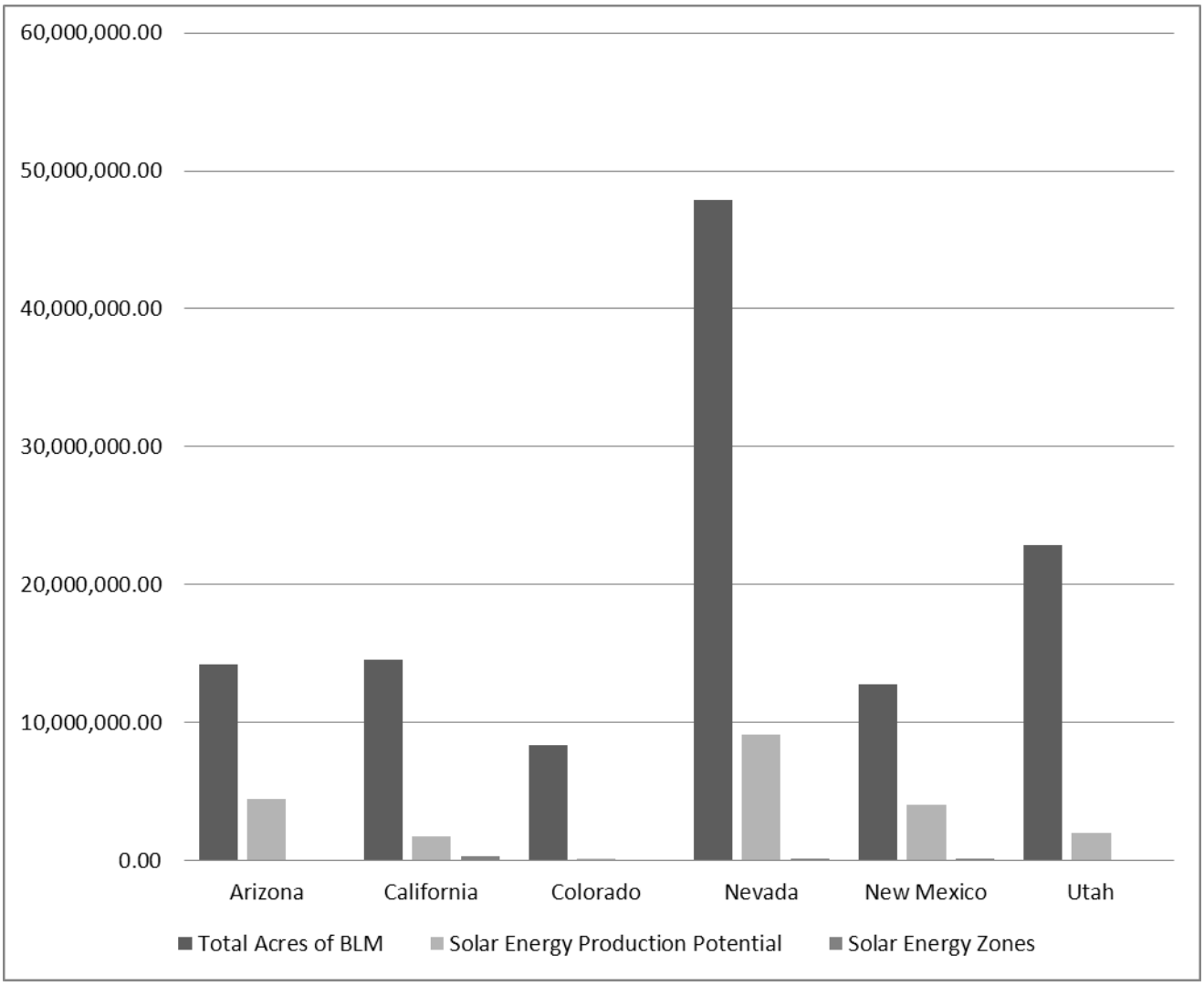
As noted earlier, wind and solar farms can consume thousands of acres. The visual disruption from these plants is significant. The 12 MW solar farm in Upper Sandusky, Ohio consumes 80 acres of former farmland, for example. Almost nothing grows under the solar panels because the panels intercept the sunlight. Wind turbines generating 1.5 MW typically have a hub height of 260 feet with another 115 feet from the hub to the tip of the rotor, for a total height of 375 feet. By comparison, the U.S. Capitol building is just less than 289 feet tall and the Statue of Liberty is 305 feet tall. The newest "tall" towers from GE have a hub height of 393 feet and can generate 2.3-2.7 MW. From the hub to the tip of the rotor is another 154 feet, so the structure from ground to rotor tip is 547 feet. These are massive structures. The proposed Cape Wind project in the Nantucket Sound would install 130 tall turbines across a twenty-five mile area and, although Cape Wind has been granted federal approval, local opposition is significant and legal battles continue on a variety of fronts.

State and local laws, as well as some federal rules, control the development of private lands. NEPA rules for example, do not generally apply to private lands but even projects on those lands must meet Clean Air Act and Clean Water Act requirements. They must mitigate any wetland losses and any

effects on cultural or historical sites must be controlled, in addition to meeting state and local land use requirements.

Developing green energy on the federal estate is controlled by the national government and those lands can provide many sites for large-scale alternative energy production. After all, the federal estate contains over one-third of the nation's on-shore lands. There ought to be thousands, if not millions, of acres of public land suitable for wind and solar farms and geothermal installations. The Bureau of Land Management (BLM), for example, manages just over 258 million acres, much of it in the arid West. Surely there are many suitable alternative energy sites on just those acres, let alone on the 193 million acres of forest and grassland managed by the National Forest Service. In fact, there are many such sites. The question is not whether there are suitable lands but whether current policies will allow them to be developed.

Ideal conditions for large-scale solar generation exist on the BLM lands of the desert southwest. Those conditions include the appropriate latitude for maximizing the number of daylight hours and the geographic location's effect on weather patterns. Sites that are often cloudy are not appropriate for solar installations (Solar Power: Environmental Benefits, n.d.). In 2011, the BLM prepared a draft programmatic EIS for solar energy siting on BLM lands in Arizona, California, Colorado, Nevada, New Mexico and Utah. The BLM first identified areas with physical conditions appropriate for solar energy production that have not already been set aside as Wilderness, Wilderness Study Areas, Areas of Critical Environmental Concern, National Monuments and Parks, etc. Next, the BLM worked with the states to identify lands that could be readily developable without substantial environmental controversy. Of the nearly 99 million acres that the BLM estimates are potentially suitable for solar production, the EIS identifies twenty-four Solar Energy Zones totaling 677,384 acres, which is less than .01 percent of BLM lands in the five states. See Graph 1 below.




