



The European Network  
of excellence on the  
Geological Storage of CO<sub>2</sub>

# Large-scale and demonstration CCS projects; pilot and test sites for CO<sub>2</sub> capture, transport and storage

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21<sup>st</sup> February 2022, CO2GeoNet Webinar



# Classification of CO<sub>2</sub> capture, transport and/or storage projects according to project size<sup>1,2</sup>

Scale	Definition
<b>Large-scale projects</b>	Projects that enable CO <sub>2</sub> capture/injection rates of > 400 kt CO <sub>2</sub> /year (process industry) or ~ 800 kt CO <sub>2</sub> /year (power generation)
<b>Demonstration projects</b>	Projects that have a capture/injection rate of < 400 kt CO <sub>2</sub> /year with overall > 100 kt CO <sub>2</sub> captured/injected
<b>Pilot projects</b>	Projects with an overall amount of < 100 kt CO <sub>2</sub> captured/injected (over a few years)

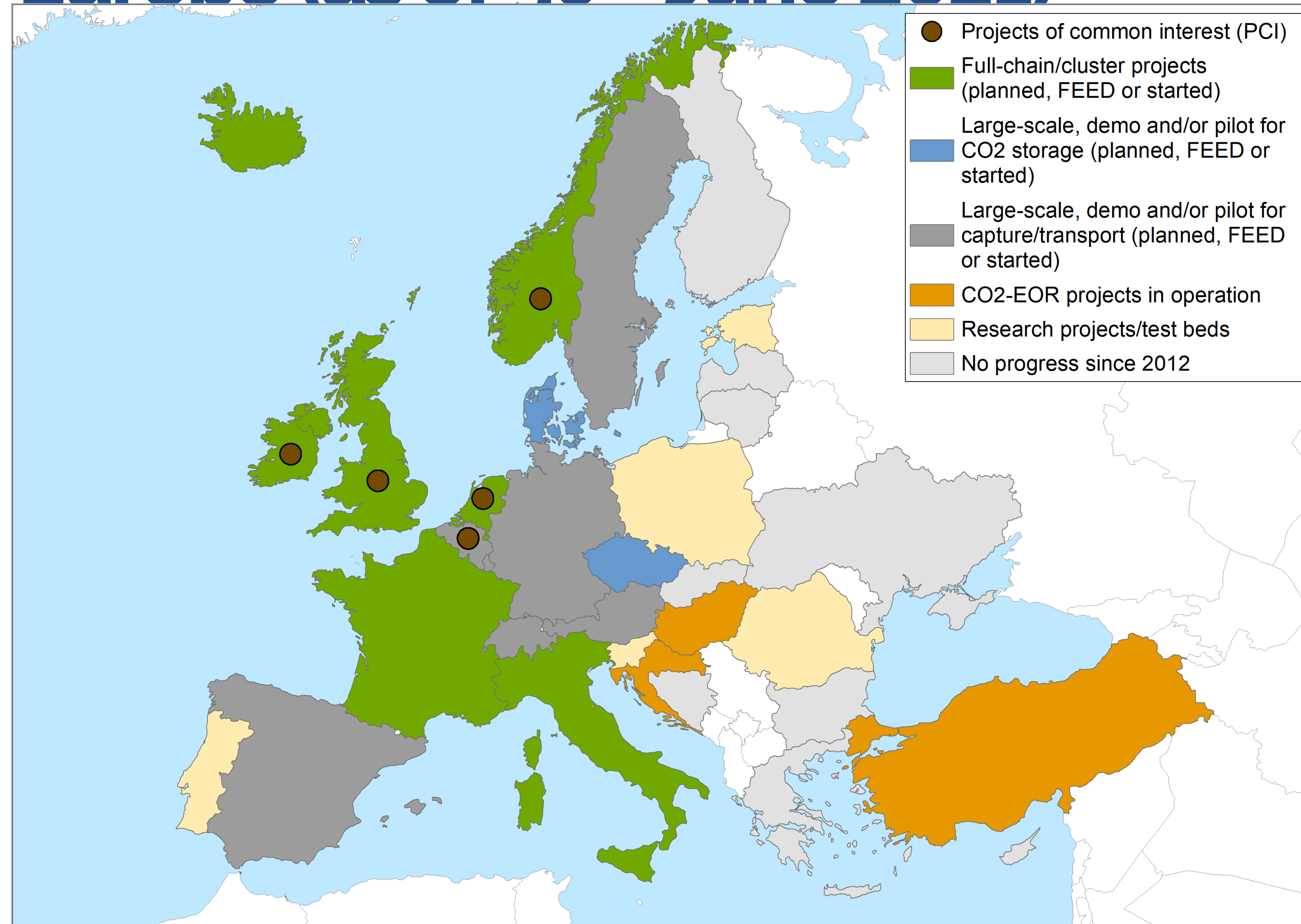
<sup>1</sup> GCCSI – Global CCS Institute (2020): Global Status of CCS 2020. — Report, 80 p.

