FACTORS SHAPING LONG-TERM FUTURE GLOBAL ENERGY DEMAND AND CARBON EMISSIONS

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ABSTRACT

This presentation discusses the forces shaping long-term future global energy demand and carbon emissions. The most important factors shaping future global energy demand and carbon emissions are population and technology. Population acts to set the scale of human activity, though there are many subtleties that work to either temper or magnify the basic scale effect. These factors, such as "tastes," which temper the effect of population on energy demand are sometimes bundled under the heading "socio-economic" factors. Their effects can be significant.

Future global populations will likely grow more slowly than they have in the recent past. The possibility exists that global population could reach a peak during the 21st century and begin to decline. However, such trends may also be accompanied by other trends such as an aging population, living longer, which could have implications that are just beginning to be explored. The distribution of population is likely to continue to shift away from the developed world toward the developing world.

Technology is perhaps the most important factor shaping future carbon emissions. Technology is the broad set of processes covering know-how, experience and equipment, used by humans to produce services and transform resources. As such it, together with the number and composition of human population, sets the scale of human activity, and more importantly determines the character of human activity. The present state of economic development is a reflection of the history of technology. Energy technology is particularly important. Energy is used by humans to transform resources and as such is a key feature determining standard of living. Fossil fuels have been and can be anticipated to continue to be relatively abundant and a relatively inexpensive source of energy. Estimates of the resource base place no meaningful limit on emissions during the 21st century, though the composition of fossil fuels may change. But, the history of energy technology has been characterized by an expanding suite of energy sources and an ever changing energy-technology mix.

Stabilizing the concentration of greenhouse gases in the atmosphere implies that annual global carbon emissions peak and subsequently decline. Thus, it is critical that all of the world's major emitting nations develop and deploy technology consistent with this pattern. A broad portfolio of technologies is anticipated to be engaged in a world that stabilizes CO_2 concentrations. Major technology categories include both those with which we are familiar such as end-use energy efficiency, nuclear power, solar and wind power and the substitution of low-carbon-to-energy fossil fuels for higher carbon-to-energy alternatives, as well as less familiar technologies such as carbon dioxide capture and storage, biotechnology, and hydrogen systems.

The role of technology is to manage the cost of any CO_2 concentration. It is technically feasible to stabilize the concentration of CO_2 at a wide range of levels with present technology, but the cost of doing so is greatly reduced with the development of an enhanced set of technology options. That is, the extent to which resources must be diverted from other human activities toward providing energy services without concurrent CO_2 emissions depends on technology. And, an enhanced energy technology portfolio would reduce the extent to which resources must be diverted.

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