



## Conflicts of interests/interaction with other underground use

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# ANNEX I. CRITERIA FOR THE CHARACTERISATION...

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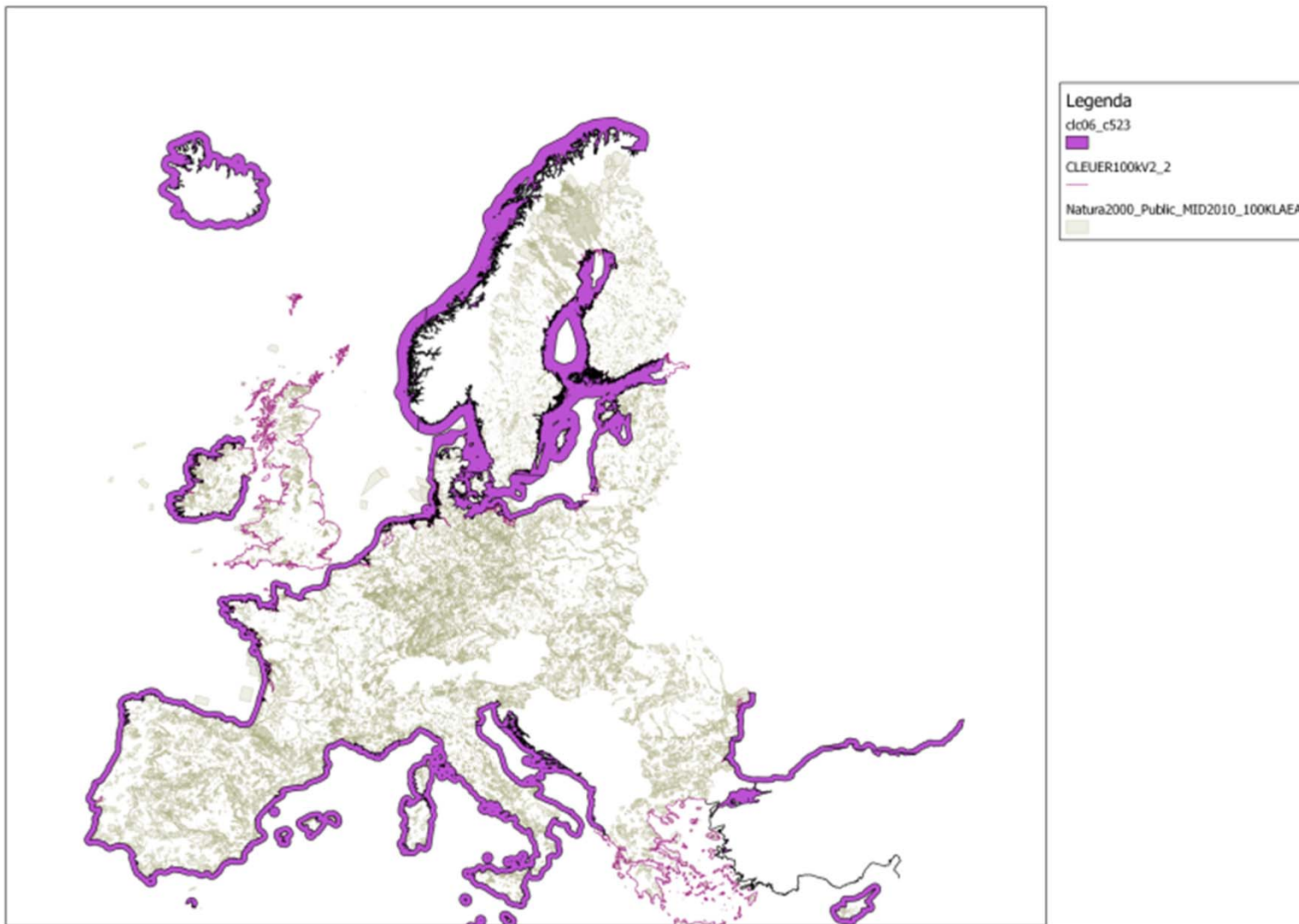
The following characteristics of the complex vicinity shall be documented:

.....population distribution.....

