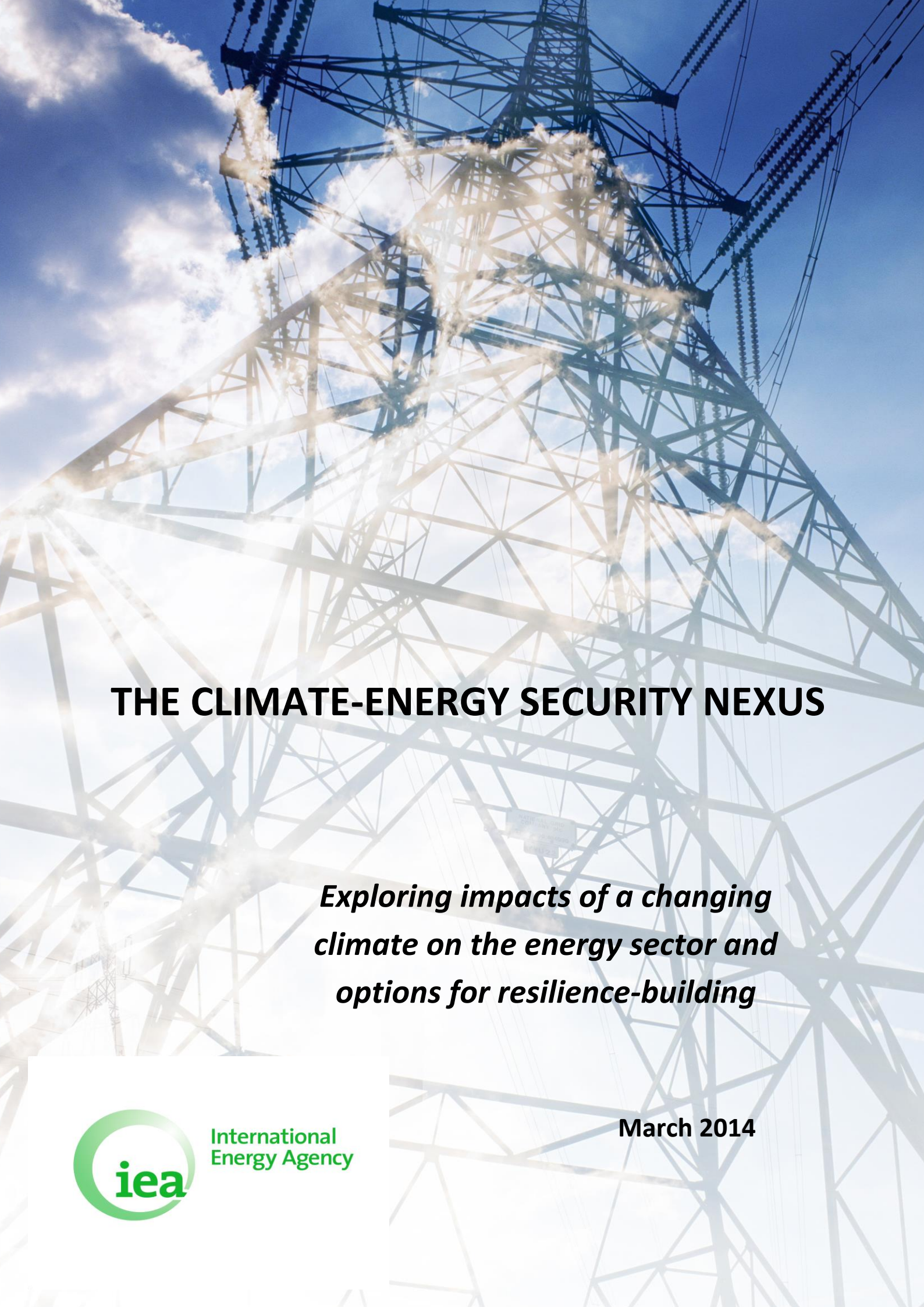

THE CLIMATE-ENERGY SECURITY NEXUS

Exploring impacts of a changing climate on the energy sector and options for resilience-building

