IEA Experts' Group on R&D Priority-Setting and Evaluation (EGRD)

RD&D Needs for Energy System Climate Preparedness and Resilience

Utrecht, The Netherlands, 13-14 November 2013

Workshop Summary

The IEA Experts' Group on R&D Priority-Setting and Evaluation (EGRD) convened a workshop on 13-14 November 2013 in Utrecht, The Netherlands, in support of the Forum on the Climate-Energy Security Nexus (the Nexus Forum), focussing on the technology RD&D aspects related to climate resilience of the energy system. Some forty participants met to discuss how climate trends are currently impacting energy systems and how to protect energy systems from future climate changes. Workshop participants identified climate change challenges, highlighted a broad sampling of activities underway in various countries and industries, and identified high-priority gaps and opportunities for RD&D planners. Particular emphasis was placed on opportunities for accelerating technology progress and reducing costs.

Attendees included selected experts from the Nexus Forum and representatives from the IEA energy technology network. In addition to EGRD national experts, the workshop sought input from RD&D decision makers, strategic planners, and program managers from industry concerned with energy systems and climate preparedness and resilience.

This document reflects key points that emerged from the discussions held at this workshop. The views expressed in this paper do not represent those of the IEA or IEA policy nor do they represent consensus among the discussants.

Overview

All energy systems, ranging from traditional fossil fuels to renewable energy, are vulnerable to the impacts of climate change. Increasing temperatures, decreasing water availability, extreme weather events, and sea level rise, separately or in combination, will affect important elements of nearly all energy systems. Projected impacts include damage to critical infrastructure, decreased power generation capacity, increased electricity demand, logistical challenges to the transport of critical goods, and other disruptions to a reliable supply of affordable energy. Some of these impacts will be localised, while others are likely to affect broad geographic areas. The interconnectivity of the energy sector increases the likelihood that local events will have wider repercussions, including cascading impacts on other sectors (e.g., transportation, communication, water, health). Industries with operations concentrated in vulnerable regions will be particularly susceptible to these impacts.

Current energy systems need to be strengthened and made more resilient. Future energy systems need to be designed and built to operate reliably under the full range of projected climate changes. Successful

solutions necessitate a clearer understanding of the array of projected impacts, the greatest risks and needs for adaptation, and current opportunities to develop more climate-resilient energy technologies.

Current Efforts Underway to Build Climate Resilience of Energy Systems

Industry, government, and other entities are undertaking efforts to assess energy sector vulnerabilities to climate change and develop appropriate response strategies. The private sector has begun to conduct vulnerability assessments and, to develop and deploy climate resilience technologies. The oil and gas industry, for example, held workshops to help companies plan for projected climate impacts and build resiliency into their long-term business models. Entergy, a U.S.-based power and gas company, launched a project to quantify climate risks on the Gulf Coast and identify economically sensible and prioritised approaches to address them. EDF, a French utility company, is investing in dikes, moving its aerial lines underground and rescheduling planned outages for maintenance and refuelling to accommodate changing weather patterns.

Governments are also working to develop better climate data, making such data more available to local and regional authorities, improving decision making and climate response frameworks, identifying technologies for climate proofing physical infrastructure, and defining smart resilience strategies. Government efforts also focus on developing policy frameworks that remove market barriers and encourage market preparedness and resiliency. Research is underway to develop innovative climate-resilient technologies like green adsorption chillers, thermosyphon cooling, and heat absorption nanoparticles for coolants. While these efforts indicate a growing recognition of climate impacts, the pace, scale, and scope of these efforts is inadequate and must increase, given the widespread and pervasive nature of the challenge.

Major Barriers to Climate Resilience

Efforts to strengthen the climate preparedness and resilience of energy systems are severely hampered by the lack of supporting information, technologies, and policies. Climate change has produced fundamental shifts from historical experience. Previous assumptions need to be reconsidered and validated. Inadequate information on climate change, impacts, and interactions impedes the development of useful models and can contribute to ineffective or misinformed planning policies and response strategies. In addition, the risks and opportunities may vary by region and locality, significantly compounding the challenges of effective design and planning.

The failure to carefully consider climate change impacts in all aspects of energy project design, planning, and management presents a considerable hurdle to building resilience into energy systems. Energy practitioners, especially planners, must be encouraged to incorporate climate proofing in all decision-making processes. Climate response strategies need to be developed at every scale, from the entire system level down to the individual asset. Full buy-in on this strategy is essential—from top management to facility operator.

While some climate resilience technologies are being developed, most are still in their infancy. Stakeholders tend to have competing incentives, and no enabling framework has been established to guide energy or climate policymaking to support development of the needed technologies. Lack of a sound investment environment, relevant information, and suitable financial vehicles further impedes progress.

Approaches Needed to Build Climate Resilience and Preparedness

Society will be grappling with climate adaptation, specifically preparedness and resilience, for decades or even centuries. As a result, efforts to build resilience must consider actions to address both near-term and long-term needs, as climate change impacts can be expected to vary over time. A flexible, risk-informed approach will enable all stakeholders to adapt as new climate information and data are made available. New information will need to be rapidly translated into actionable plans and policies so that stakeholders can anticipate new challenges and act accordingly.

