

GEOLOGICAL POSSIBILITY OF HYDROGEN STORAGE CAVERNS LOCATION IN THE UPPER PERMIAN (ZECHSTEIN) STRATIFORM ROCK SALTS AND SALT DOMES IN POLAND

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Underground hydrogen storage in salt caverns may provide an alternative form of energy storage by hydrogen pumping to the underground space during the surpluses in power production and its extraction and consumption in times of increased demand. Salt caverns, leached in thick rock salt bodies of salt domes or stratiform salt occurrences are one of recommended optimal form of such gas storage.

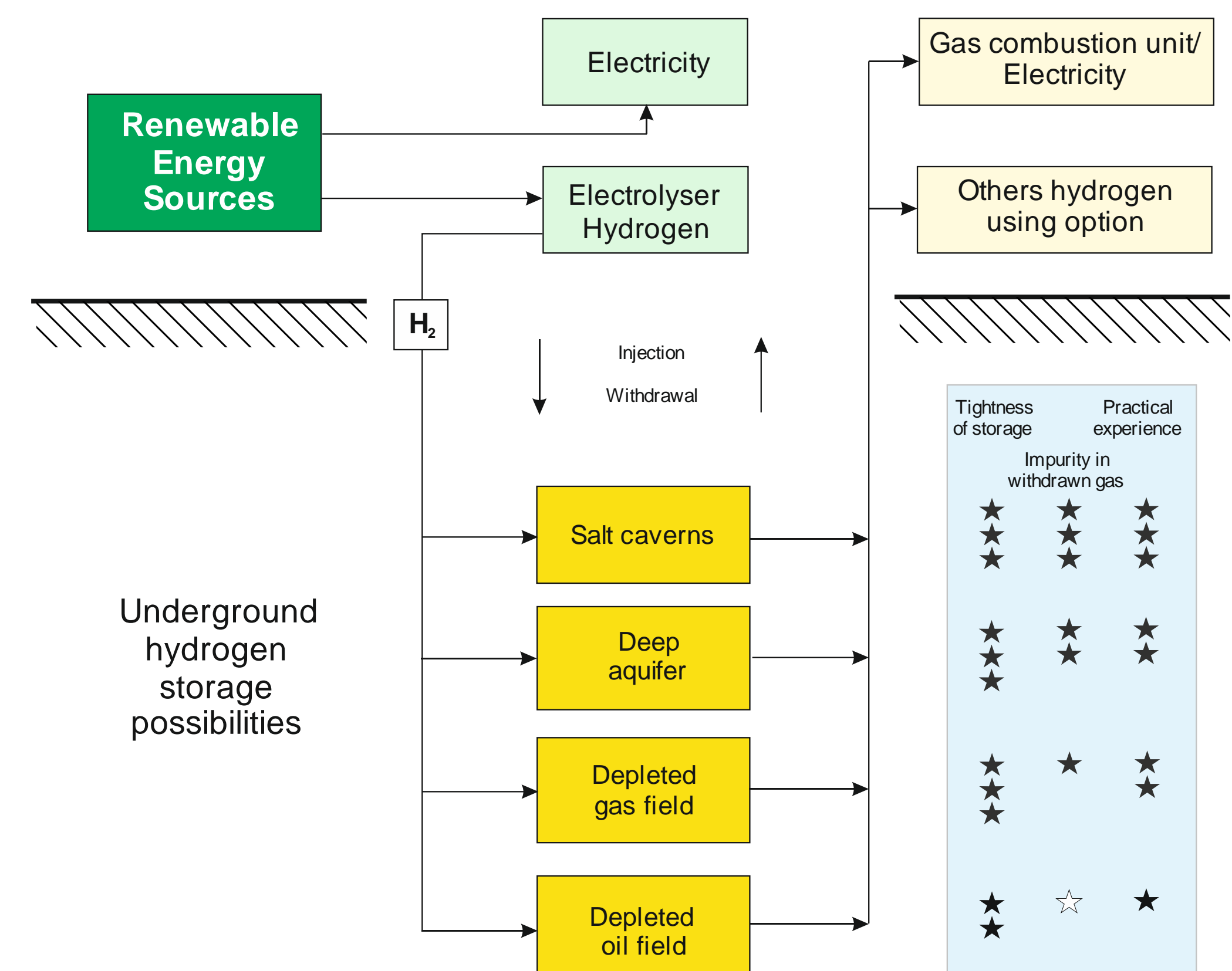
Characteristics of selected salt domes from the Polish Lowlands favorable for location of hydrogen storage caverns

Salt dome name (ability scale)	Recognition stage of salt dome	Depth/ thickness min. - max. of cap rock (m)	Cap rock lithology
ROGÓŻNO (I)	relatively good	54,5-328,8 /12,8-286,3	clay-gypsum- anhydrite
DAMASŁAWEK (II)	good current seismic & borehole	184,0-1050,0 /2,5-294,1	gypsum-clay
ŁANIĘTA (III)	good	90,0-308,6 /29,6-241,4;	gypsum-anhydrite
LUBIEŃ (III)	good	151,5-358,0 /81,5-169,0	gypsum-anhydrite
GOLENIÓW (IV)	medium	702,2/185,8	gypsum-clay
IZBICA KUJAWSKA (IV)	low	144,0-412,0 27,7-207,2;	gypsum-clay
DĘBINA (o)	low	47,3-121,0 /94,0-122,0	clay-gypsum- anhydrite



Distribution of optimal-prospective areas for location of hydrogen storage caverns in the stratiform rock salt occurrences and in salt structures in the Upper Permian (Zechstein) deposits in Poland

The Miocene rock salts occurred in southern Poland are generally unfavorable for such cavern storage because of numerous clastic interbeds and intensive tectonics.



The concept of underground hydrogen storage in geological structures

Data on the prospective occurrences of Upper Permian (Zechstein) rock salts in Poland enabled to point out within the stratiform salt bodies and salt domes several areas and single boreholes in which geological parameters of salt bodies are optimal or prospective for location of hydrogen storage caverns. Assumed geological criteria for stratiform salt such bodies are as follow: for the optimal location a salt body thickness is >100 m and the depth of body top no deeper than 1 km but the prospective sites characterize with a salt body top placed in 1-1.5 km interval and its thickness is >145 m. In the Zechstein stratiform rock salt bodies in Poland were distinguished 9 optimal and 9 prospective areas as well as dispersed 27 optimal and 4 prospective boreholes, in which geological parameters of these rocks favored location of hydrogen storage caverns.

Number of optimal and prospective areas and boreholes favored location of hydrogen storage caverns in the stratiform Upper Permian (Zechstein) rock salt bodies in Poland

Cyclothe m	Area		Borehole	
	optima I	prospective	optimal	prospective
Northern Poland				
PZ1	5	1	17	2
South-western Poland				
PZ1		4	6	1
PZ2	-	-	3	1
PZ3	4	4	1	-
Total	9	9	27	4

The salt domes were selected using two basic criteria: the maximum depth to the salt level, accepted as <1 km, and the degree of the previous development of the dome. A lower importance was assigned to the thickness of the salt series, accepted as at least 1000 m. Analysis of the degree of exploration and development of 27 salt domes in Polish Lowlands resulted in selection of seven hitherto undeveloped domes that preferably meet the geological and reservoir criteria for locating underground hydrogen storage caverns: Rogóżno, Damasławek, Lubień, Łanięta, Goleniów, Izbica Kujawska and Dębina, arranged in order of decreasing utility. A detailed analysis of the state of their geological exploration, involving basic geological parameters of the seven selected domes was the base for evaluation of the utility of the selected domes as sites for hydrogen storage caverns.