<sup>2</sup> Martínez, R., Vincent, C., Czernichowski-Lauriol, I. Arts, R., Boavida, D., Carneiro, J., De Dios, J.C., Falus, G.,Giorgiev, G., Hladik, V., Grunnaleite, I., Kucharic, L., Nilson, P.A., Okandan, E., Persoglia, S., Poulsen, N.,Quinquis, H., Sava, C., Suárez, I. & Wójcicki, A. (2013): Opportunities for CO<sub>2</sub> storage pilot projects. — CGS Europe report, October 2013, 68 p.

# Political and economic realities in Europe

- The **situation between 2010 and 2017** was characterized by cutbacks in public funding, lack of comprehensive climate policies and a too low carbon price of only ~ EUR 5/t CO<sub>2</sub> → so that there was no rationale for economic actors to invest into CCS.
- With the perspective of achieving its climate and energy targets for 2030 and beyond, the EU has launched **in 2020 the new EU Innovation Fund for low-carbon technologies**. It replaces the former NER300 and could be seen as additional stimulus for preparation of new CO<sub>2</sub> storage projects.
- Oversubscribing of large-scale projects took place and a number of projects are referred to selection in a second stage; a majority of projects is related to CO<sub>2</sub> utilisation.
- Our intensive study of country-specific information (Annex of the State-of-play report) shows **significant variations among the assessed European countries**.
- Different reasons for this development are: (i) CCS is not part of the national climate-protection policy, (ii) lack of awareness of the technology, (iii) insufficient geological storage capacity, (iv) other socio-economic issues

# CO<sub>2</sub> capture, transport and storage projects on all scales and at all stages of planning and development, including full-chain/cluster projects and Projects of Common Interest (PCI) in Europe (as of 30<sup>th</sup> June 2021)

