NATURAL RESOURCES DEFENSE COUNCIL

Statement of

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Before the

Subcommittee on Energy and Environment

Committee on Science and Technology

Unites State House of Representatives

May 17, 2007

Summary

General

- Carve out federal research and development (R&D) dollars for independent studies of environmental impacts to 1) understand the cumulative impacts of large scale deployment of these ocean and geothermal energy technologies, 2) avoid early public black-eyes that will set the industry back years, and 3) support an open and transparent permitting and regulatorty process by building consensus among regulators, the public, and industry around the environmental benefits and impacts of real concern
- Look at regions with resources that have high energy production potential and build baseline data on the nature of the resource and the ecosystems in place that surround the resources.
- Use the baseline data and analogous technologies to narrow and bound unknowable potential environmental impacts.
- Focus "lessons learned" studies on the areas of greatest environmental uncertainty.
- Use these studies to inform adaptive management strategies so that projects can proceed in the face of the real uncertainty surrounding some impacts and also still be eligible for private sector financing.
- Consider a federal fund to support the more extensive potential adaptive management options including removal for the first few projects.
- Utilize early successes in this approach as test cases for future, more large-scale deployment initiatives.

Geothermal Energy

- Include independent R&D on the environmental impacts of geothermal technologies in the Advanced Geothermal Energy Research and Development Act of 2007.
- Build consensus among regulators, the public, and industry around the real environmental impacts and ways to avoid, manage, and mitigate these impacts so that the technologies can be deployed as quickly as possible.
- Ensure that studies cover the environmental impacts of enhanced geothermal systems and of the cumulative effects of multiple large-scale projects in the same region.
- Ensure that technology R&D covers improving the thermal efficiency of geothermal systems to maximize the potential energy that can be captured and minimize the number of projects that need to be developed.

Ocean and Hydrokinetic Energy

- Focus federal R&D dollars on studies of a few regions with high resource potential, study other manmade installations in oceans, rivers, and lakes in order to anticipate impacts of ocean and hydrokinetic technologies, and prioritize post-installation lessons' learned studies.

- Require access for independent pre- and post-installation environmental studies as part of eligibility for any federal subsidies.
- Ensure that studies address the cumulative impact of multiple projects and of multiple installations within one project.
- Exclude offshore wind from the Marine Renewable Energy Research and Development Act of 2007 except to study offshore wind projects to learn lessons that may inform other projects and as part of regional cumulative impact analyses.
- FERC should work with state and federal natural resource management agencies to do a programmatic environmental impact statement for the licensing of new hydrokinetic technologies.
- Regional studies should help build consensus around areas that are best suited for early development and those that should be avoided at least until the potential impacts of the technologies are much better understood.

Introduction

Thank you for the opportunity to share my views on geothermal, ocean, and hydrokinetic energy technologies, the environmental pros and cons of these important sources of renewable energy, and the environmental issues related to these technologies that should be addressed in the context of federally supported research and development. My name is Nathanael Greene. I'm a senior policy analyst for the Natural Resources Defense Council (NRDC) and one of our main experts on renewable energy technologies. NRDC is a national, nonprofit organization of scientists, lawyers and environmental specialists dedicated to protecting public health and the environment. Founded in 1970, NRDC has more than 1.2 million members and online activists nationwide, served from offices in New York, Washington, Los Angeles and San Francisco.

Mr. Chairman and esteemed members of this committee, as you know, U.S. energy policy needs to address three major challenges: reducing global warming pollution, providing affordable energy services that sustain a robust economy, and increasing our energy security. Renewable energy technologies including geothermal, ocean, and hydrokinetic energy can play a critical role in meeting these goals, and these technologies have the potential for dramatically increased deployment over the coming decades. These sources of energy can be used to produce electricity and thermal energy with little or no global warming pollution or local or regional air pollution, and they draw on domestic energy sources that are naturally replenished and do not vary in cost. By using these technologies we avoid burning fossil fuels, particularly coal and natural gas and to a lesser degree oil. The heat-trapping gases released when we burn these fuels make the power sector the largest single source of global warming pollution. These fuels are also responsible for other significant environmental and public health impacts during mining, drilling, processing, and combustion, and they expose our economy to price volatility and energy insecurity.

All energy technologies cause some environmental damage. Being better than fossil fuels is a necessary condition, but hardly sufficient. Independent research and development focused on the environmental characteristics of these technologies is critical to maximizing their positive impacts and to avoiding, managing, and mitigating their negative ones. Good R&D on the environmental impacts is also critical to an open and transparent permitting process and in building a constructive relationship between regulators, the public, and the industry so that these technologies can be deployed in a manner that is quick, efficient and responsible.