Environmental groups, according to official statements at public hearings and in general, overwhelmingly support the idea of solar power and the idea behind the Solar Energy Zones in their comments at public meetings and written comments to the BLM. But, many believe the Solar Energy Zone proposals go too far, are in the wrong places and need to be modified or, in some cases, are outright rejected. Concerns were raised about the effects on the Sonoran Desert Tortoise, gulleys and other riparian areas, animals and insects. The Southern Utah Wilderness Alliance (SUWA), for instance, noted that the Wah Wah Valley (one of three proposed Solar Energy Zones in Utah) is too near lands with Wilderness characteristics. Other groups complained about insufficient water in the Wah Wah Valley to sustain solar production (Chapter 5). The Sierra Club asked that two of the Solar

Energy Zones in California be removed from consideration entirely. All told, the amount of 'uncontroversial' land available for solar energy production on public lands in the five states suggests that we should not expect widespread, significant production of solar from the public lands in the near future (Solar Energy Development, n.d.).

One of the serious chokepoints for developing any form of alternative energy on the public lands is the time and energy that must go into producing and reviewing an Environmental Assessment (EA) or Environmental Impact Statement (EIS). A President may order agencies to expedite review of an EIS or EA (as President Bush did to speed up the approval process for oil and gas and President Obama did to speed up approval of solar and wind-generating facilities) but ordering an agency to expedite something and actually having it happen is not the same thing. According to our conversations with BLM officials, even expedited reviews in the BLM take a minimum of three years and are more likely to take five years. The result is that, just as there were few actual "shovel ready" projects that could be implemented when the Congress passed the American Recovery and Reinvestment Act, there are few energy sites of any kind on the public lands that can be developed easily, quickly or perhaps ever, regardless of the wishes of a Congress or President.

There is no single action arena for approving the development of green energy. Approving a wind energy project, for example, often requires local building permits, changes in zoning, navigation through state regulations and production of an EIS or EA. In addition, it might require Section 404 permits if it affects any of the waters of the United States. If, as is often the case in the West, transmission lines cross private and public lands, negotiations must be carried out with federal and state agencies as well as private parties. The local building board, state regulators, federal regulators, and comment periods for and challenges to an EIS and state and federal courts are separate chokepoints at which different participants challenge the project.

Progress through these different arenas or chokepoints is not necessarily linear, as some arenas

are in play simultaneously. Others require approval in another arena to even be considered. A Section 404 permit for example, is only considered after an EIS is completed. And, the Army Corps may ignore the recommended alternatives in the EIS. These processes are messy, complicated, and confusing.

**Choices and Decisions**

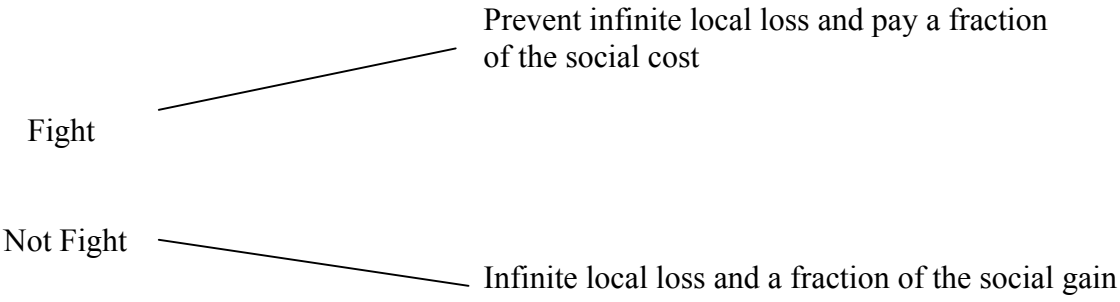
In the spirit of the unscrupulous diner's dilemma mentioned earlier, we now turn to what we call the green vs. green dilemma. The dilemma is as follows: green activists sit down at the alternative energy development policy table. If the individual pays the costs of each person's choosing to preserve a local area from alternative energy development, those costs will be weighed against the local benefits of preservation. But if everyone at the table shares the costs of preservation, while the benefits remain local, there is little incentive to compare total costs and benefits. Just like each diner ordering the expensive meal, each activist chooses local preservation. The result is lots of local preservation but little alternative energy development. Activists usually base their opposition to new development, especially on public lands, on the value they place on a particular area such as a viewshed, watershed or on local fauna and flora, some of which may be endangered. Clearly, people are attracted to wild places for psychological reasons and development would harm the enjoyment people get from them remaining wild. Local environmental resources such as watersheds and endangered species however, are more than amenities. They are valued parts of integrated or interwoven natural systems and ecosystems. They provide ecosystem benefits for which there are few metrics for determining their value to humans.

What we have is an action arena in which some participants place essentially infinite value on a local resource that could be substantially harmed by alternative energy development. These participants strongly object to being classified as Not In My Backyarders (NIMBY). They see themselves as trying to 'save' their local environment, not as serving some private interest. NIMBY, as generally defined, is pejorative as is its companion term, BANANA (Build Absolutely Nothing Anywhere Anything (or

Anyone). A reason that activists react negatively to being labeled as NIMBYs or BANANAs is that the terms are usually construed as referring to people acting out of narrow, selfish interests. Activists we have talked to genuinely believe they are acting out of generous and even altruistic interests.

We believe, however, that NIMBY is not an accurate way to evaluate the green vs. green dilemma. Local activists believe they are acting to protect local but broad interests, not narrow ones. Saving habitat for a local endangered species or preserving a viewshed is acting to preserve something to which the activists attach very high, if not infinite value. On the other hand, their share of the benefits from increased amounts of green energy is not infinite or even large. If increasing green energy production is a public good, it is a relatively low-valued one. We are back to the free rider problem in which locals say they support increased amounts of green energy but the local contribution will be inconsequential to the overall goal. They decide, rationally, to protect their local resources.

One way to view the dilemma and the decision to act or not when a alternative energy project is proposed is in the form of a decision tree. The decision to fight has a potential payoff of infinite value and the cost of the action is shared with everyone else in the country. Even a small chance of winning is sufficient to motivate. The decision to not fight is often chosen if the development has an infinitely negative payoff and a fractional positive payoff.




