

Geological hydrogen exploration: Optimize decision-making with play-based exploration, value of information and geological chance of success.

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Summary

The transition to a low-carbon economy requires exploration for low carbon energy sources, including geological (natural) hydrogen. Hydrogen exploration is like an aleatoric game with sparse information; Chance of success is expected to be modest. Most evaluations are undertaken by: (a) junior exploration companies, some of which have little experience in hydrogen geology or hydrogen detection, and (b) research institutes that deliver results on research timeframes. Conversely, investors need to quickly assess whether a hydrogen exploration project is as 'good' and prospective as the 'competing' investment opportunities. A reliable framework for comparing hydrogen regions, plays and drilling targets is essential so that hydrogen exploration investors can make wise decisions. Thankfully, hydrogen explorers do not need to 're-invent the wheel'; Globally standardized and trusted best practices are already available.

The authors have adapted the systematic methodology of petroleum play-based exploration (PBE) for early-stage hydrogen exploration projects (Figure 1). PBE is the most appropriate exploration framework because it has methods to: Identify the most prospective plays across a country; Assess the value of existing information; Model the geology holistically; Make reasonable estimations about hydrogen trap and resource sizes; Map the geological chance of success; Design the optimal data collection program based on the value of future information (Figure 2).

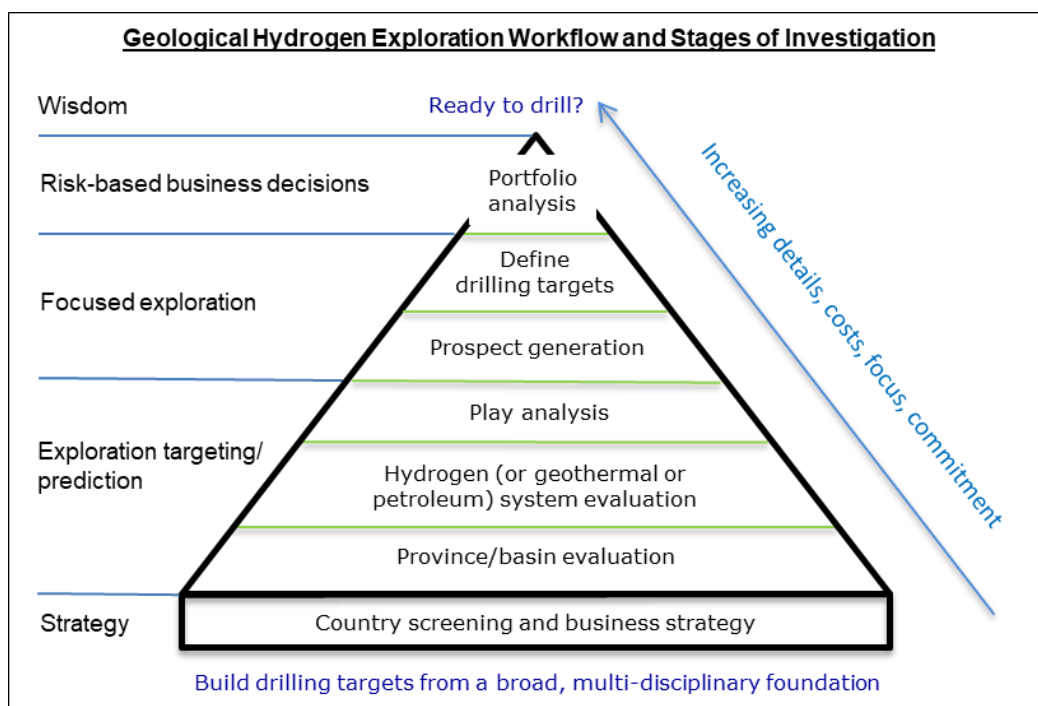


Figure 1. The succinct version of the hydrogen Play-Based Exploration process. It displays the staged purposes, goals, and the most suitable stakeholder for each scale of investigation in an exploration/evaluation project (Modified after Route to Reserves, 2018). *An H₂ play is defined by the authors as a regional reservoir and trap mechanism/top seal pair containing a portfolio of fields, discoveries, prospects, leads and occurrences of H₂ at anomalously high concentrations.

