



## Review

# A review of the technical and economic evaluation techniques for shale gas development



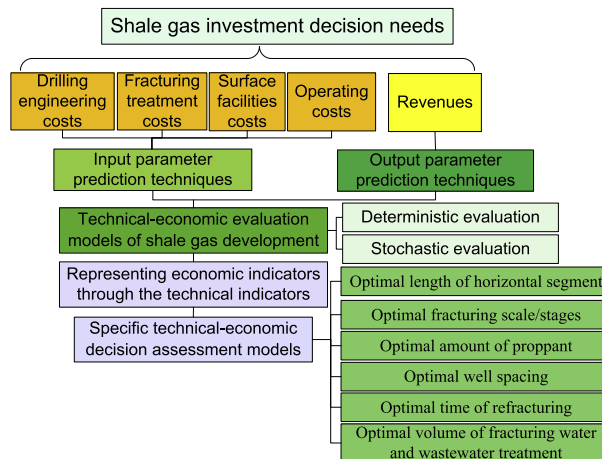
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## HIGHLIGHTS

- We review the technical–economic evaluation techniques for shale gas development.
- The current status of the technical–economic evaluation techniques is investigated.
- Recent evolution and development of the evaluation techniques are identified.
- Future probable focuses and trends of the evaluation techniques are presented.

## GRAPHICAL ABSTRACT



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## ABSTRACT

Shale gas, due to its clean-burning and efficient nature, is becoming an increasingly promising alternative energy resource. It is commonly held that promoting shale gas development will gradually play a significant role in meeting the energy needs of economic and social development as well as reducing harm to the environment. Given the significant implications, many countries are pursuing shale gas opportunities. However, numerous concerns have been raised about the economics of shale gas development, as it is difficult to evaluate. Accurately evaluating the economic viability of shale gas development to reduce investment risks and increase investment opportunity is the key issue that needs to be urgently addressed. This paper presents a systematic review and examination of the technical and economic evaluation techniques for the development of shale gas to provide an overview of their current status. Over time, some progress has been made in existing technical–economic evaluation techniques. It is worth noting that these techniques need to be further improved to more precisely assess the economic feasibility of developing shale gas for assisting investment decisions effectively. For this reason, various potentially useful ideas and approaches are presented to propose some potential improvement in evaluation techniques for shale gas development, which may materialize in possible future trends.

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## 1. Introduction

### 1.1. The progress of shale gas development

With the growing demand for energy and the declining conventional oil and gas production, shale gas, as a significant energy option, has received increasing attention worldwide. Compared with other fossil fuels, shale gas is a clean-burning and efficient energy resource, which contributes to reduce a country's overdependence on high-energy consumption and high-pollution discharge resources and offer more options for reducing air pollutants and greenhouse emissions [1,2]. Naturally, these benefits are accompanied by numerous potential environmental concerns primarily involving water, air, land and community during the development process, which may generate opposition to developing the shale gas industry [1,3]. Nonetheless, actively implementing best practices can effectively address these issues [3,4]. It is a common belief that renewable energy resources are one of the most efficient and effective solutions to sustainable development. However, a long road remains to achieve a transition from today's fossil-fuel-dominated world to a green and low-carbon future. Thus, increasing the use of shale gas can serve as one of the transitional energy solutions helping to bridge this gap [5]. At the present stage, shale gas is a realistic option that can help generate more time and space for renewable energy development and that supports the sustainable development of the economy, society, and the environment [6,7]. For these huge implications, many nations are pursuing shale gas resource opportunities.

Based on technological advances and policy support, the development of shale gas resources has made a series of breakthroughs. Shale gas development (displayed in Fig. 1) [8–13] has played a key

role in giving the United States (US), formerly a natural gas importer, the ability to export natural gas [13,14]. This development has helped the US to successfully ensure its energy security and significantly reduce carbon emissions [1–3,7,15]. Canada has become the second country to achieve the commercial exploitation of shale gas. The successful development of shale gas in Canada, has injected new vitality into the nation's natural gas production, which had previously experienced a rapid decline. Similarly, in recent years, China has also vigorously pursued the development of shale gas. As of 2012, apart from North America, China was the only nation that had attained the commercially feasible production of shale gas [16]. Once large-scale commercial production occurs in the future, it will be vital to provide a crucial guarantee for China, which seeks to build a low-carbon and sustainable economy by implementing economic transformation strategies.

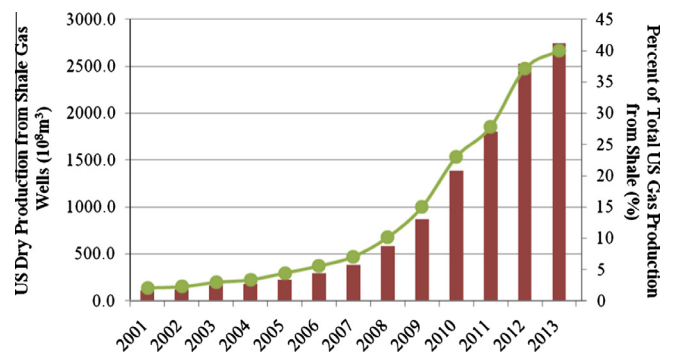


Fig. 1. Shale gas production growth in the US from 2001 to 2013 [8–13].

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