As is evident in the figure, local interests will dominate the decision calculus. Of course, there is still the free rider problem as one voice is not likely to be decisive, so one gets the benefits or costs of an action whether or not s/he participates. But, environmental activists are likely to have a higher

degree of 'subjective efficacy' than others (Moe, 1988; Acevedo and Kreuger, 2004). This trait, which leads them to overestimate the significance of their own contributions, encourages them to join groups. A study of participation in Common Cause, a non-profit citizen watchdog group, showed that a combination of low cost and laudatory purpose encourages people's initial decision to join (Rothenberg, 1992). Those most likely to join Common Cause were affluent, highly educated, politically active and politically liberal—all traits that were sufficient to overcome a low initial cost of membership. In addition, those who remained members stayed because of a 'learned commitment' to purposes i.e. they found the group's purposes compelling and the activities pleasurable. This suggests that at least some people will overcome the urge to free ride and will involve themselves in protecting local environmental assets. These activists show up to public hearings, try to get appointed to stakeholder forums and submit testimony and even their own studies about the proposed project. Such ongoing participation may not stop a project but it might change it enough to make it more palatable.

The decision to not fight may be only temporary. An activist may consider in which action arena he or she is most likely to be effective. Participating in public hearings and stakeholder forums is something that many project opponents avoid. Instead, they move to a completely different arena—the courts. One interest group that has become a frequent guest of the court system is WildEarth Guardians (WEG). WEG has filed scores of suits against those they feel have violated environmental laws. They have petitioned to have thousands of rivers in Colorado protected from any intervention, including hydroelectric projects. Any instances where they feel companies are abusing the environment and thus neglecting or at best, not aware of environmental laws, they take those companies to court to ensure they are aware of their actions.

The decisions activists face in the various action arenas can be categorized according to three choices identified by A. O. Hirschman's (1970) book, *Exit, Voice and Loyalty: Responses to Decline in Firms, Organizations and* States. When faced with a decline in one's benefits, Hirschman said a person

could *exit* the relationship, *voice* opposition and provide proposals for change or remain loyal to the situation. Loyalty to firms or brands is an example. Accepting a policy based on party loyalties or because it comes from a politician one attaches him or herself to are others. It may be too expensive for an activist to participate in each action arena that exists in the American system of federalism—local planning board, city or county council, agency hearings and court proceedings, for example. A rational strategy, once one decides to not exit all action arenas, is to be loyal in some and exercise voice in others.

| Choice | Outcomes |
|---|---|
| Exit | Physically or emotionally leave the action arena. Those who exit from one arena however may return to the issue when it enters another action arena. |
| Voice | Be actively involved in opposing the project. Submit testimony at public hearings, get appointed to stakeholder forums and submit studies relevant to the process and issue. Organize opposition and post propaganda online. Meet with politicians. Stir public opinion. |
| Loyalty | Accept the process and believe that it will produce a 'fair' result. Alternatively, believe that one person's participation has little value and invest time and energy into something in which s/he is more likely to have an impact. |

**Integrating the Analysis**

In order to understand why local green groups chose to oppose regional alternative energy projects, it is necessary to view their decision through the IAD lens. It seems almost unorthodox, at times, for conversationalists to oppose projects that would ultimately have a positive effect on the environment

and would lead to less pollution in the long run. It is the decision by energy companies to site their project in what the green group views as an *especially* damaging location that often riles the conservation group; they see a myriad of other options for siting. Even if on a personal level, individuals that are part of a conservation group think that employing more alternative energy is preferable to less. As part of that group, they will have faith in the process and might even begin to actively oppose alternative energy plants.

*Policy Arena*

Since all actors in the following case studies are operating in the same policy arena, that context must be thoroughly understood. One of the major conflicts that will characterize these studies is the inherent friction created from the federal system. As will be explored in depth in the following chapter, many federal environmental regulations are written so as to ensure that the federal government is able to retain exclusive authority over their lands, despite their location. Thus, states are forced to accept a certain level of interference. States can, however, choose to make laws that are stricter than those imposed nationwide. For example, Utah has a higher smoking age -nineteen- than the rest of the country, where an individual can smoke once they are eighteen. Understanding the policy arena also incorporates an understanding of alternative energy type, siting conditions and specific area conditions, all of which are factors explaining why that particular area was chosen. Additionally, there should be an exploration of the preferred policy outcomes and how those match up with the actual outcomes, if they even match up at all.

| Local Stakeholders | State Stakeholders | National Stakeholders |
|---|---|---|
| Citizens, user groups | User groups | User groups |
| Local politicians | State politicians | National politicians |
| Homeowner associations, special districts | Public Service Commission | Rent seekers |
| Energy companies | Utility Companies | Energy companies |
| Green groups and nonprofits | Green groups and nonprofits | Green groups and nonprofits |
| Planning and zoning commissions | State regulators and the judiciary | National regulators and federal courts |
| Farmers and ranchers | | |

*Stakeholders*

Once the context is understood, the agents acting in that context must be considered. Generally there are several key stakeholders, those at the local, state, and federal level. The beliefs, values, and preferences of these stakeholders must be reviewed and compared with their respective communities. Are these stakeholders benefitting from the proposed energy plant or what do they stand to lose if the plant is or isn't sited? What is the preferred outcome of the situation for each stakeholder, how do these outcomes match up with the realized outcome and how much control to these stakeholders have over the outcome? The positions of each of the players must also be considered, in addition the information

available to them and how they use that information.

Generally, these players fall into four distinct categories. First, we will discuss citizens. These citizens may be user groups that enjoy access to these areas and the beauty or recreation it provides them. Second, are the politicians. Politicians will generally push for policies that got them elected to office and will keep them in office. Also, politicians have the power to appoint those in the third category— bureaucrats and regulators. It is those in charge of the regulating agencies that decide how legislation passed by politicians is implemented and applied. These bureaucrats implement laws on at every level of government, from small homeowners' associations regulating the use of solar panels to national agencies managing wind energy proposals. Finally, interest groups can lobby politicians, bureaucrats, and citizens for their support. These interest groups may be on other sides of the issue and will lobby for outcomes that benefit them most at every level of government.