International Energy Agency

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THE CLIMATE-ENERGY SECURITY NEXUS FORUM:

Enhancing Resilience of the Energy Sector to Climate Change

Background on the Nexus Forum

1. The threat that climate change poses to energy systems is a new area of interest for the IEA and one that goes to the IEA's core mission of enhancing energy security. Much has been said about the role of the energy sector – production and use – in mitigating human-induced climate change, but comparatively little attention has been paid to the impacts of climate change on the energy sector. This has begun to change in recent years with increased recognition that mitigation and adaptation must be undertaken in tandem. This stems from current understanding that the world has already committed to a certain degree of climate change, whether or not it can collectively meet the 2-degree goal.

2. Climate trends that are expected to have impacts on the energy system can be characterized by both long-term gradual changes, such as increasing air and water temperatures, and changes in short-term extreme events, such as heat waves, droughts, heavy precipitation, and storms. Changes in weather and climate extremes will occur globally and in all regions, albeit unevenly, according to projections in the IPCC Fifth Assessment Report (AR5). These impacts, as well as combinations of these impacts that can intensify their effect, will have significant implications for business as usual in the energy sector. Moreover, changes in climate involving increased frequency or intensity of extreme weather events present important challenges for the energy sector, even if the cause of any individual event cannot be tied to rising greenhouse gas concentrations.

3. Impacts can be expected on energy supply, whether based on renewable, nuclear, or fossil fuel technologies, as well as on energy demand patterns especially in fast-growing urban areas. For example, according to IEA estimates, 1°C of warming can be expected to reduce available electricity generation capacity in summer by up to 19% and 16% in Europe and the U.S., respectively, in the 2040s.[1] Reduced water availability and increased competition for limited water resources that are needed, in particular, for thermal power plant cooling and for hydropower generation, stand out as major threats to the energy sector in coming years. A changing climate can also impact availability of feedstocks for electricity generation, and the integrity and efficiency of transmission and distribution systems.

4. To help address these challenging realities, the IEA launched the Nexus Forum as a platform to enhance awareness of the impacts of a changing climate on the energy sector and share emerging experience on building energy sector resilience. The Nexus Forum has several goals:

a. to promote and disseminate the growing body of analysis of the impacts of a changing climate on the energy system;

b. to initiate a dialogue among a variety of interested stakeholders on this important issue; and

c. to solicit input from key stakeholders across a range of sectors on how to improve energy sector resilience to climate impacts.

[1] IEA, 2013, *Redrawing the Energy-Climate* Map: WEO Special Report, OECD/IEA, Paris.

Summary of Nexus Forum meetings to date

5. Three Nexus Forum meetings have been organized to date. A summary of each meeting is provided here with a brief list of key messages that emerged. Some overarching messages emerged that were cross-cutting across the broad subject of energy system resilience, and are presented in a following section.

1st Nexus Forum: Implications for Business (8 November 2012)

6. The first Nexus Forum was held at the IEA headquarters in Paris with the theme of "exploring the impact on business of changes in energy from a changing climate." It served as an agenda-setting session on energy resilience to climate change for both energy suppliers and energy-intensive industries. Key messages that emerged from the 1st Nexus forum included:

a. A stronger business case to rationalise action on resilience needs to be made. This will require improved understanding of the trade-off between short-term spending and long-term risk hedging/cost-effectiveness. Better documentation of current climate impacts, resilience solution options, and co-benefits of adaptation measures would help.

b. The increasing vulnerability of the energy supply sector, which has traditionally been viewed as economically robust, needs to be recognised. Planning timelines need to be extended from the immediate/short-term to longer-term thinking 10-20 years out. Internal decision-making on multiple fronts (e.g., design standards, operating conditions, life-cycle analysis) must develop to incorporate resilience questions. On the energy use side, demand side management can help to manage impacts.