- ➔ proximity to valuable natural resources (including in particular Natura 2000 areas pursuant to Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds(1)OJ L 103, 25.4.1979, p. 1. and Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora(2)OJ L 206, 22.7.1992, p. 7., potable groundwater and hydrocarbons);
- ➔ activities around the storage complex and possible interactions with these activities (for example, exploration, production and storage of hydrocarbons, geothermal use of aquifers and use of underground water reserves)



# The protected areas (Natura 2000, EEA)

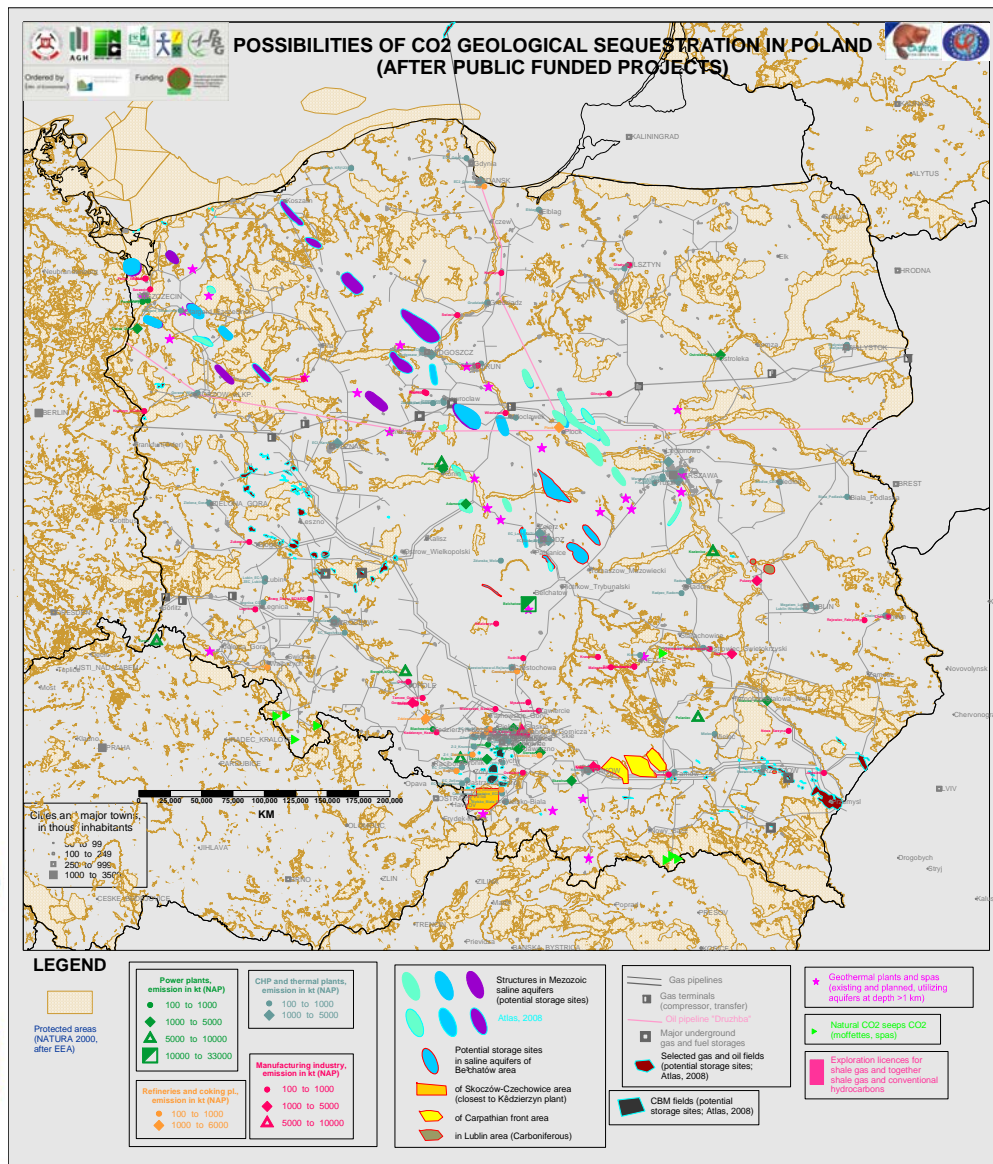


# The protected areas (Natura 2000, EEA)

- A large part of territory of EU states is covered by protected areas,
- Certainly CO<sub>2</sub> injection facilities cannot be located within the protected areas but storage permits would enclose these areas,
- Precisely, CO<sub>2</sub> plume would be located under protected areas and it should be proven no leak may occur (?).
- Also pipeline routes could cross the protected areas and exploration permits (on CO<sub>2</sub> storage sites) could overlap with Natura 2000.