Each of these stakeholder types has a set of tools available to them; some tools are distinctly assigned based on stakeholder type, other tools are available to all types, regardless. Citizens can petition interest groups, donate money to causes, or join groups in order to expand their impact. Both citizens and interest groups share many tools in common. Citizens and interest groups can take advantage of politicians, especially during an election year. If they do not receive the answer they want from a politician, they can start a voter initiative. As part of these groups or as an individual, citizens can file lawsuits in order to have energy plant construction halted or ended all together. When proposals are put up for public comment, citizens and groups can use this period as a way of creating noise around a project proposal so it will receive more attention. Additionally, citizens and groups can protest projects or make themselves into an unofficial watchdog.

Politicians have several tools that are unique to their position. They can propose and pass legislation that will either help or inhibit projects. Under their legislative duties, politicians also have the power to implement taxes or fees and set mandates and goals that will affect projects. In order to

gain support, politicians can make policy statements regarding their opinion on a certain problem or how they would like to see an outcome be achieved. They appoint bureaucrats and individuals at regulatory agencies. Politicians also control the funding that these agencies receive, which can in turn, dictate how powerful these agencies are.

Bureaucrats and members of regulatory agencies set and control many of the barriers to entry for energy projects. Homeowners' associations regulate covenants, conditions, and restrictions. Lower level bureaucrats implement nuisance laws, planning and zoning laws and set local procedures. Utility company bureaucrats set rates and make decisions over what type of energy they choose to buy. Further up the bureaucratic chain are policy implementers; here federal and state environmental institutions are created and framed.

All of these stakeholders have access to the following set of tools, some of whom have learned to use them expertly. Lobbying politicians is available to all stakeholders, even politicians, who can pressure each other to pass legislation. Stakeholders can also take issues to court and make the judiciary clarify legislation. Using media to change public opinion and garner support for your cause is a widely available tool, which must be used carefully. Social media has become a newer tool, and a favorite of conservation groups.

| | **Citizens** | **Interest Groups** | **Politicians** | **Bureaucrats & Regulators** |
|---|---|---|---|---|
| **Voice**: Clamor, media, letter writing, initiatives | X | X | X | |
| **Procedural Tools**: Comments EIS/EA, zoning, studies | X | X | X | |
| **Lobbying** | X | X | X | X |
| **Policy Tools**: Rate setting, taxes, mandates, | | | X | X |

| | | | | |
|---|---|---|---|---|
| regulations | | | | |
| **Courts**: Nuisance laws, procedure | X | X | | |

*Rules in Use*

The next step is to analyze the rules that stakeholders adhere to. Rules may be formal listed rules such as legislation, or informal rules such as implicit community standards. Formal laws include all of the federal environmental institutions that have multiplied over the past fifty years. Any federal laws that govern businesses may also be part of these formal rules. In this text however, we focus only on energy siting. States also have their own set of formal rules. Some states such as Massachusetts and California have their own NEPA process, an environmental review procedure that will be explored in depth in the next chapter. Local counties, cities, districts, and even homeowners' associations may also have their rules regarding how energy can be sited and how the construction of these sites can occur. Informal rules involve the unspoken set of cultural values and societal norms that govern how people act (Smajgl, Leitch, & Lynam, 2009). These rules can include how individuals are expected to operate once they join an interest group or a regulatory agency. The way in which the four types of stakeholders interact is also governed by informal rules. Many of the rules describing how these groups should use the tools available to them such as the media, are governed by these unspoken standards. Also, using these rules in a more untraditional way than what has been described above, outside of their customary use, fits into this description.

*Analyzing Outcomes*

Once all of the above components are understood, then the final outcome of the situation can be

analyzed. First, all of the possible outcomes should be recognized. Then, achieved outcomes should be compared with the policy objectives. It is important to note whether the results were satisfactory or important and if they had a lasting effect. What are the expected results of these outcomes and will they affect areas outside of the immediate policy arena?

In order to fully understand the stakeholders, their expected or preferred outcomes should be studied. Citizens will prefer whichever outcome will give them the most utility and benefit; this may mean cheaper utility rates, more energy options or greener energy options. Interest groups will want to see their policies being implemented. Politicians will seek after rents or votes, possibly both at the same time. Bureaucrats will try to seek outcomes that will allow them to keep their jobs, meaning they will trend towards outcomes that have little negative impact or controversy.

The purpose of the following narratives is to analyze the patterns of interaction between green interest groups, energy siting companies, regulators, and regulating agencies, citizens, and politicians. By understanding the patterns of interactions, readers will be able more thoroughly understand the outcomes and why those outcomes matter. Additionally, readers will be able to understand how to apply the IAD framework in order to understand future green v. green conflicts.

Endnotes

[1] Since Hardin first wrote about the commons, scholars have distinguished between common property in which there are no relevant institutions (open access) and common property as a social institution complete with use rights, sanctions, and norms. All references in this discussion to the commons or common property should be understood as open access.

[2] Carrying capacity is not a fixed or even constant measure across all systems of grazing. The absolute number of cows able to use a particular pasture without destroying it varies according to timing of the grazing, rest periods, moisture, weather, etc.

# Chapter 5 Solar Energy

*Introduction*

Luz International Ltd. built and operated nine solar-electric generating stations in the Mohave Desert during the 1980s. Those plants continue to operate but Luz International had to declare bankruptcy in 1991 as their state property tax exemption expired and other state and federal support programs ended. Two decades later, under many of the same directors including the founder Arnold Goldman, BrightSource Energy is building the $2.2 billion Ivanpah Solar Electricity Generating Statidon (SEGS) in the Mohave Desert. This plant is making headlines as "the world's largest concentrat[ed] solar power plant under construction" (BrightSource Energy, 2010).

One of Bright Source's biggest hurdles has been the desert tortoise, which is listed as endangered under the ESA. BrightSource officials knew the site they chose was desert tortoise habitat and worked out mitigation plans including installing 50 miles of fencing at a cost of $50,000 per mile. They obtained permission from the U.S. Fish and Wildlife Service to move up to 38 adult tortoises off the site. Their permits allowed them to kill three tortoises accidentally each year during the construction phase of the project. It turns out that the original survey of tortoises underestimated the number of tortoises actually living on the site and in early 2011 state and federal agencies required that construction could not continue until a new environmental assessment was completed.