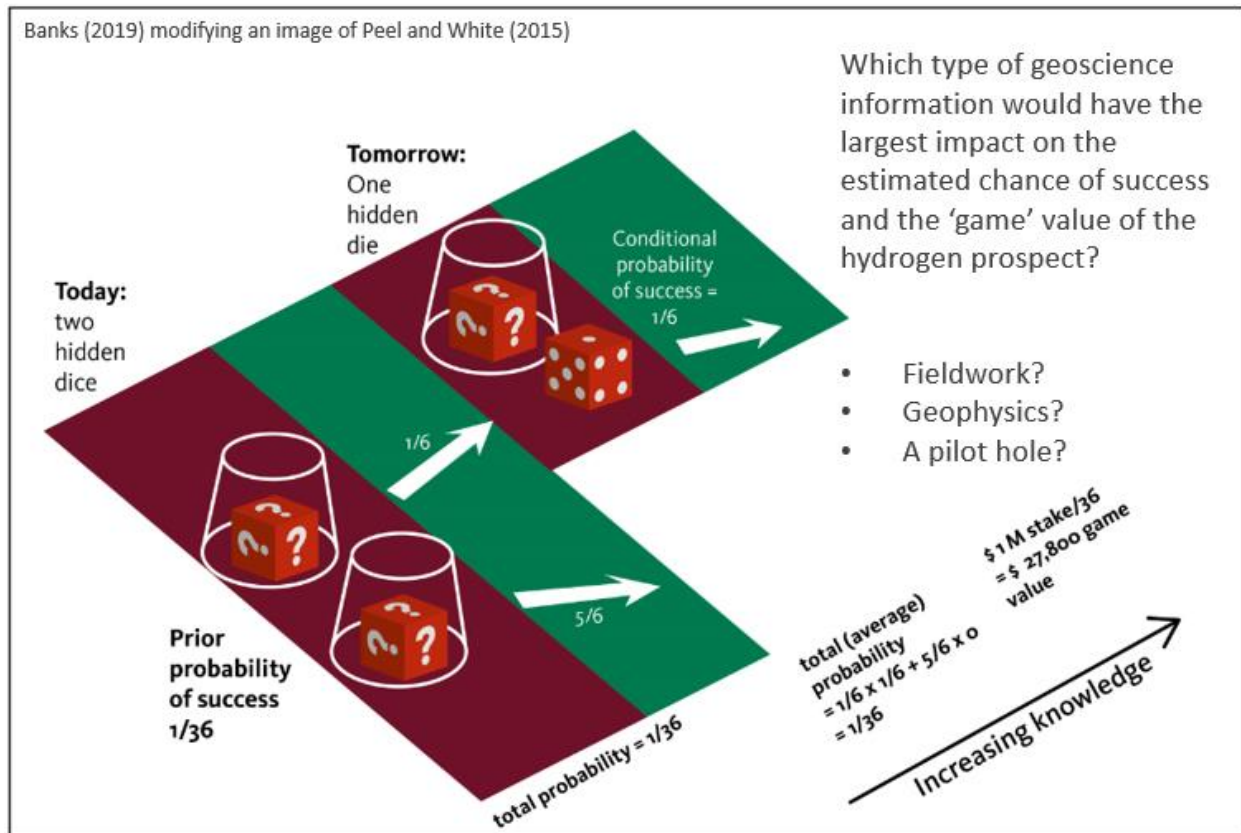


Figure 2. The process to assess the value of information from a future program (Banks, 2019).

Theory, Method and Workflow

Hydrogen Play-Based Exploration. A critical component of this evaluation framework is that enables integration of information across basin to wellbore scales, and down to 5 km deep. An initial phase of hydrogen PBE is evaluation of basin/province scale, for geology and uncertainties. One example is estimating the richness and yield potential of a natural hydrogen source rock. Ranking a /region. A subsequent PBE step is to rank the portfolio of natural hydrogen prospects at play-scale. The hydrogen exploration framework developed by these authors is being applied by a hydrogen exploration company. It provides the client with a method to conduct systematic and repeatable evaluations on whole countries, and quickly focus their hydrogen exploration from country- to county-scale. The workflow is consistent across jurisdictions and organizations. This enables global exploration opportunities to be objectively compared, risked and ranked.

Value of Information. There is currently a scarcity of subsurface information to create hydrogen geology models. Geoscientists are reliant upon 3rd party data, interpretations and geological analogues that were probably not acquired and processed for hydrogen. Before building hydrogen hypotheses and models from this information, it is imperative that the value, relevance and reliability of the information for use in a hydrogen model is determined. A value of future information analysis helps exploration companies to do this, to prioritize data collection by how much the data may reduce uncertainty. The exploration framework we use starts with a Value of Information analysis.

Chance of Success. Estimating the exploration program's chance of success is vital to convert geology into probability and risk for non-geologist stakeholders. We display how to assess the likelihood that the hydrogen geology hypotheses represent the subsurface.

Results and Conclusions

All hydrogen exploration stakeholders need to quickly make optimal business and expenditure decisions with limited information, in a new and rapidly changing industry. The presentation accompanying this abstract will summarize the value of hydrogen PBE workflow for: Play-scale geology; Value of Information analysis; Mapping the geological chance of success. Using a systematic approach can help other hydrogen exploration companies and research institutes to make reliable decisions and plans despite limited information.