General Comments Relevant to Both Families of Technologies

The environmental impacts of renewable technologies such as geothermal, ocean and hydrokinetic energy must be considered in the context of the detrimental alternative outcomes if we choose to not actively deploy these technologies. Most of the traditional energy sources (e.g. coal, natural gas, oil) ensure a far different and potentially much more devastating environmental future. Meeting our energy service needs through improved energy efficiency is the fastest, cleanest, cheapest option, but even the most efficient technologies require some energy to operate. Outside of the transportation sector, if we're not using renewable energy then chances are we're using coal, natural gas, and nuclear power and some oil primarily for heating.

The consequences of not moving away from these traditional fuels to energy efficiency and renewable energy are severe, and impact almost every aspect of the environment and public health. None of these consequences are ultimately more urgent than reducing global warming. The recent Intergovernmental Panel on Climate Change report concluded that there was at least a

90 percent chance that heat-trapping pollution was the main cause of warming since 1950. The science is clear: global warming is real, it's already occurring, and we're responsible for it. We can avoid catastrophic damage, but only if we start reducing our rate of pollution seriously within the next 10 years and achieve 60 to 80 percent reductions by 2050.

This is where renewable energy technologies such as geothermal, ocean, and hydrokinetic energy can be so beneficial. The heat-trapping gases emitted during combustion of fossil fuels make the power sector the largest single source of global warming pollution. Developing geothermal, ocean, and hydrokinetic energy, as part of a renewable energy portfolio, is a vital step towards replacing a significant amount of the fossil fuel-generated power. Moreover, there is a domestic argument as well. The United States is the largest emitter of heat-trapping gases, causing 25 percent of global warming despite having just 4 percent of the world population. Geothermal, ocean, and hydrokinetic energy are domestic renewable energy sources that can reduce our carbon footprint globally, and encourage other countries to do the same.

Of course, no energy technology is without environmental impacts, and simply being better than fossil fuels is a little like being better than a poke in the eye—it's a necessary but not sufficient aspect of a truly sustainable energy mix. Studying the environmental characteristics of renewables serves two critical purposes: 1) it allows us to identify, avoid, manage, and mitigate the real environmental impacts of renewable energy technologies; and 2) it builds a constructive relationship between regulators, the public, and industry that focuses on the real impacts and not "red herring" issues that have limited impact and can obstruct the deployment of strong projects. Taken together these outcomes are needed to allow for the best public review and permitting process.

Ocean energy is currently used to produce just a few megawatts and geothermal just a few thousand megawatts of energy, in spite of the fact that both families of technologies could easily be scaled up to produce tens of gigawatts within the next few decades. However, the relative infancy of these technologies presents two important challenges. First to understand the real sustainability of the technologies, it is insufficient to look at the impacts from a single project. We must also study the cumulative impact of these technologies brought fully to scale, and lay out our vision of what we want these industries to ultimately become. Second, both families of technologies are particularly vulnerable to major setbacks that could stifle growth if early projects become notorious environmental failures.

In the context of federal research and development legislation, we should focus on two types of environmental risks to understand the cumulative impacts and avoid early public black-eyes. The first type of risk involves impacts that we can predict with increasing accuracy with greater experience and data collection. An example of this type of risk would be determining the chance of whales being hurt by the sounds of construction. The more we learn about whales' habits in the region of the project, and what effective mitigation measures we can take to avoid and minimize impacts on whales, the more we can quantify the probability of whales being affected by project construction.

The second type of risk involves impacts that we cannot predict because they result from new types of interaction that simply have never occurred before. An example of this type of risk would be how a geofluid would spread when introduced into a hot-dry rock geothermal heat source to create an engineered aquifer. Another example would be how fish might adapt to underwater turbines in a river. These would be first-of-a-kind interactions and the probability of the possible impacts is fundamentally unknowable.

We can address the first kind of risk by building a detailed understanding of the baseline conditions in the area of a potential project. Unfortunately, given that many species may pass through a given part of the ocean or land only during certain seasons, developing this database may significantly slow a proposed project. If, instead of studying the baselines on a project-by-project basis, we identified a few regions with high resource potential, and focused federal R&D dollars on building the necessary baseline data in those areas, we could facilitate the permitting of individual projects. This would help us develop a better understanding of what the cumulative impacts might be in a region where multiple projects are likely.

Research and development dollars can also help narrow and bound the uncertainty associated with unknowable risks. For instance, if we were considering a certain type of ocean thermal technology, previously collected baseline data would allow us to conclude that a project in that region of the ocean would have a very low chance of interacting with endangered or at-risk fish populations. Further study of similar equipment coupled with modeling the worst-case scenarios might allow us to conclude that even the development of multiple projects would be very unlikely to have any significant impacts of the fish populations. In other words, even for unknowable risks associated with putting new technologies into new conditions, federal R&D can help build consensus around the issues of greatest potential concern and those that are very unlikely to impose significant restraints.