*History*

Solar power is the collection of the sun's light and its conversion into energy. Humans have been indirectly harnessing the power of the sun since the shift to an agriculturally based society. The Greeks, Romans, and Chinese first used solar power to light torches with glass and

mirrors for religious purpose. By 600 AD, the science behind solar power had evolved enough to be used to heat homes and buildings.

French-Swiss scientist Horace de Saussure saw the potential to use the sun's energy in the early 1700's, and tested this potential through experiments. He built a small "hot box," or greenhouse, and measured temperatures inside the box. After rotating the box for several hours, he discovered that temperatures reached up to 189 degrees Fahrenheit. He revised the design of his box by adding several layers of glass and insulation to reduce heat from escaping the box (Butti & Perlin, 2005). Following Saussure's experiments, researchers looked for new ways to improve the technology. Edmond Becquerel, for example, generated a continuous current using sunlight in 1839 (Frass & Partain, 2010). He created the first known copper-cuprous oxide thin-film solar cell after submerging two brass plates in liquid and allowing sunlight to heat them (Frass & Partain, 2010).

Solar energy technology took a leap forward with the discovery of selenium in 1873. Selenium is a solution that produces energy when it is exposed to light, making it an obvious choice when trying to find useful materials with which to convert sunlight into energy. Ten years following the discovery of selenium, American C.E. Fritts used it to develop the first solar cells, also known as wafers. Wafers continue to be used in today's solar cells and panels (U.S. Department of Energy: The History of Solar, n.d.). Early pioneers of quantum mechanics, including Albert Einstein, developed the theoretical underpinnings of converting solar energy to electricity. In the early 1900's, Einstein published a paper on the photoelectric effect (work for which he later won a Nobel Prize), leading to further experiments and development of "photovoltaic technology". This photovoltaic technology made it possible to mechanically run equipment normally powered by electricity. In 1954, almost 75 years after Fritts' original

discovery, Bell Labs created the first silicon solar cell capable of running everyday electrical equipment. Not only was Bell Labs able to duplicate Fritts' cell, but it also increased efficiency from 1% to 6% (Frass & Partain, 2010). Research during this time also led to the design of solar-heated buildings. With the advent of the bipolar transistor, photovoltaic (PV) efficiency more than doubled to 15% (Green et al., 1999). This technology was used by NASA to power satellites and observatories, providing data to scientists about the earth's atmosphere (U.S. Department of Energy: The History of Solar, n.d.).

Passivated Emitter Solar Cells (PESCs) were the next breakthrough. They were simple to make and remained the industry standard for almost ten years. They were developed out of efforts to 'passivate' or prevent electrons from escaping from the backside of the cell. These cells were 'passivated' across the entire cell, leading to over 22% efficiency (Green et al., 1999). By 1999 the PESC model was surpassed by the Passivated Emitter Rear Locally-Diffused (PERL) cell, which contains a thermally oxidized and newly texturized surface on the backside (Green et al., 1999). Another fairly recent change has been the use of small, inverted pyramids on the cell to capture more light. The application of miniscule layers of silicon on the cell has also increased energy output. Additionally, scientists combine layers of the photovoltaic material into one solar cell, creating higher energy efficient cells. .

*Solar Energy Basics*

The Photovoltaic Effect, discovered in the early 1900's, uses cells which function as semiconductors. It is a basic process through which photovoltaic (PV) cells convert sunlight into energy and electricity. Edmund Becquerel, a French physicist, discovered the Photovoltaic Effect in 1839; he found that certain materials would produce an electric current when submerging two brass plates in liquid and exposing them to light (Sandia National Laboratories, n.d.). When these

cells are exposed to sunlight, energy is reflected, passed through, or absorbed. Photovoltaic cells convert the absorbed energy into usable energy. These Photovoltaic cells are typically used in solar panels seen on roofs (U.S. Department of Energy, Basic Types, 2011).

In order to create effective technologies and mechanisms, a variety of cellular materials are used, depending on the purpose of the solar technology. These elements are used in both pure forms and compound combinations to effectively convert the light into energy. Silicon, an element used in both early solar devices and today, was discovered in 1824 by Swedish chemist Jöns Jacob Berzelius (It's elemental, n.d.). Silicon can be produced by heating sand with carbon at extremely high temperatures of 2200 degrees Celsius, as well as being found naturally (It's elemental, n.d). Semi-crystallin silicon is an alternative to silicon. Although it is not as widely used as silicon because the flow of electricity is not as effective, it costs far less than using silicon (U.S. Department of Energy, Basic Types, 2011). Each type of silicon is produced differently based on its intended use and solar cell technology. The primary types are described below:

Single- Crystal Silicon is the highest-purity silicon, created by melting the single crystals and then cooling them slowly. This process allows for the growth of a new rod or "boule" as the material solidifies slowly. Three processes can grow a "boule": the Czochralski, Float-Zone, and Ribbon silicon processes. The Czochralski process dips a crystal into molten silicon and then slowly pulls it out, creating crystals. The crystallization of the "boule," allows photovoltaic charges to flow and act as conductors. In contrast, Float- Zone silicon crystals are put through an electromagnetic coil, creating higher purity crystals than Czochralski crystals. These crystal rods must then be sliced into thin wafers once single crystal rods have been produced. Unfortunately, this slicing process wastes 20% of the silicon. Both the Czochralski and Float-Zone methods are

expensive and complex, but well developed (U.S. Department of Energy, Basic Types, 2011). Ribbon silicon is a single-crystal silicon technology which forms into thin wafers and is less costly to produce than other silicon forms. The tradeoff is that the efficiency of Ribbon silicon is approximately 16.2% (Alternative Energy, 2010).

Multicrystalline silicon is less expensive than single-crystal silicon, but far less efficient due to the lower grade material used. Because of its square molecular shape and structure, it is able to fit compactly into a photovoltaic module. These variations of silicon are based on the purity of crystals, molecular structure, and its ability to absorb solar radiation.

Amorphous silicon is a photovoltaic compound commonly used in calculators and wristwatches, and can be produced in lower temperatures. It's economically advantageous because the production cost is significantly less than it is for photovoltaic. Amorphous cells are also thicker allowing them to absorb 90% of the sunlight they are exposed to. Amorphous cells are not stable, however, as output decreases by as much as 20% over time (Department of Energy, Photovoltaic cell, 2011).