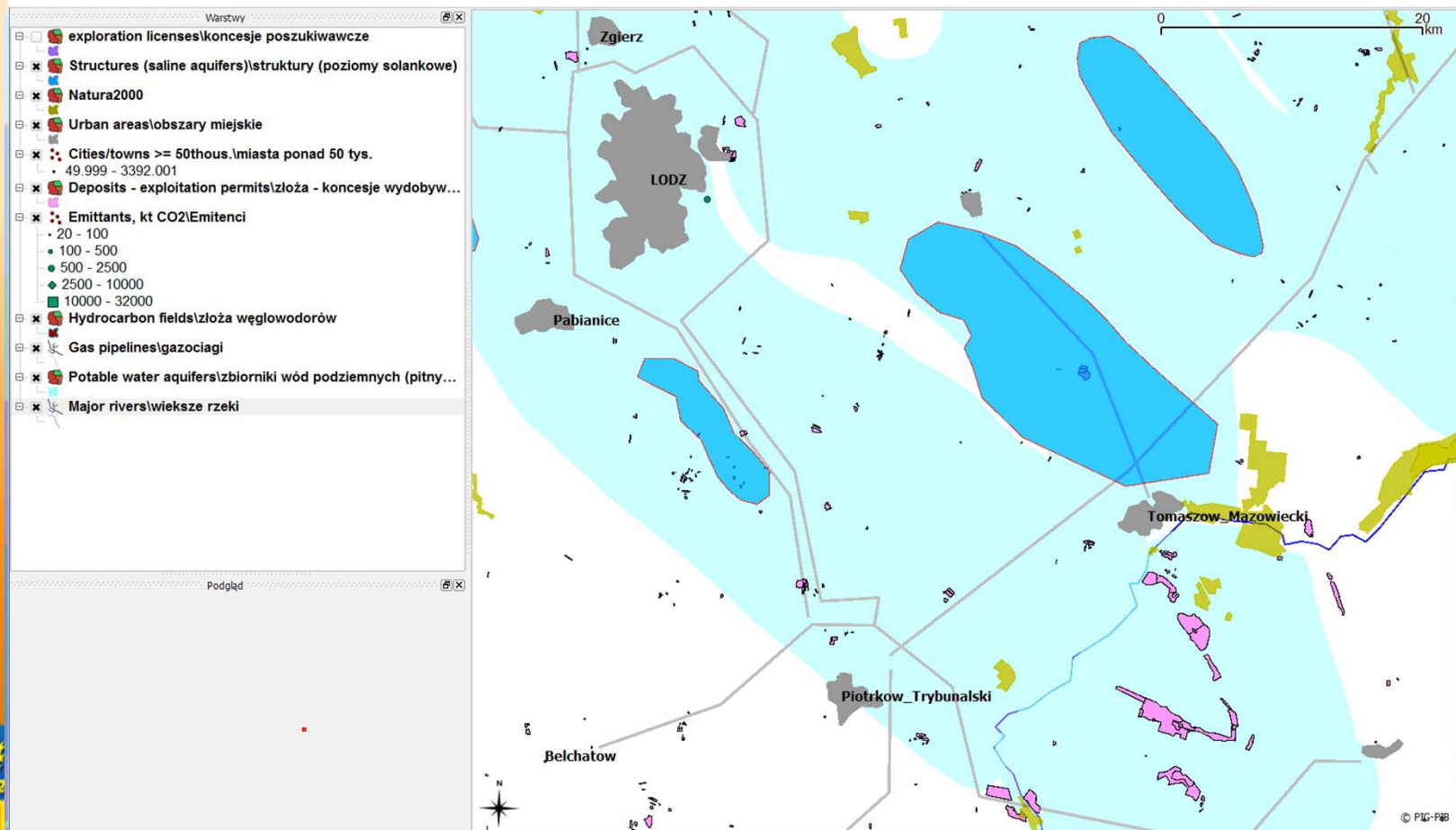
# The protected areas



- ➔ As an, example, situation in Poland,
- ➔ Dotted **yellowish** areas denote Natura 2000.
- ➔ Multicolored areas/polygons – storage sites (~storage permit areas),
- ➔ Some storage sites include protected areas but location of injection facilities is not a problem.

