Adapting wind energy for shale oil recovery

Jack Bridges, Armin Hassanzadeh

Pyrophase Inc, USA

Using radio frequency (RF) technology, wind and solar power are attractive methods for heating unconventional resources, especially to reduce CO_2 emissions and water consumption. There are advantages and difficulties related to using these approaches to extract fuel from oil shale resources. To illustrate, we used the energy flow diagram developed by the Bechtel Group for an electrically powered in situ shale oil recovery system. For the case where a power plant is used, the net energy ratio (NER) is 3, assuming 50% efficiency for the power plant. When electric energy is directly input via wind power, the NER is 6. Variations on this base case were assessed, including varying the mix of wind and oil shale energy sources and changing site distance from power lines. Solar and wind require more equipment investment to produce the same average power unless supplemented by the grid in a mix. Varying the mix is economical and provides power when the wind is not blowing. If power is used from the grid, the load from the electrical oil shale heating can be varied to stabilize the grid by increasing the load as wind increases and reducing the load as the wind wanes. For remote locations off-gas from the shale pyrolysis process is a practical source of fuel for the power plant. Solar energy is another attractive option for the western portion of the oil shale deposits, which are distant from the main electrical grid and near prime solar locations. We also assessed the production of CO_2 using these approaches. The amount of CO_2 produced in the power plant compared to the amount of CO_2 that might be produced by combustion of products is inversely related to the NER. Wind and solar energy produce no CO_2 emissions during operation and use essentially no water. Carbon capture systems require high water use that can be avoided by these methods. For above ground shale plants, using wind electrical power to dewater and preheat the incoming oil shale feed stock, can lead to a 40 % reduction in CO_2 over what would otherwise be produced.