Today there many innovative ways of building photovoltaic cells. One example is Polycrystalline Thin Film, which is a roll-based laminating system producing amorphous silicon solar cells. These cells are thin cells, which have an advantage over thicker and chunkier cells because they require less material and are generally lighter and more flexible then thick cells. The downside is that they are less efficient than thicker cells. Another example is Printable Solar Cells. These cells are produced from ink, creating semiconductors or solar cells. By using nanostructure materials, high quality electric films can be printed in less time and lower cost than manufacturing thin-film solar cells (Nanosolar, 2012). Once it has been printed on prepared aluminum foil, the cells are sorted based on function, then assembled and connected into panels,

laminated, and covered by glass.

Another innovation is polymer solar cell technology. It is is light and flexible, making it possible to gather light through ridges. Though the cell has good electrical transport, the overall performance has been poor because of small charge and short circuit. It does however, have a high conversion and efficiency rate, with the ability to trap 20% more light than flat solar cells. Plastic solar cells are also a popular because of their durability and lightweight features. Because of its flexibility these plastic cells can be placed around surfaces and used for roof tiling and siding. Plastic cells have been used on vehicles and other machinery as well. Solar concentrators that use dye are also used to absorb more light and trap to transport it for conversion in lower layers of the solar cells (Making the best Kim, 2011).

*Advantages and Disadvantages of Solar Energy*

The price of photovoltaic solar energy systems in comparison to coal is relatively high, exceeded only by offshore wind and solar thermal systems. There are, however, a number of incentive programs including tax credits, rebates, low-interest loans and grants provided by government programs to encourage the use of solar energy (Types of solar, 2012).

According to the United States Department of Energy, alternative energy like solar energy will not be competitive until "soft costs" can be reduced or diminished. Soft costs are the expenses associated with permitting, financing, interconnection, and inspection. They are estimated to create 40% to 50% the overall cost with use and installation. There is no consistency between regulations of local, state, and national governments (DOE Awards $12 Million, 2011).

President Obama's "race to the top" campaign has made the goal of access to all the necessary solar energy siting permits easier to obtain. The Obama administration has also offered a number of economic incentives as well. Several grants were awarded throughout the United

States in 2011 to financially assist in various projects conducted by local government and jurisdiction: reaching nearly 51 million Americans in 22 locations. This campaign's efforts are to make solar energy more competitive with other sources by 2020 (Rooftop solar challenge, 2012). The Department of Energy Rooftop Solar Challenge allows for local governments, utilities and installers to compete by implementing plan to reduce administrative barriers that restrict the installation of solar energy devices and help to increase the global market by making solar costs competitive (Rooftop solar challenge, 2012).

*Ivanpah Power-Case Study*

Arnold Goldman, founder of BrightSource Energy Inc., is a man with a vision of a world powered by natural sunlight. He remembers waking "up one night feeling miserable and [coming] to the conclusion that if I had to work most of my life, at least I wanted it to be valuable" (Green Prophet, 2010). What could this young man do to make his working years valuable? Alternative energy, specifically, solar energy.

Goldman graduated from the University of California-Los Angeles with a bachelor's degree in engineering and minors in philosophy and economics, after which he earned a master's Degree in computer science at the University of Southern California. After spending five years in computer development with the military and working for defense contractor Litton Industries, Goldman, along with a group of scientists from the California Institute of Technology and Xerox, founded the first word processing company in the United States in 1972: Lexitron. The entrepreneur then founded Luz International, Ltd. in Israel in 1979, which later expanded to California (Green Prophet, 2010).

As founder and CEO of Luz International, Ltd., Goldman headed the largest solar power plant of its kind in the 1980s, engineering and building nine large solar power plants in the

Mojave Desert of California. This system of plants is known as Solar Energy Generating Systems (SEGS) and produces a combined output of 354 megawatts of electricity, or enough to power 140,000 homes (BrightSource Energy, Ivanpah, 2012).

The 1973 oil crisis sparked an increase in government support for alternative energy: OPEC (Organization of Arab Petroleum Exporting Countries) had sought to display their disapproval of the United States' decision to re-supply the Israeli military during the Yom Kippur war by placing an oil embargo on the U.S. Four years later, President Jimmy Carter urged the nation to support alternative energy efforts to protect against future incidents like the 1970s oil crisis. He specifically listed fuel conservation, the development of alterative fuels, and a reduction in dependence on foreign oil as prime goals (Carter, 1977).

One of the Carter Administration's main goals was to "use solar energy in more than two and one-half million houses," by 1985 (Carter, 1977). Just two years after Carter's speech, the Iranian Revolution shattered what little stability Iran had and gave way to a new government. The new regime exported oil inconsistently and at a significantly lower capacity, sparking the 1979 energy crisis. The United States' oil supply was again severely impacted as a result, reinforcing Carter's message that alternative energy was a brighter and safer option than the current dependence on unreliable foreign oil.

The favorable politics and the relative novelty of the ESA allowed SEGS to be built with little opposition. Opposition facing green energy companies was considerably less concentrated and established during Luz's peak than now. Luz Industries began constructing their solar plant during the perfect window of opportunity, sandwiched between a high public approval, as a result of the energy scare in the 1970s, and little organized resistance.

By the late 1980s, government policies promoting and enabling the construction of solar

power plants began to expire. These policies included federal and state tax credits (some as high as 10%), exemption from property taxes, and special depreciation schedules. While continual construction of plant after solar plant gave the impression that Luz International Ltd. was still a lucrative business, the company was barely treading water, selling one plant to raise money for the next plant and relying heavily on tax credit renewals.

By the late 1980s, state and federal solar and geothermal energy tax credits and investment tax credits were beginning to expire and politicians did not seem willing to extend them. As a result, Luz began building plants in increasingly shorter time periods to qualify for the tax credit: SEGS IX was built in 7 ½ months in 1990 to fit the restrictive time stipulations of the Federal tax credit. Luz International had to pay huge cost overruns in order to rush construction of SEGS IX, which was the final blow to the company. Finally, in late November of 1991, the company filed for bankruptcy, halting construction of a tenth plant and permanently dissolving plans for an eleventh and twelfth (Berger, 1998: 38-45). After selling SEGS IX to NextEra Energy Resources, which already owned SEGS III-VIII, Luz International completely disbanded. The spirit and drive behind the company, however, continued to thrive in the individuals who drove it in its prime.

