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INTRODUCTION TO THE 2012 CRITICAL REVIEW

Energy supplies and future engines for land, sea, and air

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To ancient civilizations, the essential elements for life and evolution were fire, water, soil, and air. In contemporary societies, fire is translated to energy supply and use. One of the great technological advancements of civilization has been the discovery and engineering of a wide range of energy-producing devices that convert "fuel" to kinetic energy adopted for virtually every application of the modern world, ranging from infrastructure (habitat) to transportation. The evolution of technologies for energy supply and use have fostered an incredible range of ideas since long before Roman times and continue to this day to push engineering frontiers to their limit. This year's Air & Waste Management Association (A&WMA) Critical Review (Wilson, 2012) provides a reminder of the history of energy technologies as a background for looking into the future of energy-driven demography.

The author and presenter of the 42nd Annual A&WMA Critical Review is David Gordon Wilson, professor of mechanical engineering in the Department of Mechanical Engineering at the Massachusetts Institute of Technology. Prof. Wilson is an expert on energy technologies, and has worked on aspects of energy production and use throughout his career. His research interests have especially involved the development of turbine technology. Like many experienced technologists and academicians, he has a long-standing concern not only for advances in technology, but also national energy development and policies, relevant to conservation and environmental protection.

With the harnessing of combustion through various "engines" using not only wood or biomass, but also fossil fuels, heat is converted to energy including electricity. Methods to supply "cheap and reliable" energy have driven the developed world to extraordinary pinnacles of human activity in less than a century or two. Accompanying this evolution has been an increasing stress on the environment, which stimulated great public concern midway through in the twentieth century. By the late twentieth century, two critical constraints on energy production were recognized: first, the supply of fuels, especially petroleum, became increasingly limited and unequally distributed across the world; and second, environmental stress from by-products of energy supplies and use was identified and control, especially in the developed world.

Since the mid-1900s, major efforts have committed to finding technologies with improved efficiency, broader applications, and improved means for environmental protection. Motivated by both limitations in fossil fuels and environmental considerations, increased efforts to decarbonize the energy supply and develop renewable sources have taken place, focusing beyond historical hydroelectric resources to biomass, wind, and solar energy use (e.g., Global Energy Technology Strategy Program [GTSP], 2011). To achieve reliable and efficient sources of energy supply, a wide range of new technologies has been considered, resulting in their design and demonstration, with application to stationary sources and transportation. (e.g., National Research Council [NRC], 1980; McNeil, 1990; Gray et al., 1991.).

To a great extent, energy technologies have driven worldwide industrialization, while instituting technological advances in major improvements in thermal efficiency and environmental protection. At the same time, energy demand from conventional fuel supplies has rapidly increased since World War II in the developed world. Since the 1960s, this demand has rapidly expanded to the developing world, especially in East Asia and India. The stress imposed on petroleum supplies, particularly, has led to increased concern in the United States and Europe for implementation of national energy policies. Attempts to shape a long-range policy in the United States have been fragmented and shortsighted in scope and design. Curtailment of U.S. dependence on imported petroleum in favor of domestic fuel resource development and expansion of major quantities of alternative energy has largely failed. However, major steps have been taken to foster energy conservation and improvement of energy intensity. Important progress also has occurred in the private sector improving efficiencies of energy production, with parallel reductions in pollutant emissions both from transportation, electricity generation, and the industrial sector (e.g., Energy Information Administration [EIA], 2012).

The environmental stress and human-ecological risk from exposure to air pollution has become increasing complex, involving a wide range of pollutants found in the atmosphere (e.g., Hidy et al., 2011). One of the recent perceived critical stresses on energy and environment derives from concern for the potential impact of climate change from radiative forcing associated with fossil fuel emissions (e.g., Intergovernmental Panel on Climate Change [IPCC], 2007). Attempts to deal with the international scope of this issue in the light of energy demands have resulted in ambiguous, schizophrenic energy "policies," especially in the United States. These have fostered

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decarbonization, while suppressing nuclear energy development and underwriting continuing reliance on fossil fuels.

To respond to the need for new ideas in public energy policy, Prof. Wilson completes his review with a suggestion for an alternative "democratic" energy cost-demand management independent of direct government intervention. The approach could steer modern society to continue conservation measures, while accelerating implementation of non-fossil-fuel resources and energy production technologies. Such ideas along with advances in technology could be considered as a component of a forward-looking free-market energy policy, which would be sensitive both to the continued needs for a reliable, environmentally respectful energy supply. Prof. Wilson's technology review and suggestion for public policy should bring an active discussion to the presentation of the 2012 Critical Review.

A&WMA members and guests are invited to read, attend, and comment on the 42nd Annual A&WMA Critical Review. The presentation of the review and the discussants commentary is planned for Wednesday, June 20, 8:00–11:30 a.m. (EDT), in the Lone Star Ballroom at the Grand Hyatt in San Antonio, Texas, as part of A&WMA's 105th Annual Conference & Exhibition. The invited discussants include Allan H. Legge, Ph.D., F.A.A.A.S., F.A.W.M.A., P. Biol. (President, Biosphere Solutions); Glenn C. England (Principal Consultant, ENVIRON); John G. Watson, Sc.D. (Research Professor, Desert Research Institute); and Stephen C. Peck, Ph.D. (President, SCP Analytics). A fifth invited discussant, Alan C. Lloyd, Ph.D. (President, International Council on Clean Transportation), will provide a written critique of the review for discussion during the panel.

The discussants will provide different perspectives on aspects of energy development and management, and will agree (or disagree) with the narrative and conclusions of the review author and of one another. They will identify additional issues and offer alternative commentary. Comments also will be solicited from the floor and from written submissions to the Critical Review Committee Chair. The Chair will synthesize these points in the October issue of the *Journal of the Air & Waste Management Association*. Members are encouraged to suggest topics and authors for future critical reviews and apply for membership on the Critical Review Committee to participate actively in the process. Anyone interested in joining the Committee, please send an e-mail to dhidy113@comcast.net.

Critical Review Committee (2011–2012)

George Hidy, Chair
Judith C. Chow, Past Chair (2001–2008)
Mitchell Baer
Luis Diaz-Robles
L. Friedl
Peter Mueller
Thomas Overcamp
John Watson

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