Climate resilience strategies must be tailored for implementation at the local and regional levels as climate vulnerabilities may vary by country and locality. While private companies will need to understand and address climate vulnerabilities, this process can be technically challenging, time-consuming, and data-intensive. Companies need both resources and expertise to clearly understand the risks to their assets and thoroughly assess appropriate actions. Communication of climate adaptation needs and strategies to both the public and private sectors will be critical in building support for policies and eliciting action.

To encourage innovation and accelerate implementation of climate resilience measures, governments must build enabling policy and institutional frameworks that support such efforts. In market-based economies, financial vehicles and incentives, like carbon prices, loan guarantees, subsidies, and similar instruments, can provide an important boost to building climate change resilience.

RD&D Needs

RD&D needs for building climate change resilience and preparedness will vary for different countries, regions, technologies, and energy systems. The workshop identified some overarching needs for technology development and for building enabling frameworks for climate resilience and preparedness.

Technology

RD&D needs differ for various energy technologies with a focus required on developing energy technologies that are more resilient to droughts, wildfires, storms, floods and sea level rise, including "hardening" of existing energy infrastructure (e.g., transmission and distribution lines, power plants, oil and gas refineries and offshore and onshore oil and gas platforms). Specific technology needs identified include the following:

- For thermoelectric power plant cooling systems (coal, natural gas, nuclear, geothermal, concentrated solar) and oil and gas production, improvements in cost-effective and more energy-

and water-efficient technologies are needed, including enhanced water capture/reuse, and use of non-traditional waters.

- With an increase in intermittent renewable energy (solar, wind), developing resilient smart grid technologies is becoming increasingly critical. Smart grid technology needs include distribution automation, automated service restoration, robust communications systems, and advanced metering infrastructure (AMI) integrated with outage management systems (OMSs).
- Technologies for farming climate-robust crops that can increase biofuel production is another area that requires further investigation.
- Technologies that help in preventing damage from an extreme weather event or assist in damage assessment need to be developed as well. These include unmanned aerial vehicles (UAVs), selective undergrounding of transmission and distribution lines, and vegetation management.

Enabling Frameworks

Successful development and deployment of advanced technologies in this area require supportive and enabling frameworks that can assist in ensuring that the technologies are effective, affordable and accessible to the energy sector. Specific needs identified in this area include:

- Holistic approaches to explore and address needs for technology solutions and related RD&D, made available to and adapted to support all stakeholders (government, private, and financial sectors).
- Models that illuminate impacts and vulnerabilities and provide meaningful specificity at the regional and local levels across a range of varied energy systems.
- Risk assessments that cover entire energy systems and take into account the interconnected nature of current energy systems with other sectors.
- Metrics to measure progress and common definitions for such terms as *climate preparedness* and *climate resilience* are needed to drive improvements in climate resilience of energy systems.
- Cost-benefit analyses to evaluate climate resiliency measures in existing and new systems (e.g., retrofits in power plants) will point to the most effective risk reduction investments.
- Tools to assist in the incorporation of climate impacts and vulnerabilities into the design, planning, and management procedures of vulnerable energy system components.

Roles of the Different Actors

To address energy sector climate vulnerabilities and develop effective response strategies, action is required in both the near-term and long-term from all stakeholders: government, the private sector, academia, and others. Companies have already started undertaking vulnerability assessments and implementing win–win, “no regrets” measures. Such measures could be undertaken at a broader scale and at an accelerated pace. Government and the private sector could expedite RD&D activities by identifying the top priorities for climate resilient investments, developing enabling policies and incentives, and developing better analytical and technical information. Government could play an important role in developing and disseminating tools and information to support such activities.

Conclusions and Path Forward

The workshop identified critical RD&D needs related to the climate vulnerabilities of energy systems and associated climate resilience technologies and strategies. Results and presentations of the workshop will be made available, broadly, and key findings will be communicated to the IEA Committee on Energy Research and Technology, and the IEA energy technology network to help inform the development of national RD&D agendas on this topic.

In the long term, there is a need for stakeholders to develop robust resilience and preparedness strategies with more innovative and transformative solutions. An emphasis on basic and applied energy-related R&D can help to ensure that relevant technologies and climate response strategies are developed. Expanding communications into regular dialogues or other mechanisms will encourage information exchange between governments and institutions working in this area. Establishing new policy and institutional frameworks can incentivise development of solutions and broaden the suite of advanced technologies. Further, such frameworks can spur deployment and accelerate improved resilience in the design, siting and operation of energy infrastructure. The key is to implement measures that promote the integration of energy sector climate risks into all levels of system planning.

The workshop concluded by noting that relevant RD&D activities need more focus and a concerted push by the international community. Organised sharing of knowledge; ensuring that information is public and accessible; and establishing partnerships among governments, private sector and academia can mobilise the attention and resources needed. A strong and meaningful RD&D agenda can give rise to solutions that will help avoid high consequences and save costs in the long term, while assuring a safe, affordable, sustainable and secure energy system for the future.

A more comprehensive workshop report, including detailed information on individual sessions and presentations, has been prepared by the U.S. Department of Energy's Office of Climate Change Policy and Technology, in the Office of International Affairs, and may be consulted at
http://www.ieadsm.org/egrd/