Of course this type of work should be followed with “lessons learned" studies to help avoid, manage, and mitigate future impacts and provide more information to help narrow and bound other unknowable risks. Indeed, given the much higher level of uncertainty surrounding these technologies, the lessons learned from each project during operation should be used to update the management of future projects, and the conditions of future permits, especially during the early development stage of each industry. In particular these studies should be used to inform adaptive management requirements in permits. Adaptive management requirements establish a process for changing a project operations and equipment configuration to avoid or reduce environmental impacts that are larger than anticipated. This is a critical tool for allowing projects proceed when there is a level of uncertainty around impacts that would be unacceptable if the projects' management strategies are fixed over time.

Further research on the potential environmental impacts associated with these nascent renewable technologies is needed to support adaptive management permitting requirements. Given the limits on our ability to establish baseline data and the unknowable risks associated with new technologies in new conditions, regulators must be able to require projects to adapt their management to address unacceptable levels of impacts (that may not appear at present). The baseline data and studies to narrow and bound unknowable risks will be critical to identifying unacceptable levels of impacts (e.g. is the line crossed at one bird or fish or caribou or one hundred?) and what alternative management options are possible.

Making adaptive management work is not only important from the environmental perspective; it is also critical to making projects acceptable for private sector financing. Lenders and investors will not support projects that face potentially significant costs or lost capacity as a result of management being forced to avoid or manage an unforeseen impact. Developing a clear, transparent permitting process, that includes state and federal agency input in developing adaptive management requirements, will also help attract private funding.

Indeed, given the importance of adaptive management to making some first-of-a-kind projects acceptable from an ecological and public health risk perspective, and the challenge that some adaptive management options might pose to a project's financing, the federal government could play an important facilitating role in ensuring geothermal, ocean, and hydrokinetic energy deployment. The government could create a fund that covers a portion of the costs associated with the most extreme and expensive changes in management that might be necessary for early projects. For example, if there is a very small chance that geofluid could leak from an engineered aquifer into ground water or to the surface, but such a leak would require the project to immediately cease operations, the federal government could help insure against such a risk for the first few projects. I recognize that this specific recommendation is beyond the scope of R&D legislation, but the types of studies I have discussed above would help identify and limit the conditions where this type of fund would be necessary.

Recommendations

- Carve out federal research and development (R&D) dollars for independent studies of environmental impacts to 1) understand the cumulative impacts of large scale deployment of these ocean and geothermal energy technologies, 2) avoid early public black-eyes that will set the industry back years, and 3) support an open and transparent permitting and regulatorty process by building consensus among regulators, the public, and industry around the environmental benefits and impacts of real concern
- Look at regions with resources that have high energy production potential and build baseline data on nature of the resource and the ecosystems in place that surround the resources.
- Use the baseline data and analogous technologies to narrow and bound unknowable potential environmental impacts.
- Focus "lessons learned" studies on the areas of greatest environmental uncertainty.
- Use these studies to inform adaptive management strategies so that projects can proceed in the face of the real uncertainty surrounding some impacts and also still be eligible for private

sector financing.

- Consider a federal fund to support the more extensive potential adaptive management options including removal for the first few projects.
- Utilize early successes in this approach as test cases for future, more large-scale deployment initiatives.

Geothermal

Geothermal energy is a particularly attractive source of renewable energy because it can serve as baseload power (e.g. provide steady electricity on a consistent and predictable basis). This gives it the potential to displace some of the dirtiest power generation--coal-fired baseload power. Direct use of geothermal heat and geothermal heat-pump technology also allows industry, commercial, and residential buildings to avoid natural gas and oil that are currently used for heating and cooling needs.

There are already an important number of geothermal projects in operation today, but the next 10 to 15 years could easily see a ten-fold increase in deployment. In addition, enhanced geothermal systems represent a new technology and an area of significant potential growth. As a result, it is important that the R&D bills under consideration by the subcommittee be amended to explicitly require research and development related to the potential environmental impacts of geothermal development along the lines discussed above.

For the traditional geothermal technologies, R&D would help especially in terms of building consensus among regulators, the public, and industry around the most significant environmental impacts. It could also prove useful in determining which impacts are "red herrings" that might need to be monitored, but don't need to be a focus of concern. However, it is important to recognize that many geothermal resources are remote from demand centers and thus land-use impacts will grow considerably with cumulative development of multiple projects in the same region.