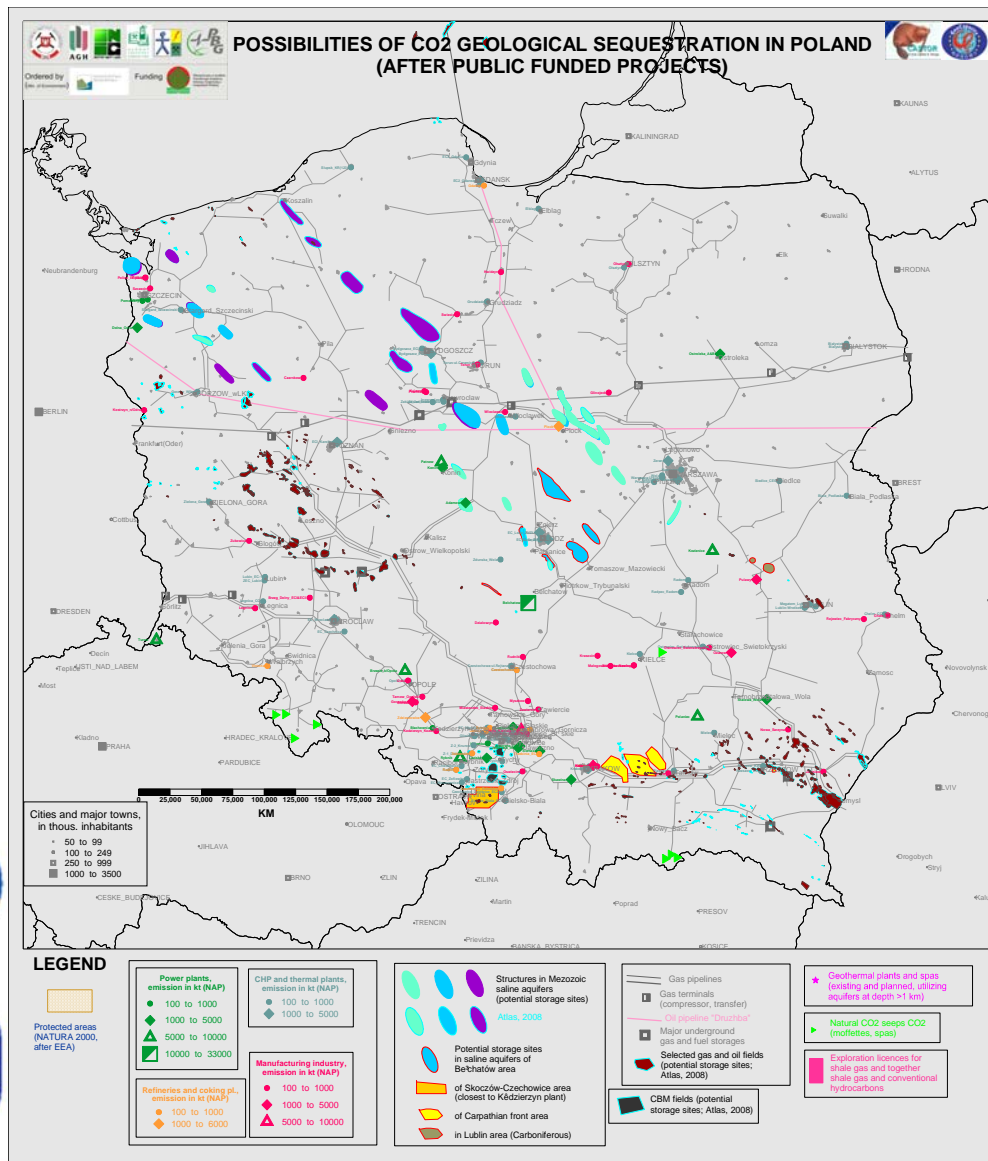


# Potable groundwater resources



Though it can be proved CO<sub>2</sub> migration into shallow groundwater reservoirs is not possible, CO<sub>2</sub> storage would (indirectly) definitely affect deep groundwater resources.

