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Fossil Energy: Drivers and Challenges.

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Concerns about rapid economic growth, energy security, and global climate change have created a new landscape for fossil energy exploration, production, and utilization. Since 85% of primary energy supply comes from fossil fuels, and 85% of greenhouse gas emissions come from fossil fuel consumption, new and difficult technical and political challenges confront commercial, governmental, and public stakeholders. As such, concerns over climate change are explicitly weighed against security of international and domestic energy supplies, with economic premiums paid for either or both. Efficiency improvements, fuel conservation, and deployment of nuclear and renewable supplies will help both concerns, but are unlikely to offset growth in the coming decades. As such, new technologies and undertakings must both provide high quality fossil energy with minimal environmental impacts. The largest and most difficult of these undertakings is carbon management, wherein CO2 emissions are sequestered indefinitely at substantial incremental cost. Geological formations provide both high confidence and high capacity for CO2 storage, but present scientific and technical challenges. Oil and gas supply can be partially sustained and replaced through exploitation of unconventional fossil fuels such as tar-sands, methane hydrates, coal-to-liquids, and oil shales. These fuels provide enormous reserves that can be exploited at current costs, but generally require substantial energy to process. In most cases, the energy return on investment (EROI) is dropping, and unconventional fuels are generally more carbon intensive than conventional, presenting additional carbon management challenges. Ultimately, a large and sustained science and technology program akin to the Apollo project will be needed to address these concerns. Unfortunately, real funding in energy research has dropped dramatically (75%) in the past three decades, and novel designs in fission and fusion are not likely to provide any substantial offset in the next 30 years when they are most needed internationally.