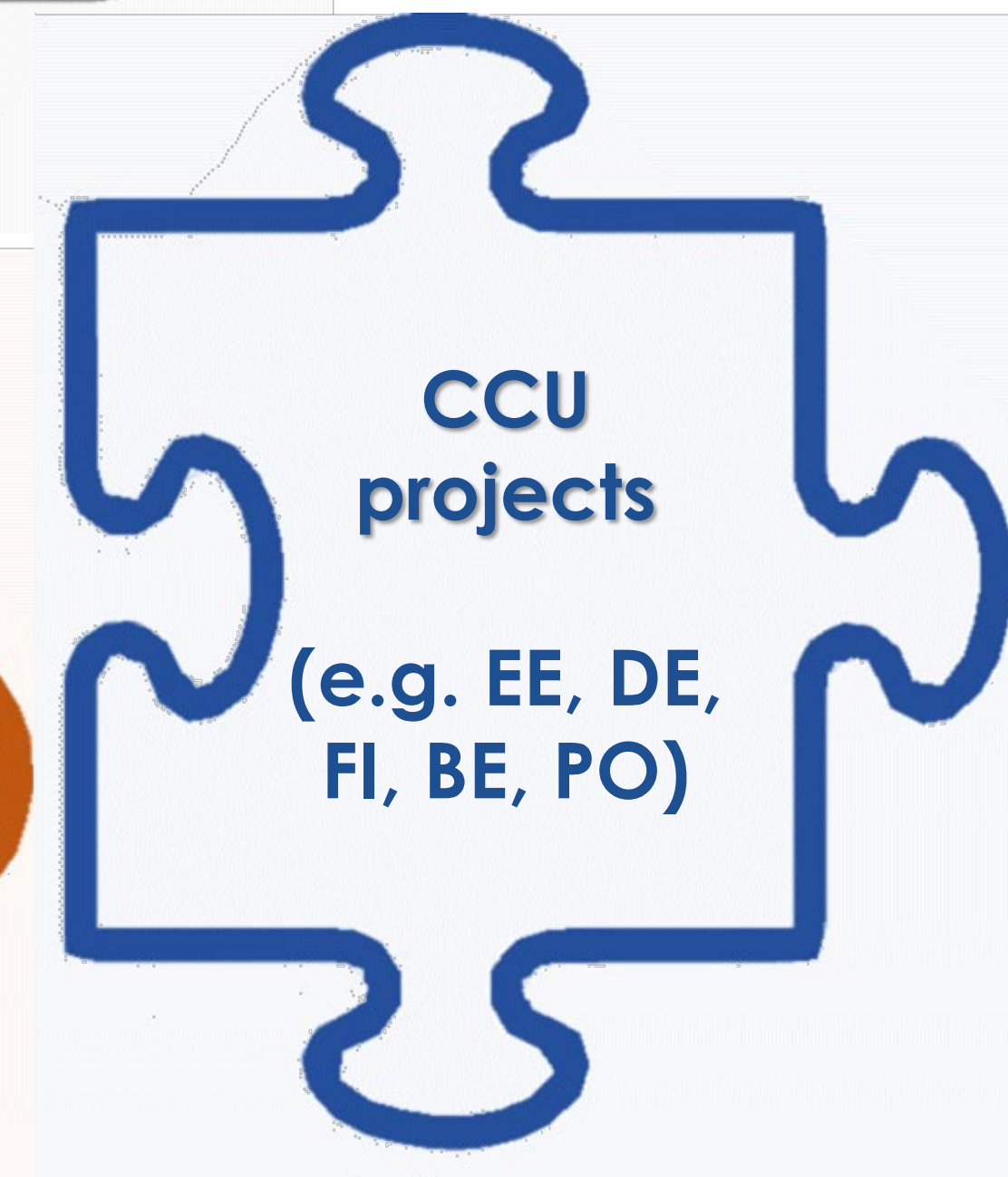
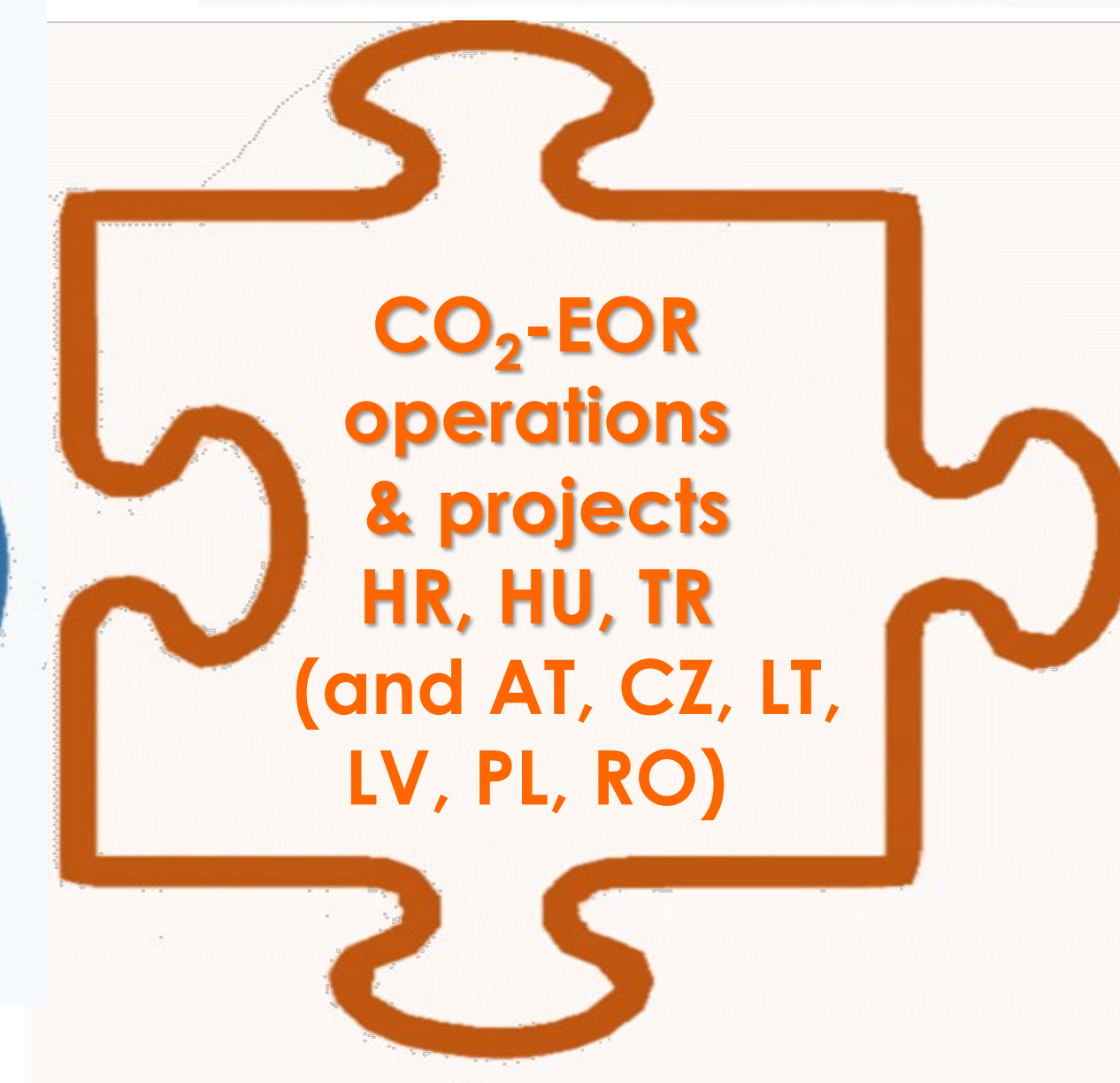
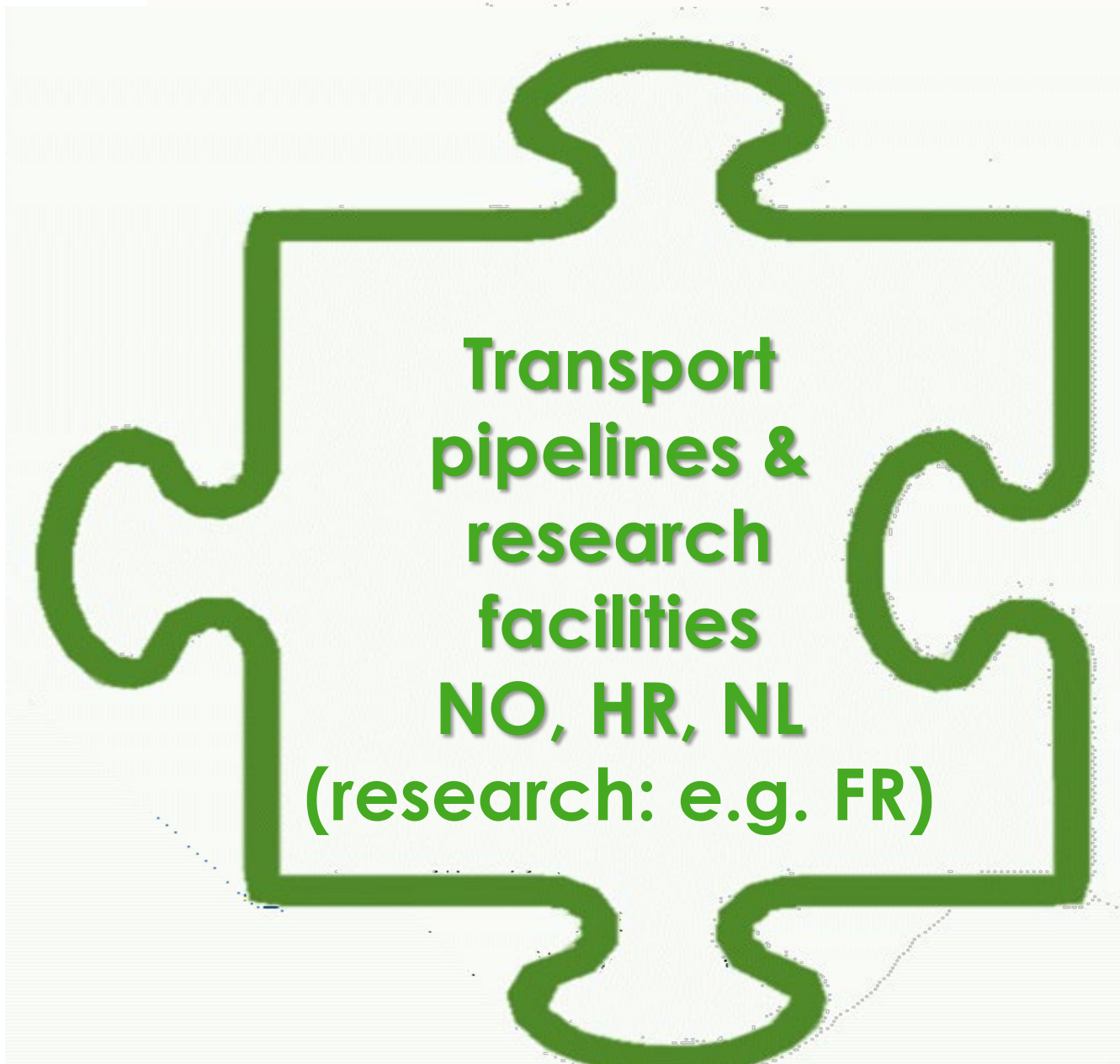