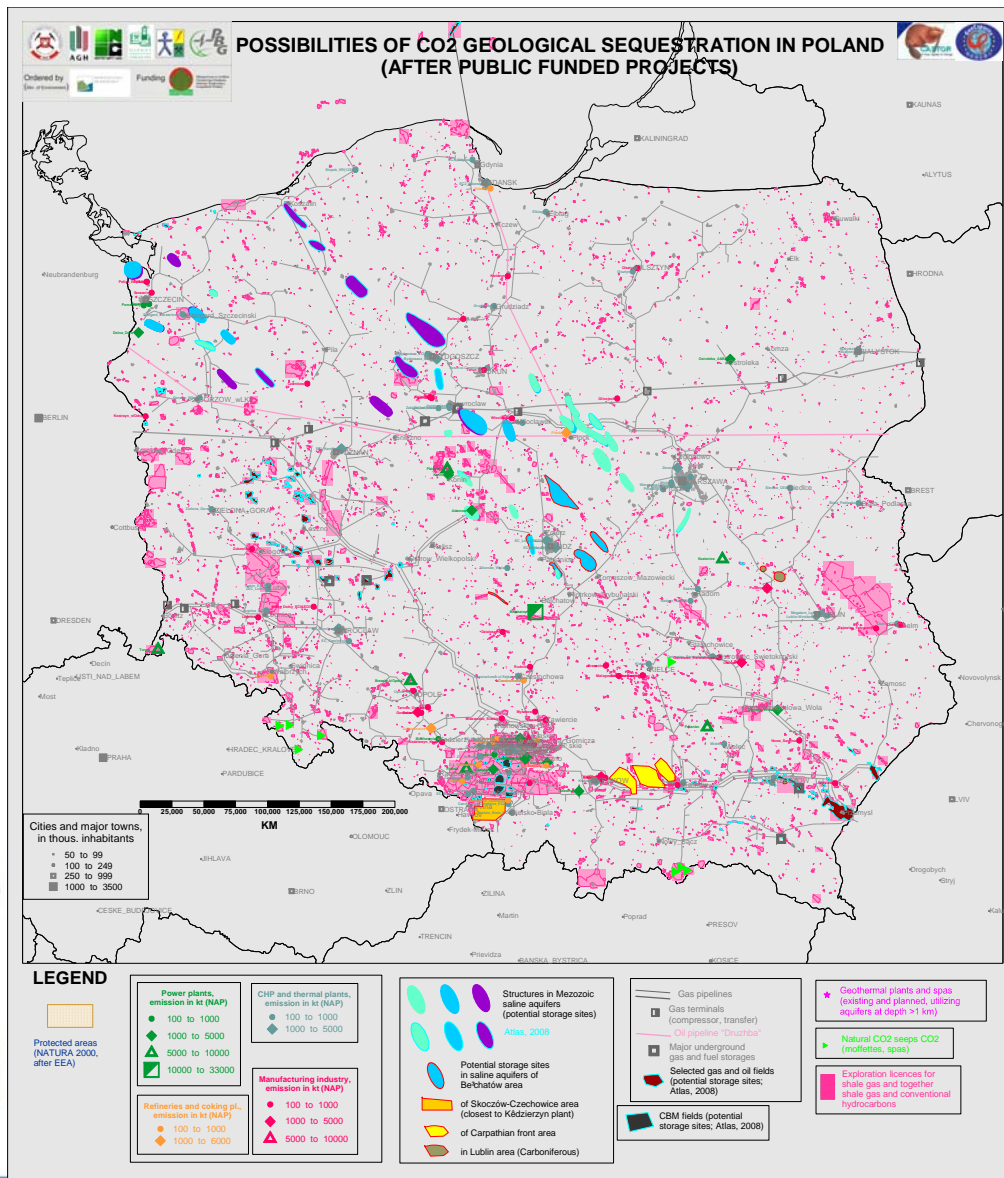
# Hydrocarbon production



- ➔ As an, example, situation in Poland,
- ➔ **Brown areas** denote hydrocarbon fields,
- ➔ Depleted/depleting hydrocarbon fields are good CO<sub>2</sub> storage sites (or HC storage sites) age sites,
- ➔ Storage in saline aquifer structures would rather do not disturb HC production.