In 2004, Arnold J. Goldman reassembled the original team of Luz International Ltd. to form Luz II Ltd., later renamed BrightSource Energy, Inc. After the relatively successful SEGS I-IX solar plant, which continues to produce seventy percent of all solar power currently produced in the United States, BrightSource proposed several new projects and by early 2012 had several developments underway, including the Ivanpah Solar Electricity Generating Station (ISEGS) in the Mojave, which, if it is finished, will be the largest solar plant to be built since the Luz International's solar power plants in the 1980s.

The Ivanpah Solar Electricity Generating Station consists of three separate solar power thermal plants. Altogether, the three solar plants have a planned capacity of 392 MW. It has received a $1.6 billion loan guarantee from the U.S. Department of Energy. President Obama singled out the Ivanpah project in his weekly address on October 2, 2010, praising the solar plant as a "revolutionary…state of the art facility," that will create jobs and help the nation achieve its clean energy goals (BrightSource Energy, Ivanpah, 2012). The project will consist of 4000 acres of mirror fields, fences roads, fences, and transmission lines. An acre is roughly equivalent to a football field without the end zones. So, the Ivanpah facility will be about the size of 4000 football fields. The mirror field will contain nearly 200,000 glass mirrors, each the size of a garage door. Those mirrors will focus on three 460-foot-tall "power towers." The project is located a few miles from the Mojave National Preserve, the nation's third largest unit of the National Park system outside of Alaska.

A great deal of opposition to the Ivanpah project and other potential solar projects on public lands emerged. Kim Delfino, Defenders of Wildlife's California program director, cautions, "California is starting to see a new kind of gold rush, but this time it's going to be our wind, sunlight, and public lands that are up for grabs" (Navarro, 2009). A sampling of opposition from the green community can be found on an online blog, titled the "Mojave Desert Blog." Writers on the blog have many concerns, the first of which was the possible destruction of this diverse habitat. They also discuss their concern over potential harm to the desert tortoise and other native, rare plants in the area. These writers were also concerned that one solar plant would open the floodgates and soon the whole area would be developed. Finally, there were concerns raised over the possible loss of viewsheds and the "fragmentation" of the desert landscape (Mojave Desert Blog, 2010).

BrightSource chose an area of the Mojave Desert that is rich with ecological resources (Seltenrich, 2011). Besides the desert tortoise, there are at least twelve species of rare plants on the site (Clarke, 2009). Individuals such as writers for the Mojave Desert Blog writer and groups such as the San Francisco's "Desert Survivors," a self-described "affiliation of desert lovers committed to experiencing, sharing and protecting desert wilderness wherever we find it," make it their mission to ensure that such environmental impacts are correctly and fully reviewed (Desert Survivors, 2009). Members of these groups are passionate and committed to protecting their local resources from development of any kind.

While opposition from grassroots organizations is significant, the first major hurdle BrightSource faced was a strenuous review from the California Energy Commission. Their review process mandated under the California Environmental Quality Act was combined with the BLM's NEPA process in an attempt to expedite the process and increase efficiency. There were so many environmental concerns, however, that the process took three years.

BrightSource knew they were attempting to build in desert tortoise habitat and performed the preliminary biological survey necessary to move forward. That survey found just 16 tortoises and, based on U.S. Fish and Wildlife Service formulas, BrightSource was granted permission to move thirty-eight tortoises and kill three a year (accidentally) during its three-year construction phase (Danelski, 2011). After three years, the California Energy Commission granted unanimous approval to the project and BrightSource agreed to the stringent environmental restrictions that included 50 miles of turtle fences designed to keep turtles out of the area, reducing the number of "power towers" from seven to three, and reducing the project's footprint by 12%. On October 7, 2010, Ivanpah received the BLM's Records of Decision (ROD), giving them the green light to start construction. Twenty days later, BrightSource Energy formally broke the ground at Ivanpah

at a celebratory commemoration.

BtightSource employed as many as 100 biologists to make sure they were meeting the environmental restrictions and by February, 2011 project biologists found many more tortoises than expected from the initial survey. The BLM ordered the company to stop construction on the plant and authorized a new biological assessment to be performed. The results of the revamped evaluation were stunning: ninety percent of all non-adult tortoises would most likely be exterminated in the process of building the three power plants. Biologists estimated that would equal as many as five hundred forty seven individual underdeveloped tortoises per year. The rest of the tortoises—the lucky ones—including one hundred sixty resident adults, would be manually transferred to off-site pens to be held during the winter and later relocated to a permanent protected reservation. In total, the Ivanpah complex would destroy approximately three thousand forty four acres of desert tortoise habitat and displace over three thousand desert tortoises, killing many of those tortoises in the process (Seltenrich, 2011)..

The U.S. Fish and Wildlife Service (FWS) ended up renegotiating stipulations with BrightSource Energy in June of 2011 that would permit building plans to continue, if certain conditions were met. The FWS released a "new Biological Opinion…[which] includes new stipulations for translocating tortoise[s], as well as new requirements for protecting them from predators and increased monitoring and fencing. The FWS also requireed BrightSource to purchase more land as compensation for loss of desert tortoise habitat" (U.S. Fish and Wildlife Service, 2011). The first tortoise relocation at Ivanpah occurred on October 10, 2011. The company posted a picture of the "healthy female tortoise" on their blog post after the successful translocation, describing the process in detail (BrightSource Energy: First tortoise translocation at Ivanphah, 2011).

Construction of the solar power plant continues, as project biologists work to ensure the safety of each tortoise found on the site, following the guidelines illustrated by the FWS. In a blog post, BrightSource outlines the steps taken in each tortoise's "individual 'disposition' plan, which tracks the tortoise's health, activity, [and] habits." Afterwards, tortoises undergo an all-inclusive medical assessment to determine whether the animals are healthy or if they may "carry a potentially-fatal respiratory disease that is prevalent and contagious among the desert tortoise population." The area chosen as the relocation land for the tortoises is reviewed multiple times previous to actual transfer to evaluate "if the "recipient population" … can safely accommodate additional tortoises." The animals are then only trans-located during specific intervals in the spring and fall and when temperatures are between sixty-five and ninety-five degrees Fahrenheit (BrightSource, Energy: First tortoise translocation at Ivanpah, 2011).

While some opposition continues against ISEGS, BrightSource continues their plans with backing from government and green energy proponents worldwide and applause from environmentalists for managing to produce alternative solar energy while also saving the endangered desert tortoise. The plant is set to finish construction in 2013 as the "largest solar plant under construction in the world" today (BrightSource Energy, Ivanpah, 2011).