c. The allocation of risk and responsibility between government and private actors is still unclear. If governments set requirements for resilience actions, this could be interpreted as acceptance of responsibility for climate impacts, with potential legal ramifications. Among industries, at issue is whether high-risk (i.e. more vulnerable) industries should bear more risk and responsibility than low-risk industries.

d. While energy systems often encompass a wide geographic area (e.g., lengthy transmission lines carrying electricity to urban centres from distant generation facilities), climate impacts are often felt within a limited geographic scope, such as a city. As a consequence, municipalities and other local authorities are often key actors. Strengthening the relationship between national and local level governments can help to better manage climate impacts.

2nd Nexus Forum: Cities and Insurance (26 June 2013)

7. The second Nexus Forum took place at the UK FCO offices in London with the theme of "exploring opportunities for city-level responses and the role of insurance in building resilience to the impacts of a changing climate." It focused on two aspects of energy resilience that emerged as pivotal issues from the first Forum – cities and insurance – and proved to be highly complementary topics. Key messages that emerged from the 2nd Nexus Forum included:

a. Cities can develop strong local action plans to build resilience and guide the response in the event that energy security is compromised. Attention is recent but growing – 78% of C40 member cities reported working on resilience issues in 2013, up from 30% in 2011. Climate adaptation and

resilience can be addressed in dedicated plans or alternatively, integrated into existing plans (e.g. low-carbon development plans and civil emergency response plans).

b. Central governments can encourage resilience planning by requiring or incentivising resilience-building measures, potentially linked to funding support. They can also guide development of a standardised process for resilience planning, while national resilience-building frameworks could help cities identify the level of resilience that they should aspire to and ensure consistency across cities.

c. Insurance is key to resilience building as a tool for risk-sharing and maintaining economic stability. While compulsory insurance requirements can be difficult to implement effectively, insurers could motivate resilience-building behaviour through risk-based pricing and other incentivising measures and products, provided clear indicators such as building codes or labelling requirements are in place.

d. Fund managers and insurers should encourage resilience measures by highlighting their economic logic, while the introduction of new resilience requirements/regulation could support lending on high climate-risk investments.

3rd Nexus Forum: Electricity Sector Resilience (25 October 2013)

8. The third Nexus Forum was held at the IEA headquarters in Paris with the theme of "exploring impacts of a changing climate on the electricity sector and options for resilience-building." It showcased several recent studies that had emerged over the previous year, underscoring the increasing attention directed at this issue. Key messages that emerged from the 3rd Nexus forum included:

a. Existing energy security measures will be useful for building the resilience of the electricity sector to some of the impacts of climate change, in particular experience with extreme weather events. Nevertheless, there is an urgent need to better understand future impacts and their costs and to integrate them into the traditional decision-making and risk assessment processes that inform planning in the electricity sector.

b. Many businesses still view resilience measures as high cost but low probability and therefore as uneconomic. Others, alert to climate risk, have developed adaptation strategies tailored to expected regional and sector impacts; their experiences indicate that there may in fact be considerable strategic advantage in taking precautionary measures. However, incentives from external sources – governments, shareholders, and insurers – may still be necessary.

c. Representatives of the insurance industry explained how climate information is already being integrated into risk assessment processes with a potentially major effect on longer-term investment planning, indicating a need to develop risk/cost/benefit approaches for the energy sector.

d. Participants shared their experience with climate/energy data gathering, impacts analysis, risk assessment, and modelling and several instructive examples were presented. The discussion underscored the need for better quantification of impacts as well as development of ways to integrate climate models with energy models and derive results at the regional level.

Overarching/cross-cutting messages from the Nexus Forum meetings

9. Several overarching messages emerged out of all three Nexus Forum meetings concerning the need for strong government leadership on energy resilience, an improved analytical base for resilience planning, and increased pubic-private cooperation and collaboration. These are elaborated here.