# Production of mineral resources

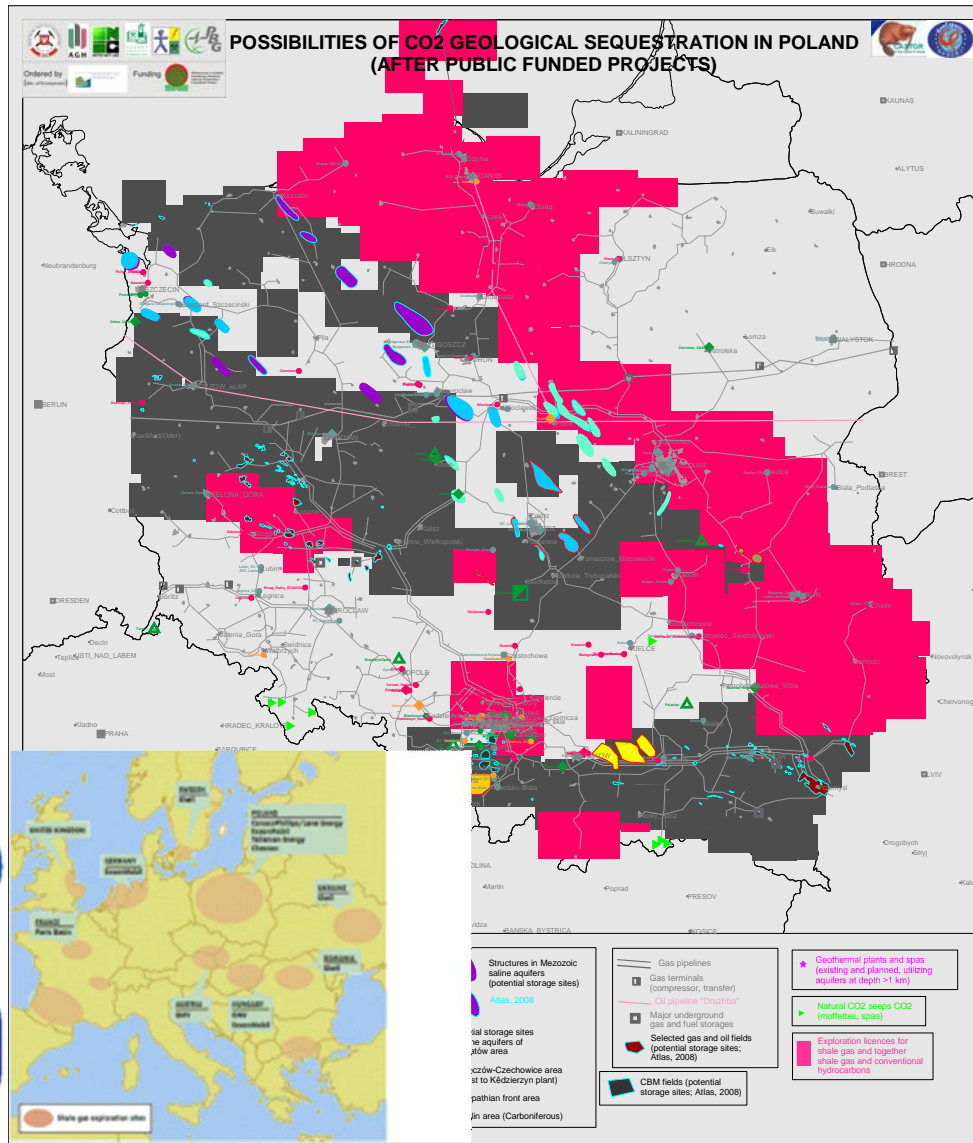


- ➔ **Pink areas** denote various exploitation permits,
- ➔ Coal, ore mining areas - CO<sub>2</sub> storage might not be recommended in the same place,
- ➔ Shallow use of the subsurface (peat, gravel, etc.) is not a problem for CO<sub>2</sub> storage,
- ➔ Hydrocarbons – see previous slide.





