Energy strategies to confront climate change

Energy is one of the most critical resources for the welfare and prosperity of society, supporting all aspects of our lives worldwide. It causes adverse environmental and societal effects, notably climate change, which is the severest global problem in the modern age. Transforming our energy systems to be sustainable will not be easy or possible without a common global aspiration for action. There will be no silver bullet to the energy and climate challenges ahead, but the solutions will most likely be found through linking energy technology innovations, security, energy poverty, and environmental and climate impacts.

Energy is a multidisciplinary field in the true meaning of the word, providing a platform that integrates knowledge from different disciplines rather than a single well-defined, indexed scientific discipline. Understanding the essence of energy and its numerous connections to society and the environment requires viewing it from many different perspectives. Sometimes, too narrow minded a view on energy may turn a well-intentioned energy solution into a grave problem—modern history witnesses several such adversities. It goes without saying that multidisciplinary thinking will be of the utmost importance in coming decades in evolving from a fossil fuel-based to low-carbon economy to find the best and optimal solutions for the society as a whole.

Although energy is often beset by environmental issues with geopolitical ramifications that may even shake the world economy and world peace, several positive trends in energy can be identified. After nearly four decades of intensive development and deployment, many new energy technologies such as solar and wind power are at last closing the price gap with traditional energy resources. Cost-effectiveness is one of the prerequisites for mass production, but, once achieved, the market penetration of new technologies may reach unpredicted dimensions. Who could have guessed that photovoltaics (PV), a marginal embryonic energy technology just a decade ago, would plummet in price and skyrocket in capacity to become one of the fastest growing alternatives today, representing a hundred billion dollar global business. PV is expected to reach a global installed capacity of a hundred thousand megawatts in the next few years.

Modern science is full of exciting discoveries that have potential of leapfrogging in energy. Nanoscience and biotechnology may one day lead to radical innovations that could revolutionize energy production. New materials, innovative technologies, and information technology could in turn lead to radical improvements in energy efficiency. Understanding and evaluating the potential of such breakthroughs will necessitate building a strong link from science through technologies to applications. Transforming scientific discoveries into practical solutions requires the integration of different technologies and disciplines. Interdisciplinary thinking is invariably the key to success.

The present energy system is a result of historical evolution in traditional sources and technologies. One may argue that global energy has reached a kind of equilibrium in terms of the sources used, as the changes in their market shares are quite moderate (although many problems and challenges are waiting around the corner). The energy revolution required to mitigate the climate change predicted by the middle of this century is a massive perturbation for which the present energy system was not originally designed (nor does the present evolution of the energy system yield a robust enough solution). Large-scale exploitation of new technologies, for example, intermittent renewable energy sources, will therefore require innovative integration and interfacing with the present energy system. System solutions such as smart grids or intelligent control will therefore be as important as the clean energy technologies themselves. Viewing new energy technologies in a whole energy system context will be vital.

Environmental and social problems are not exclusively a concern of traditional energy sources; they can also be a feature of clean energy technologies and renewable energy as well. Future sustainable systems will require critical assessment of the drawbacks and benefits of all energy sources. Empirical evidence of the impacts of exploiting huge amounts of new energy sources is still missing. For example, the debate surrounding the environmental and ethical issues of bioenergy crops demonstrates the sort of challenges that could be encountered.

Policies are instrumental in the energy and climate context in many aspects. Policy measures are essential in bringing about the necessary changes to achieve our challenging energy and climate goals. Furthermore, they deal with a broad range of themes linked to technologies, markets, climate, environment, security, poverty, etc. Policy making thus inherently addresses multidisciplinary issues.

Traditional communication channels often view energy and environment from a limited perspective. Interdisciplinarity, although recognized as highly important, has seldom been a leading motive in the energy literature. *Wiley Interdisciplinary Reviews (WIREs): Energy and Environment* aims at filling the gap that has existed in addressing energy issues as a whole and in approaching energy from a multidisciplinary perspective.

WIREs Energy and Environment is a new type of review journal that highlights latest progress from different perspectives: technology, systems, economy, policy, security, and environmental impact. It provides not only detailed reviews of the current state-of-the-art in this highly interdisciplinary field but also offers landmark cases and trend-setting commentaries. The journal advances collaboration between different disciplines of science and technology, and strong interaction between engineers, physical and life scientists, economists, sociologists, and policy makers.

We are very enthusiastic about *WIREs Energy and Environment*. We believe it has the potential to fill needs of a broader readership in energy and environment. We are convinced that it will help bridging several disciplines within the energy field.

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