Population growth and the pressures spawned by increasing demands for energy and resource-intensive goods, foods, and services are driving unsustainable growth in greenhouse gas (GHG) emissions. Recent GHG emission trends are consistent with worst-case scenarios of the previous decade. Dramatic and near-term emission reductions will be needed to ameliorate the potential deleterious impacts of climate change. To achieve such reductions, fundamental changes are required in the way that energy is generated and used. New technologies must be developed and deployed at a rapid rate. Technologies such as carbon capture and storage, renewable, nuclear and transportation technologies are particularly important; however, global research and development efforts related to these technologies currently appear to fall short relative to needs. Even with a proactive and international mitigation effort, humanity will need to adapt to climate change, but the adaptation needs and damages which are associated with these activities are not pursued in earnest. In this review, research is summarized that indicates increasing global and regional temperatures and ties climate change to increasing GHG emissions. GHG mitigation targets necessary for limiting future global temperature increases are discussed, including how factors such as population growth and the growing energy intensity of the developing world will make these reduction targets more challenging. Potential technological pathways for meeting emission reduction targets are examined, concerns are discussed, and global and United States modeling results are presented that suggest that the necessary pathways will require radically transformed electric and mobile sectors. While geoengineering options have been proposed to allow more time for serious emission reductions, these measures are at the conceptual stage with many unanswered cost, environmental, and political issues.

Biography

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