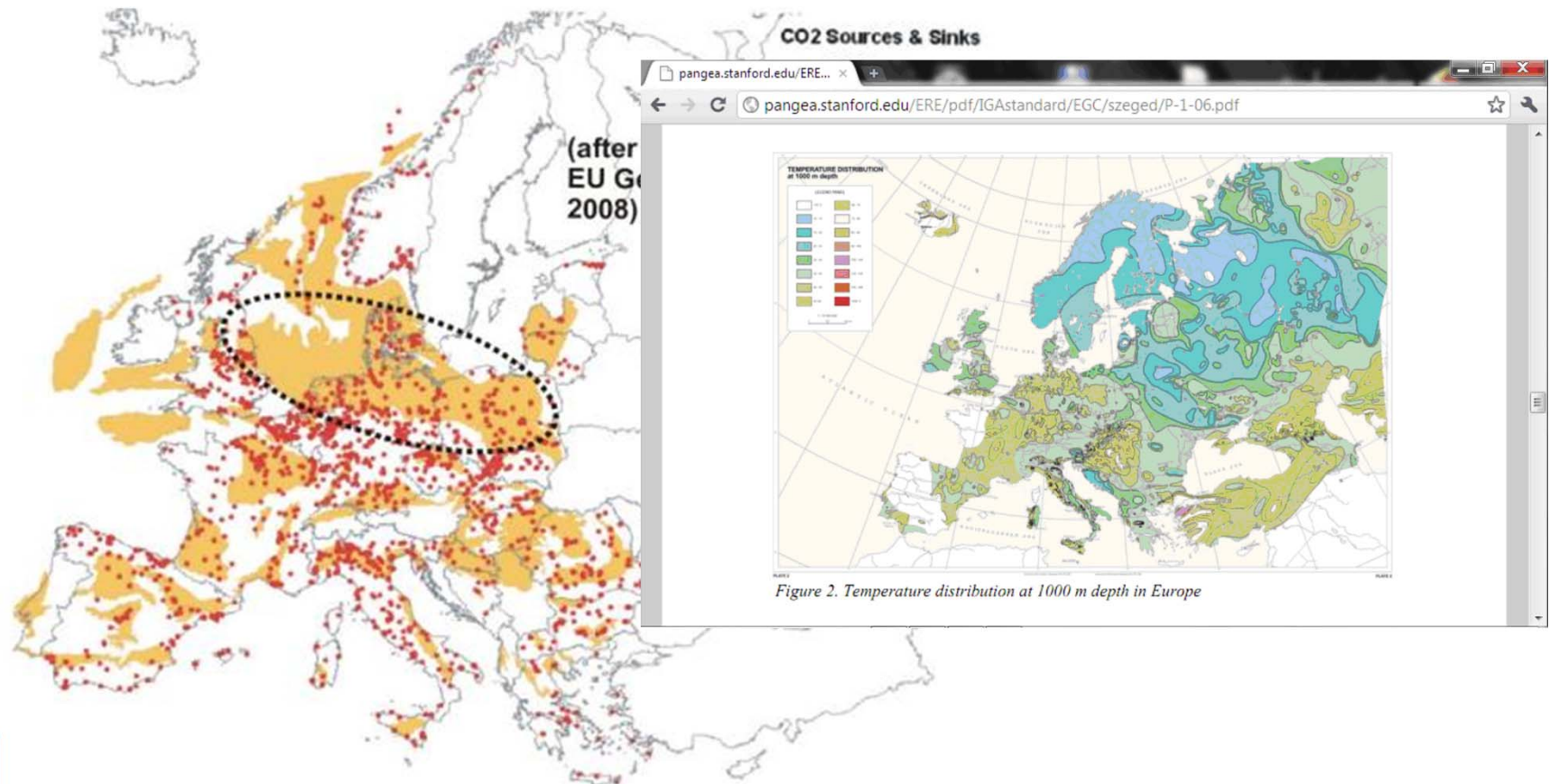
# Exploration permits (hydrocarbons)



- ➔ **Pink areas** denote exploration permits on shale gas (of depth range usually bigger than CO<sub>2</sub> storage) and other HCs,
- ➔ **Grey areas** denote exploration permits on other HCs,
- ➔ Future production permits on shale gas could cover far bigger areas than in conventional HCs.



# Geothermal applications



- Onshore aquifers suitable for CO<sub>2</sub> storage could be used in low enthalpy geothermal,
- In case of enhanced geothermal systems usually not the same target formations are used.

# CCS and geothermal – is this really a conflict?

Queensland CO2.pdf - Adobe Reader

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## Electricity Generation from an Engineered Geothermal System using a Supercritical CO<sub>2</sub> Geothermal Siphon

Hal Gurgenci<sup>1,2</sup>, Victor Rudolph<sup>2</sup>, Tapan Saha<sup>2</sup>, Peter Jacobs<sup>2</sup>, Joe Dong<sup>2</sup>, Max Lu<sup>2</sup>

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This submission is about the infrastructure and resource implications associated with a yet unproven but very promising technology that will not only produce emission-free electricity by passing CO<sub>2</sub> through a hot dry rock reservoir but will also sequester the total CO<sub>2</sub> output of from coal-fired power plants three times its installed capacity through partial losses of the CO<sub>2</sub> to the subsurface structures.

The technology is being pursued by the Queensland Geothermal Energy Centre of Excellence. There are discussions towards future collaboration with the Japanese CRIEPI (Central Research Institute of Electrical Power Industry), Massachusetts Institute of Technology and the Department of Energy of USA.