Strengthen government leadership on energy resilience

a. Without clear political and policy signals from government on the importance of building energy resilience, the business sector will be slow to respond to messages from the scientific community on climate impacts. In the short term, governments can lead by designing enabling policy frameworks to support resilience measures and development of climate-resilient technologies. Governments can also require development of resilience plans at the local and sector-specific levels. Experience sharing in these areas needs to start urgently.

b. Governments have a special role to play in communicating the urgency of climate-related impacts and the necessity of resilience-building action. A better informed public could increase acceptability of climate resilience discussions and generate the political license to act. In addition, the cost/benefit case for resilience planning and investments in resilient technologies needs to be articulated more clearly to the electricity sector, to the energy sector more broadly, and to related sectors (e.g., finance and insurance).

c. Over the longer term, governments can consider options to incentivise action and stimulate private investment in resilience building. Careful thought should be given to the barriers to action – do they stem from a lack of funding, information, and/or coordination, or are still deeper factors at play – to those entities that should be taking resilience actions, and to how risk can and should be allocated among them.

d. Governments need to consider the limits of the adaptive potential of existing systems and technologies – entirely new ones may need to be developed. Policies will be needed to encourage technology innovation and improve coordination among energy sector RD&D projects designed to respond to the requirements of a changing climate.

Improve the analytical base for resilience planning

a. More analysis is needed to quantify the impact of climatic changes on the energy sector in order to support adaptation and resilience planning (e.g., assessment of the impact of changing long-term demand patterns on energy capacity needs). Efforts are needed to bridge the gap between climate models and energy models – which do not "speak the same language" – in order to derive results that support decision-making and risk assessment, especially at regional and local scale.

b. The electricity industry needs to build expertise in analysing climate information (e.g. downscaling global climate models) to better understand risks and determine which solutions are efficient and cost-effective. Traditional risk models relying on actual past events and historical data need to be re-examined in light of the latest climate projections, to ensure accuracy in business and asset planning in the electricity sector and risk assessment in the insurance industry.

c. Climate change is characterised by uncertainty of climate impacts over long time horizons, but this should not be a barrier to resilience building action in the energy sector. Uncertainty is inherent in

all risk assessment processes and can be addressed by repeating model runs and generating as many scenarios as necessary to support informed decision-making.

d. Barriers to good communication of climate data to decision-makers at various levels of government and in business need to be identified and overcome. A one-stop-shop platform for dissemination of climate risk information, supported through open-source information mapping, would be a valuable new tool.

Increase pubic-private cooperation and collaboration

a. Increased cooperation is needed between public and private sectors, as well as between central and local governments. Local governments, utilities, and other stakeholders should work together to raise awareness of potential climate impacts at the regional level and plan effective resilience strategies adapted to local circumstances.

b. Public-private partnerships are collaborative in nature and can foster a shared sense of responsibility. They can provide the "thought leadership" needed to develop a new resilience paradigm for stakeholders in the energy sector – one that will address both short-term actions as well as long-term structural changes.

c. Public-private partnerships can play a significant role through: pooling of expertise and supporting R&D for development of resilient technologies; provision of technical information and data needed for both cost/benefit assessments and development of new business models to price and manage climate risks; and fostering policy support for resilience-building actions.

Upcoming Nexus Forum meetings

4th Nexus Forum: Climate Change, Water, and Energy (June 2014)

10. The fourth Nexus Forum is being organised jointly with the World Business Council for Sustainable Development (WBCSD) to be held in Geneva. Its aim is to facilitate better understanding of the nexus between climate change, water, and energy issues within a target audience that includes both policy-makers and the business community. The agenda will focus on climate change impacts on water – both too much (floods, hurricanes) and too little (water shortage) – and implications for the energy sector and electricity in particular. The discussion will focus on identifying the next steps in building energy sector resilience to climate-induced water stresses, including policy responses, best practices development and sharing, and modelling support.

