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Induced Seismicity Potential of Energy Technologies

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Earthquakes attributable to human activities–"induced seismic events"–have received heightened public attention in the United States over the past several years. Upon request from the U.S. Congress and the Department of Energy, the National Research Council was asked to assemble a committee of experts to examine the scale, scope, and consequences of seismicity induced during fluid injection and withdrawal associated with geothermal energy development, oil and gas development, and carbon capture and storage (CCS). The committee's report, publicly released in June 2012, indicates that induced seismicity associated with fluid injection or withdrawal is caused in most cases by change in pore fluid pressure and/or change in stress in the subsurface in the presence of faults with specific properties and orientations and a critical state of stress in the rocks. The factor that appears to have the most direct consequence in regard to induced seismicity is the net fluid balance (total balance of fluid introduced into or removed from the subsurface). Energy technology projects that are designed to maintain a balance between the amount of fluid being injected and withdrawn, such as most oil and gas development projects, appear to produce fewer seismic events than projects that do not maintain fluid balance. Major findings from the study include: (1) as presently implemented, the process of hydraulic fracturing for shale gas recovery does not pose a high risk for inducing felt seismic events; (2) injection for disposal of waste water derived from energy technologies does pose some risk for induced seismicity, but very few events have been documented over the past several decades relative to the large number of disposal wells in operation; and (3) CCS, due to the large net volumes of injected fluids suggested for future large-scale carbon storage projects, may have potential for inducing larger seismic events.