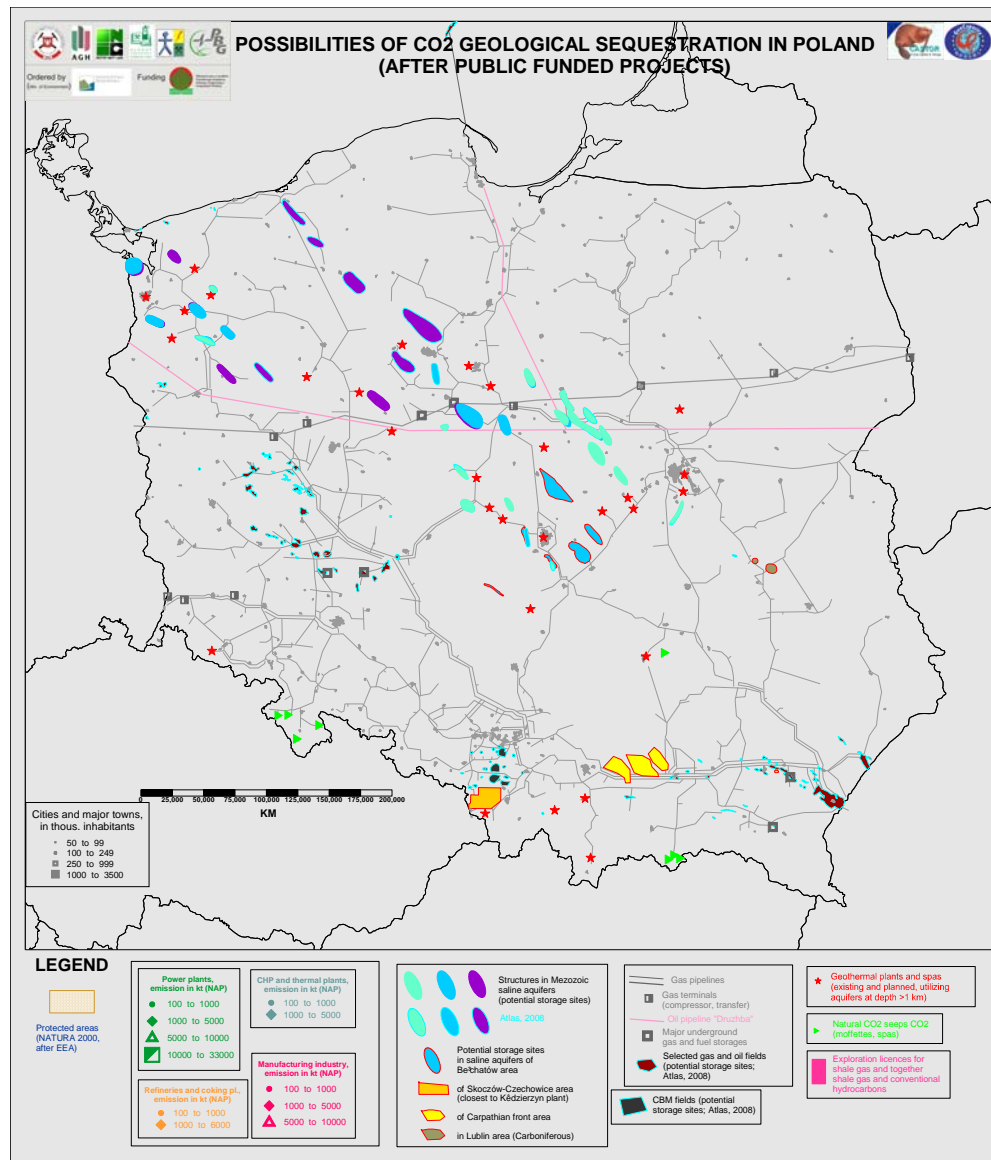
The supercritical CO<sub>2</sub> geothermal siphon concept is an extension of the technology developed and demonstrated under the heading of Engineered Geothermal Systems (EGS) over the last 30 years in USA, Europe, Japan and Australia.

### Engineered Geothermal Systems (EGS)



# CCS and geothermal

- ➔ **Red symbols** denote the present and possibly future use of geothermal resources overlapping with the depth range of CO<sub>2</sub> storage,
- ➔ Good onshore aquifers could be used for both goals but the areas of geothermal permits are not very big,
- ➔ However the impact of both uses is farther than permit areas.



# SUMMARY

- Environment protection areas (Natura 2000) – no injection facilities, exploration and transport activities might overlap with the protected areas,
- Groundwater resources not to be affected with an exception of the deep potable aquifers.
- Hydrocarbon production might rather benefit than suffer from CO<sub>2</sub> storage activities,
- Hydrocarbon storage and CO<sub>2</sub> storage could be in a conflict,
- Exploration for hydrocarbons is a matter of priorities and it should be two cases distinguished: shale gas (likely large future production licenses), other hydrocarbons (smaller production areas),
- Other mineral resources matter provided they appear within the depth range of storage complex,
- The use of low enthalpy geothermal resources and CO<sub>2</sub> storage could be in a conflict.





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