

# New study explores an untapped reserve of oil and gas resources

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### On-site Shale Heating: An Untapped Source of Hydrocarbons?

Oil shale is a type of sedimentary rock with high organic content

Heating oil shale for long periods of time (years) causes pyrolysis of its organic constituents into lighter hydrocarbons, known as in situ upgrading (ISU)

**While ISU is technically possible, is it also economically feasible?**

### Analyzing the economical viability of ISU in terms of energy consumption ratio (ECR)

ECR: ratio between input energy actually used for pyrolysis and heat losses due to absorption and diffusion

#### Factors that can greatly affect the ECR according to geological models

- Well layout:** Proper heating and production well spacing helps prevent excessive heat losses and reduce drilling costs
- Organic content:**
  - Higher organic content greatly boosts ECR
  - Organic content of 4.2% or more is needed for an ECR >3
- Heating technology:** Alternative heating methods (e.g. convection heating, microwave heating, etc.) could greatly increase the efficiency of ISU
- Catalytic effects:** Chemical or electromagnetic catalytic effects can reduce the time and temperature required for pyrolysis reactions

**These findings will help promote ISU as an economically feasible technology and secure a long-lasting and efficient source of hydrocarbons**

Economic feasibility and efficiency enhancement approaches for in situ upgrading of low-maturity organic-rich shale from an energy consumption ratio perspective  
Lu et al. (2022) | Earth Science Frontiers  
DOI: 10.13745/j.es.sf.2022.8.33-en

In a new study, researchers from China analyze various well configurations and parameters to shed light on the factors that most impact the economic feasibility of exploiting low-maturity oil shale, a hitherto untapped reserve of natural oil and gas resources, for useful hydrocarbons. Credit: *Earth Science Frontiers* (2022)

Modern societies are still very much dependent on oil and gas resources for their smooth functioning. However, natural oil and gas resources are

limited and non-renewable. In order to keep up with the growing demand for hydrocarbons, we need to find and secure alternate sources of natural oil and gas. Fortunately, a massive and mostly untapped reserve of oil and gas waits beneath us.

Oil shale is a flaky sedimentary rock with high organic content. When low-maturity [oil shale](#) is heated for extended periods of time, its [organic molecules](#) break down via [pyrolysis](#) and transform into lighter and more useful oil and gas. This forms the basis of a promising strategy known as in situ upgrading (ISU), whereby heating wells are drilled and laid out directly into the shale layer to provide the necessary heat for pyrolysis. The hydrocarbons produced on site are then extracted through a separate production well. While the process is technically feasible, there is, however, no agreement on whether it is economically feasible as well.

To address this knowledge gap, a research team from Northeast Petroleum University, China and China University of Petroleum in East China recently conducted a study on ISU technology. Led by Dr. Li Wenbiao from Northeast Petroleum University, the team analyzed the economic feasibility of ISU from the perspective of the energy consumption ratio (ECR). Put simply, ECR is a measure of how much of the energy provided to the heating wells is used for pyrolysis in relation to the energy lost to heat diffusion and absorption into minerals, water, and surrounding rock.

As described in their paper published in *Earth Science Frontiers*, the team employed a geological model to look into the factors that affect ECR the most. In their model, they accounted for the heating well design and layout, heating technology, and shale composition, among other parameters and variables.

The results of their analysis indicate that appropriate spacing between the heating and production wells is crucial to improve the efficiency of

ISU. The team also determined the minimum total organic content in the oil shale that leads to acceptable ECR values. Moreover, they also compared and contrasted new heating methods to increase the efficiency of ISU beyond the conventional approach using heating wires. "One important way to increase the efficiency of ISU is to explore alternative heating technologies, such as convection and electromagnetic heating," highlights Dr. Wenbiao.

Overall, the team hopes that the findings of their study would help pave the way for an economically viable ISU technology. "We want our results to promote the application of ISU technology for optimized oil shale exploitation," says Dr. Wenbiao.

**More information:** Lu Shuangfang et al, Economic feasibility and efficiency enhancement approaches for in situ upgrading of low-maturity organic-rich shale from an energy consumption ratio perspective, *Earth Science Frontiers* (2022). [DOI: 10.13745/j.esf.sf.2022.8.33-en](https://doi.org/10.13745/j.esf.sf.2022.8.33-en)

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