Summary of Opening Keynote Address "The Interface of Science, Technology and Security: Energy and Environment"

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According to Dr. Majumdar, the intersection of population, energy, climate change, resources and infrastructure are the likely sources of the most serious global challenges in the next 40 years. Demographic forecasts show that global population will increase by 47 percent from now until 2050, with less developed countries accounting for 99 percent of the increment. This translates into a population-energy equation that indicates a significant increase in global energy consumption and carbon emissions. At the same time, the velocity of climate change is accelerating – a key input that will need to be mapped into future global security landscape scenarios. The intersection of a growing global population and rising energy demands with climate change variabilities will pose serious challenges for the world's existing resource and infrastructure base – in particular, the high demand for, and low supply of, rare earth elements and the vulnerabilities of the global cyberinfrastructure. Rare earth materials are key enablers for energy technology in magnetics and are found in many high-tech products. However, Dr. Majumdar points out that most of the global production of rare earth metals is concentrated in China, which has a share of at least 90 percent. This situation poses a potentially serious security crisis, the likes of which were demonstrated when China blocked rare metal exports to Japan in light of Japanese detention of a Chinese fishing trawler captain in 2010. This incident illustrates the growing linkage between various seemingly unrelated security issues, an intersection created in this case by the imbalance of supply and demand for a technology resource.

Dr. Majumdar also highlights the world's increasing dependence on information and communications technologies (ICTs) coupled with growing cybervulnerabilities as an infrastructure challenge in global energy systems. He notes that cyberattacks continue to improve in their sophistication and ease of implementation, and these dynamic, fast-moving attacks carry serious implications for electric grid management. He stresses the urgency for cybersecurity as a policy priority for advanced SmartGrid research, pointing out that traditional IT cybersecurity tools are proving inadequate for SCADA, while existing SmartGrid interconnectivity is giving rise to new cybervulnerabilities. This phenomenon illustrates how technology is a driver of insecurity, and Dr. Majumdar urges increased international cooperation as a way to improve the security of energy grids worldwide. He cites the Lawrence Livermore National Laboratory's Vulnerability and Risk Assessment Program (VRAP) that provides assessments both in the U.S. and abroad as an illustration of a successful international collaborative effort that can – and should be – duplicated across the world.

The U.S. imports 60 percent of its oil, and Dr. Majumdar proposes that "we need to make this zero percent." The BP Oil Spill at the Gulf of Mexico in April 2010 serves as a wake-up call for the nation, a dramatic illustration of the costs of oil dependence. One of the key strategic take-aways from this incident is that energy innovation lies at the core of intersecting national, economic and environmental security. In this context, Dr. Majumdar provides a brief overview of the U.S. Department of Energy's Advanced Projects Research Agency-Energy (ARPA-E) as an illustration of the U.S. response to the energy challenge. It is an organization designed to fill in the technological gaps of the U.S. energy innovation hubs, initially conceived by the National Academies report, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, as an institutional response to reduce foreign dependence on energy sources, stimulate innovation to keep the U.S. as a global technology leader, and develop technological answers for clean, affordable and reliable energy. ARPA-E was officially created in 2007 by the America COMPETES Act. Dr. Majumdar provides a brief description of some of ARPA-E's ongoing programs that focus on areas of energy storage, energy efficiency, power electronics and electrofuels. In an effort to institutionalize a policy dialogue across the relevant energy communities, ARPA-E also holds events such as the Energy Innovation Summit in 2010. The participants of the Summit included representatives not only from S&T community, but also from the private sector, other DOE offices and federal agencies, investors, state and regional clean technology incubators, policy-makers, the White House and Congress, and international representatives.

Dr. Majumdar concludes his speech by pointing out that the pace and scale of innovations needed in energy technologies is accelerating: while the scientific and technological game changers of the 20th century were spread out across 100 years, it is more than likely that globalization, the enabling medium of information technology, and increasing international R&D cooperation will shorten the time line to 20 years. He is optimistic that continuous progress in energy technology R&D today will provide the world with a game changer in the near future.