*Analysis*

The BrightSource Energy case study shares much in common with the Cape Wind narrative. Both stories feature a dreamy, idealistic planner, hoping to implement their big dream of an unprecedented alternative energy plant. Both suffered from the same providential naïveté, expecting their communities to be just as excited about their project as they were. In addition, both men in charge of the project lived closed to the areas where they are attempting to site alternative energy plant, and thought they knew the area well. This case story, however, occurs

on the other side of the country, and deals more heavily with endangered species. Additionally, the BrightSource Energy case demonstrates how many environmental institutions and those promoting them have changed in the last thirty years.

*Action Arena*

Similar to the Cape Wind proposal, the Solar Electricity Generating Station is also governed by a multi-tiered system of environmental institutions. California has its own set of environmental institutions that have proliferated over the past several years, similar to the Massachusetts. When BrightSource went about reapplying for permits and gaining permission to site in California in 2010, the process was very different than it had been twenty years prior. Many new environmental laws had been passed, as well as the interpretations and reach of previous laws had been changed in court rulings. Additionally, the way that regulators fulfilled these laws had changed, as have regulators.

Not only was the permitting process different, but the community was as well. When BrightSource Energy, then Luz International, originally sited their Solar Electricity Generating Stations in the 1980's there was little resistance. After the high oil prices of the 1970's community members were happy to see alterative energies being sited. But since then so much has changed. Conservation groups have spread, and they have gotten good at using litigation. Additionally most communities now have a sour taste in their mouth when it comes to siting huge energy developments. While there is still much rhetoric from politicians on the national scale regarding the need for alternative energy, most citizens do not feel the pressure they once did to race towards new energy establishments.

One way that politicians demonstrate their desire for more alternative energy is through some combination of subsidies and alternative energy tax credits. For many companies this is

what makes producing alternative energy worth the effort and time. Luz International survived for many years only because of these credits, but was unable to continue once they had ended. A similar situation might not be too far away. Next year many tax credits come up for alternative. If the recent budget negotiations are any indicator, it is likely there will be a hard-fought battle over whether to renew these, and how to go about renewing them.

*Key Stakeholders*

As mentioned above, Arnold J. Goldman is yet another man with green dreams. His is a vision of the world's largest solar plant, and a chance to redeem his earlier solar projects. Similar to Gordon (Cape Wind CEO), Goldman is blessed with years of experience in the field. He understands how to petition politicians, work with bureaucrats, and promote his dream to community members and investors. Aside from getting the opportunity to finally achieve his dream, Goldman would obviously profit from this, financially. Goldman also has the chance now to demonstrate his improved solar energy collection system. His proposed plant in the Mojave Desert would do just that.

While Goldman has been working on the engineering behind his projects, the opposition has had time to form. Many groups have joined forces and used the internet, specifically their Mojave Desert Blog, to tout their concerns. They claim that while the Ivanpah plant will provide public goods, the overall operation will have a negative effect. These groups choose to focus on the effects that this plant would have across the entire desert, and maintain that this project will lead to a loss of viewsheds and natural landscapes. These groups also cite the potential damage this project could have on the desert tortoise and several critical plant species.

One supporter that Goldman and BrightSource Energy can begin to count on again is the government. Despite recent controversies, the Obama Administration has promised much in the

way of subsidies and tax credits to those installing solar energy plants. Obama has even praised the Ivanpah plant, specifically. After the Solyndra embarrassment in early 2012, the Obama Administration would benefit from having a profitable solar energy plant established with the help federal funds his Administration helped to allocate.

*Rules in Use*

At the state level, BrightSource Energy has faced much scrutiny from the California Energy Commission. One kindness BrightSource Energy can be grateful for was the decision to combine three processes from two separate committees into one. This sped up the process for BrightSource Energy, but also limited the opportunities for conservation groups to slow down or halt action on the siting. It has given these green groups less time to garner support during commenting periods. This seems to signal willingness on the part of the state and federal agencies to move this project forward.

Concerns over damage to desert tortoises and their habitat have also delayed the approval of the Ivanpah plant. The discovery of a larger number of tortoises than originally anticipated has caused difficulty for BrightSource Energy, through increased mitigating measures and renegotiations. It is a very possible scenario for the company to face a lawsuit charging them with Endangered Species Act violations if they are not careful.

*Informal Rules*

As BrightSource Energy has discovered, the unspoken rules that govern energy siting have changed significantly in the past thirty years. Even though the country still faces high oil prices, the oil shipped to the US is found in conflict zones, and the increased pressure of developing countries demanding oil, the desire to permit alternative energy sites has decreased. Green groups have found that they can achieve large successes in court through lawsuits

involving the purported violation of environmental laws. In the state of California an entire environmental institution has developed changing how project are handled and considered by the public. Additionally the push for preservationism, or an extreme form of conservation, has grown.

*Outcomes*

Currently, the future looks good for BrightSource Energy. They have the support of state and federal regulators. Their opposition, while vocal, has yet to file any suits or threaten any serious conflict with the company. There is no guarantee, however, that this will continue. The opposition could easily decide to file suit, or join an already organized national group. Issues regarding how the land is divided, how the desert tortoise is handled, or even threats to the viewshed, could be taken to court.

Conservations groups often benefit from filing and winning lawsuits. Not only do they gain the positive feelings that come with achieving a goal, or protecting nature and natural resources, but also they win attention from the case. Once these groups prove that they can handle themselves in the courtroom, they are more likely to attract donations of both time and money. Increased media attention from a case can also help these types of groups gain more followers.

BrightSource Energy could also gain much if the Ivanpah facility is a success. First, they could prove themselves to the local community with jobs and by providing extra protection to the area around their plant. Additionally, if their improved solar cell system is as effective they say it is, they will have increased demand for solar plants. Much of BrightSource Energy's success depends on available tax credits and subsidies. In the future, this could prove to be an Achilles' heel for the company again. There is no guarantee of continued federal funds and

healthy tax credits.

*Future*

Despite all of the rhetoric from both politicians and regulators, solar power faces severe levels of opposition. Even as the BLM has attempted to identify areas in the West where solar power could be sited, citizens and conservation interest groups have become more vocal in opposition to solar energy development. Thus, as politicians and regulators attempt to work to achieve generally approved of goals, conservation and environmental groups oppose them, at times the same groups that advocate green energy development.