



POLITECHNIKA ŚLĄSKA

WYDZIAŁ INŻYNIERII ŚRODOWISKA I ENERGETYKI

Dyscyplina naukowa: inżynieria środowiska, górnictwo i energetyka

mgr Monika Wójcik

**Ocena środowiskowa i energetyczna procesów poszukiwania
i eksploatacji niekonwencjonalnych złóż węglowodorów
z uwzględnieniem analizy ryzyka**

Promotor: dr hab. inż. Wojciech Kostowski

Promotor pomocniczy: dr inż. Paweł Gładysz

Gliwice, 2022

ABSTRACT

The impact of the hydrocarbons mining and of the gas industry sector on the natural environment is included in the nature of these activities. Exploration and extraction processes of unconventional hydrocarbons like shale and tight gas create a potential threat for the environment. The aim of this study was to identify the type of threats during the exploration and extraction processes of unconventional hydrocarbons like shale and tight gas.

The total level of risk in the shale gas wells (S-1, S-2 and S-3) and tight gas (T-1, T-2 and T-3) at Stage 1 was determined as low and not exceeding $R < 2$ value (Risk scale: 0...9). The increase of risk $2 < R \leq 4.16$ occurred in Stage 2 (industrial gas extraction). At Stage 3, the estimated risk did not exceed the value of $R \leq 4.5$.

This study also presents environmental, energy and ecological analyses of exploration and extraction processes of unconventional hydrocarbons for six wells of shale and tight gas using Life Cycle Assessment (LCA) and Thermo Ecological Cost (TEC) methodology.

The global warming potential (GWP) for shale gas estimated by the GWP 100a method is 0.003 kg CO₂eq/MJ, for tight gas 0.004 kg CO₂eq /MJ. These values are lower than estimated for hard coal (i.e. 0.042 kg CO₂eq/MJ) and liquefied natural gas (LNG) imported to Poland (0.0174 kg CO₂eq/ MJ), and comparable to values calculated for conventional natural gas in Poland (i.e. 0.003 kg CO₂eq/MJ).

The thermoecological cost (TEC) was calculated for shale gas 1.09 MJ_{ex}/MJ_{ch} and tight gas 1.14 MJ_{ex}/MJ_{ch} products, this indicator determines the rate of depletion of non-renewable energy resources. The impact on resource consumption was determined using the sustainability index which was found 1.05 for shale gas and 1.10 for tight gas.

Detailed conclusions and results have been presented in summary.