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The Sustainable Energy Challenge

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The dependence on oil and fossil fuels for over 80% of our energy and the continued emission of carbon dioxide threatening stable climate are captured in a single term: sustainability. Although we generally agree that sustainability is valuable, there is less agreement on how much sustainability is necessary or desirable. In this talk, three criteria describing increasingly strict features of sustainability will be presented and applied to evaluate the alternatives to oil and carbon dioxide emission, such as tapping unused energy flows in sunlight and wind, producing electricity without carbon emissions from clean coal and high efficiency nuclear power plants, and replacing oil with biofuels or electricity. Implementing these more sustainable alternatives requires new materials of increasing complexity and functionality that control the transformation of energy between light, electrons and chemical bonds at the nanoscale. Challenges and opportunities for developing the complex materials and controlling the chemical changes that enable greater sustainability will be presented.