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# Assessing Frontier Shale Resources—From Initial De-risking of Play Elements to Full-cycle Economic Analysis: A Case Study From the Posidonia Shale, Netherlands

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## ABSTRACT

Globally, many shale plays remain poorly investigated, and therefore, have not made the crucial change from potential resource to reserve. This paper builds on previous work which demonstrated the benefits of taking a petroleum systems-based approach to assess unproven shale resources, by combining the de-risking of play elements with an activity-based model for exploration and exploitation.

The Dutch Posidonia Shale is chosen as an appropriate case study to highlight the importance of using an integrated approach in assessing frontier shale resources. The overall approach encompasses, (a) initial de-risking of play elements based on appropriate input distributions derived from a well-calibrated 3D petroleum systems model, and (b) a full-cycle economic analysis of the resource play from exploratory drilling through to appraisal, pilot production, infrastructure development, and production.

The risked in-place resources and a notional activity-based workflow is established in order to characterize an exploration campaign. This includes the uncertainty associated with the subsurface and the surface development parameters. The development scenario goes through the four major steps: exploration, pilot production, development and full production. Two main decision gates after the exploration and the pilot production activities ensure that the decision tree is consistent with realistic scenarios. The main condition for development is the success of the initial exploratory wells. The project continues if the pilot production wells are able to test a flow >1.3 MMbbl/yr. for the entire field. In the positive case, a development facility is subsequently planned, immediately followed by full production. The resulting decision tree demonstrates that the average net present value is only slightly positive. This is driven by the large drilling costs, relatively high risk and very low recovery factors. Through a careful analysis of the scenarios where the pilot production fails, the threshold for continuation can be calibrated.

With increasing cost constraints, and uncertainty in the barrel price, operators need to take more informed decisions prior to committing to an exploration strategy in data-poor frontier shale plays. Therefore, it is demonstrated that by generating multiple stochastic scenarios, the key elements of assessing economic recovery can be rigorously tested prior to committing to exploring in a basin.