Beyond the traditional geothermal technology, the enhanced geothermal systems are an entirely new area for development and thus even more in need of R&D on their potential environmental impacts. Particular care must be taken that the geofluids injected to bring the geothermal energy to the surface do not escape the targeted heat reservoir and contaminate drinking water or reach the surface in an uncontrolled manner. Research into the steps necessary to avoid this and to understand the potential impacts of such an escape if it occurred would increase the comfort-level with this new technology.

For all classes of geothermal technologies, a key area of technology R&D that overlaps with siting-related environmental impacts is work to improve the thermal efficiency of the technologies. The efficiency of current projects is unfortunately low. Doubling this would cut in half the number of projects necessary to achieve a given level of energy production.

Recommendations

- Include independent R&D on the environmental impacts of geothermal technologies in the Advanced Geothermal Energy Research and Development Act of 2007.
- Build consensus among regulators, the public, and industry around the real environmental impacts and ways to avoid, manage, and mitigate these impacts so that the technologies can be deployed as quickly as possible.
- Ensure that studies cover the environmental impacts of enhanced geothermal systems and of the cumulative effects of multiple large-scale projects in the same region.
- Ensure that technology R&D covers improving the thermal efficiency of geothermal systems to maximize the potential energy that can be captured and minimize the number of projects that need to be developed.

Ocean and hydrokinetic energy

There are three reasons that study of the environmental impacts of ocean and hydrokinetic energy is particularly important: 1)the technology is in a nascent stage of development with only a few pilot scale projects in operation around the world; 2)due to the diffuse nature of the energy resource in the ocean and moving water, this family of technologies necessarily requires many pieces of equipment spread out over great distances to capture traditional electric utility-scale amounts of electricity; and 3)the oceans are prized for their open vistas, importance in the global ecosystem, and are particularly vulnerable to global warming.

As recommended above, R&D looking at the environmental impacts of this family of technologies should focus on a few regions with especially high resource potential, ideally for multiple technologies. Studying the ecosystems of oceans, rivers, and lakes is obviously a complicated and time-consuming process. Furthermore because so much is unknown about the interaction of wildlife with the various technologies being developed to capture ocean and hydrokinetic energy, special effort should be made to find other man-made infrastructure that can give us insights into the potential impacts. The novelty of the technologies makes post-installation studies of impacts and adaptive management even more important.

Of course the novelty of the technologies also creates understandable concerns from project developers about allowing scientists access to proprietary information regarding system design. However, these concerns should not be allowed to hinder pre- and post-installation studies. Access for independent environmental research and development should be a prerequisite for any federal support.

The idea of cumulative impacts takes on even greater importance in the context of ocean and hydrokinetic technologies. Not only should studies consider the impacts associated with multiple projects, initially, they should develop an understanding of the cumulative impacts of the multiple pieces of equipment being installed within the bounds of one project. Utility scale projects are likely to require more than one hundred individual generators. In a river, lake, or in certain parts of the ocean, the cumulative impacts of this many pieces of equipment could be dramatically different than the impacts of just one or two generators.

The only exception to the newness of this family of technologies is offshore wind energy. Given the more mature nature of this technology it is appropriate that offshore wind be generally not included in the Marine Renewable Energy Research and Development Act of 2007. The only area where offshore wind should be explicitly included is in lessons' learned studies and studies that build baseline data on regions with high ocean energy resources. Offshore wind energy projects could be an important source of information about energy project development and thus should be considered as part of post-construction studies of impacts. Also to the extent that regions are picked due to their having high resource value, the environmental effects of wind power should be considered in impact studies, as wind projects could contribute to the cumulative impacts concept described above.

Lastly, federal R&D should recognize the unique nature of our oceans, rivers, and lakes. They provide unique ecosystem services, they are used differently than land from both a commercial and recreational perspective, and they are extremely vulnerable to global warming. As a result of these differences, the policies and procedures for access for renewable energy projects are still being developed. The Minerals Management Service has taken the important step of conducting a programmatic environmental impact statement on its offshore energy permitting process. The Federal Energy Regulatory Commission should work with state and federal natural resource management agencies to do the same with new hydrokinetic technologies. On land, many individual states and some collections of states, which are anticipating significant wind power development, have taken the valuable step of conducting resource mapping to identify both productive sites and places that projects simply should not be developed. Ocean and hydrokinetic energy may be too new for studies to offer anything other than preliminary guidance, but that is an important first step and only highlights the need to get started with environmental impact R&D now.

Recommendations

- Focus federal R&D dollars on studies of a few regions with high resource potential, study other manmade installations in oceans, rivers, and lakes in order to anticipate impacts of ocean and hydrokinetic technologies, and prioritize post-installation lessons' learned studies.
- Require access for independent pre- and post-installation environmental studies as part of eligibility for any federal subsidies.
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