13.3 **Utilizing oil shale in a climate-constrained future: Electricity production with pre-extraction carbon sequestration**

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Oil shale contains large amounts of stored chemical energy. Can this energy be a valuable resource in a CO_2-constrained future? We present preliminary exploration of methods of extracting energy from oil shale with greatly reduced CO_2 emissions. Oil shale has traditionally been used to produce liquid fuels, but in a world with electric or hydrogen vehicles, liquid fuels will not be the only method of powering transport. We apply life-cycle thinking to examine the best whole-system method of utilizing energy from oil shale in the transport system with minimal CO_2 emissions. In particular, we explore the concept of electricity production with pre-extraction carbon sequestration (EPPECS). EPPECS applies a number of methods to reduce the CO_2 intensity of oil shale. First, waste heat from electricity production is used to provide retorting heat. Second, the organic matter in shale is heated in place to the point of complete decomposition into a fuel gas stream (H_2, CH_4, CO, CO_2) and carbon-rich char. Third, thermal trapping could be used to prevent production of high molecular weight hydrocarbons until they are broken down into non-condensable, low-carbon fuel gases. Preliminary results are generated using a model that includes kerogen decomposition, mineral dehydration and decomposition, and hydrocarbon cracking/upgrading. Mass and energy balances based on decomposition were calculated, and used in a full-fuel cycle model. Assuming electric vehicles with an energy economy ratio (km per MJ electricity/km per MJ gasoline) of 3, emissions per unit of gasoline equivalent could be reduced to ~0.25-0.33 of those generated by conventional fuels (on a gCO_2/MJ of gasoline equivalent basis). Difficulties with implementation of EPPECS include: how to efficiently introduce waste heat into the geologic formation, and potential carbonate mineral decomposition due to overheating of shale mineral matter. Waste heat might be efficiently introduced via a subsurface fuel cell, as proposed by Independent Energy Partners in the “geothermic” solid oxide fuel cell. Overheating of shale mineral matter could be avoided by limiting char maturation, which reduces H_2 yields but prevents decomposition of carbonate minerals.