5th Nexus Forum: Resilience Policies and Practices (November 2014)

11. A fifth Nexus Forum is anticipated at the IEA headquarters. The preliminary concept is to focus on resilience policies and needed processes to support their development. The final proposal will be decided at the time of the 4th Forum.

Overview of IEA's climate-energy security Nexus Forum workstream

12. The Nexus Forum has led to the development by the IEA's Environment and Climate Change Unit (ECC) of a climate-energy security workstream organised under the following categories: i) dialogue facilitation; ii) policy information collection and dissemination; iii) data and modelling; iv) research stocktaking regarding impacts, vulnerability, and resilience policies; and v) policy development.

- Dialogue facilitation: promote frank dialogue on topics of relevance to business and policy-making communities. The main vehicle for this has been a series of meetings co-organised by ECC. Three meetings have been held to date and were summarized above. The 4th meeting will continue with a sector-focused theme, while the 5th meeting is currently envisaged to address the topic of resilience policy development specifically.

- Policy information collection and dissemination: identify energy resilience and preparedness policies that are being used by governments and appropriate platforms for disseminating this information to stakeholders. With this in mind, the IEA Policies and Measures (PAMS) Database is being expanded to include relevant resilience policies.

- Data and Modelling: investigate how data and modelling of climate impacts on the energy system can be improved. This issue was repeatedly raised at Nexus Forum meetings. (The IEA had already begun to deepen its analysis of resilience issues, notably reflected in the 2013 *World Energy Outlook* Special Report on climate.) A session on data and modelling challenges and opportunities has been planned in the upcoming 4th Nexus Forum meeting, with the objective of better informing both policy decision-makers and the business community. Discussions have also been initiated with modelling teams at the IEA and OECD about integrating climate change impacts (and potentially adaptation/resilience policies) into their analytic capabilities.

- Research stocktaking on impacts, vulnerability, and resilience policy: keep abreast of and help to disseminate studies in this emerging literature. There has been growing attention directed at the issue of climate impacts on the energy system and the need for enhancing resilience, as illustrated by a number of studies released over the past 1-2 years. The 3rd Nexus Forum was structured in part to provide a platform for researchers involved in these studies to present their work. These included recent reports by the U.S. Department of Energy (*US Energy Sector Vulnerabilities to Climate Change and Extreme Weather*, 2013); the Nuclear Energy Agency (*Climate Change: Assessment of the Vulnerability of Nuclear Power Plants and Cost of Adaptation*, 2012); the G20/OECD (*Methodological Framework On Disaster Risk Assessment and Risk Financing*, 2012); and the WBSCD report on climate resilience in electricity utilities (forthcoming).

- Policy development: facilitate the development of resilience and preparedness policies. Building on the experience of the Nexus Forum to date, the IEA is exploring how it could play a more pro-active role in actual policy development on both the government and business sides (a possible theme for the 5th Nexus Forum). Existing processes within the IEA, as well as outreach to member states, could potentially enable future actions in this workstream.

Looking forward

13. As current understanding of energy sector vulnerabilities to a changing climate continues to expand, and with it the implications for energy security, energy resilience can be expected to rise on the policy and political agendas of governments and interested stakeholders. Building enhanced climate resilience and preparedness into the energy system will remain challenging, given current climate trends and the most recent projections of future global change, including the likelihood and intensity of extreme weather events. The IEA is still in the early stage of identifying the myriad dimensions to this challenge, understanding interrelationships between key sectors and stakeholders, and determining the best way for it to leverage its expertise and resources in this area.

14. In anticipation of a world whose climate may behave very differently in 20 years, let alone at mid-century or beyond, the IEA launched the Nexus Forum to help draw attention to the overlooked issue of climate-energy resilience. It will continue its work in this regard, in the hope that earlier assessment of and planning for the impacts of a changing climate will enable governments and businesses to better manage the attendant risks and opportunities presented to the energy sector.