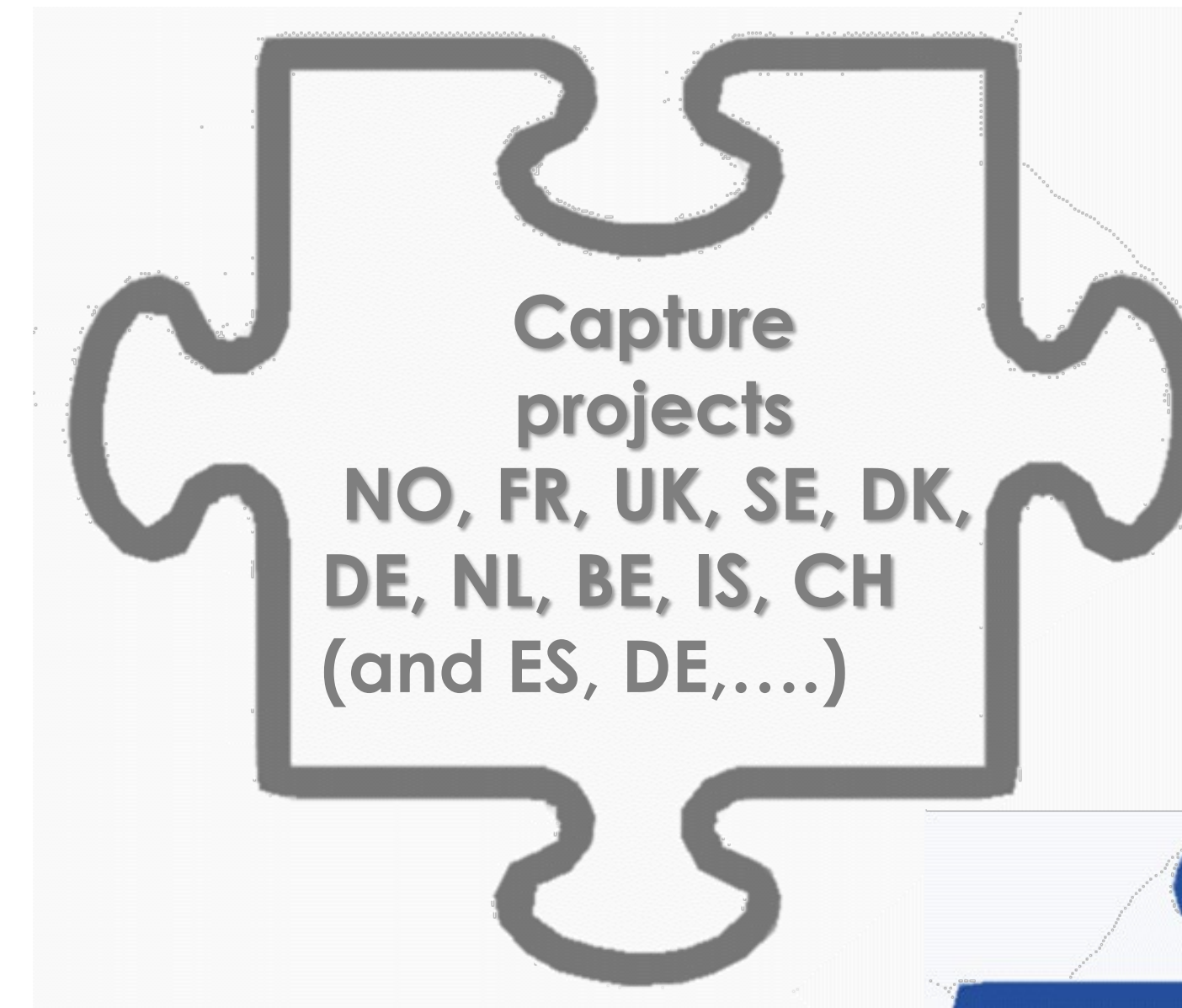
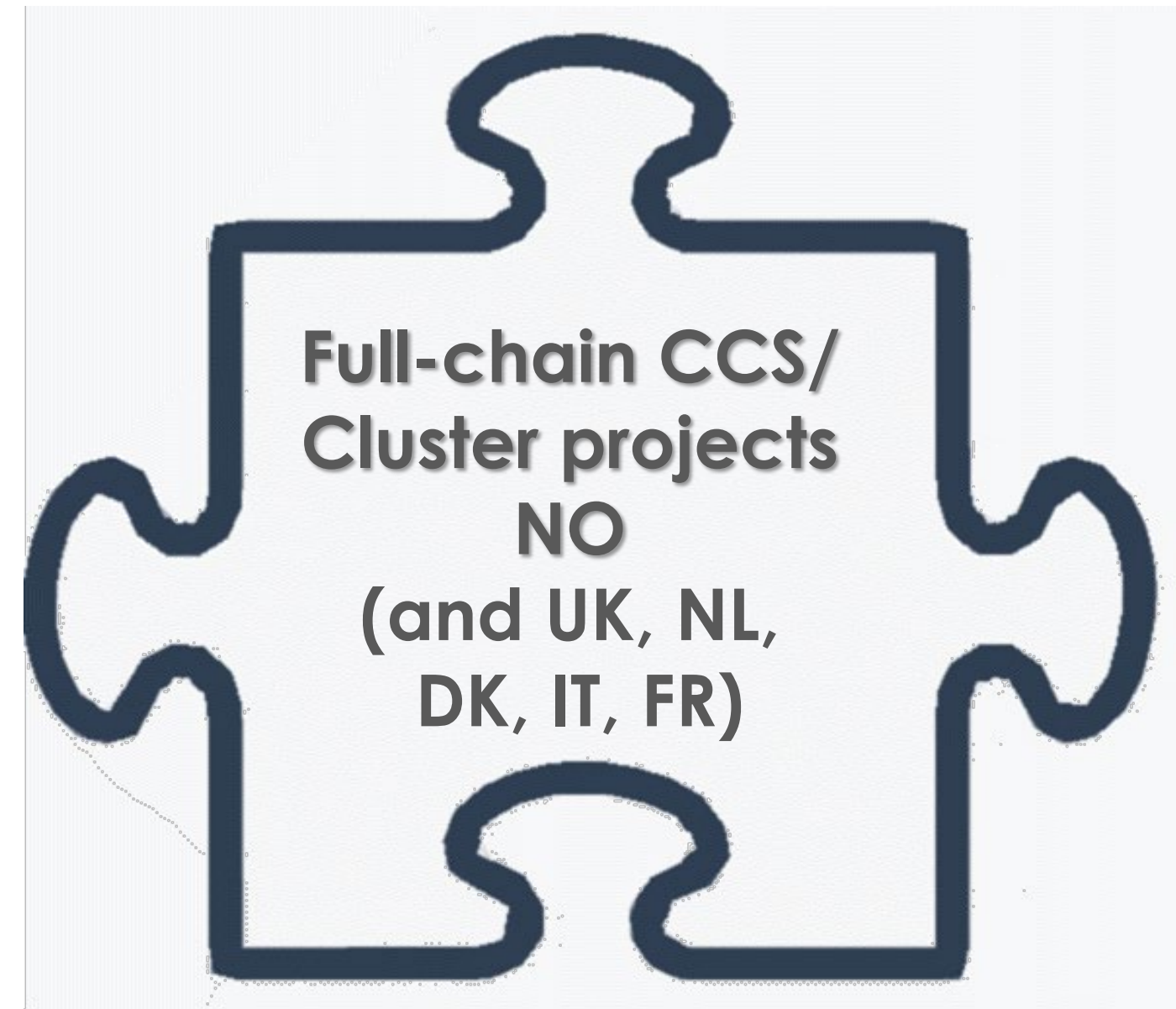


Note that the in the graphic the most “advanced” project in the country is reflected, i.e. countries that have full-chain projects in operation or advanced planning stage may also have CO<sub>2</sub> storage and/or capture projects in preparation or in operation.

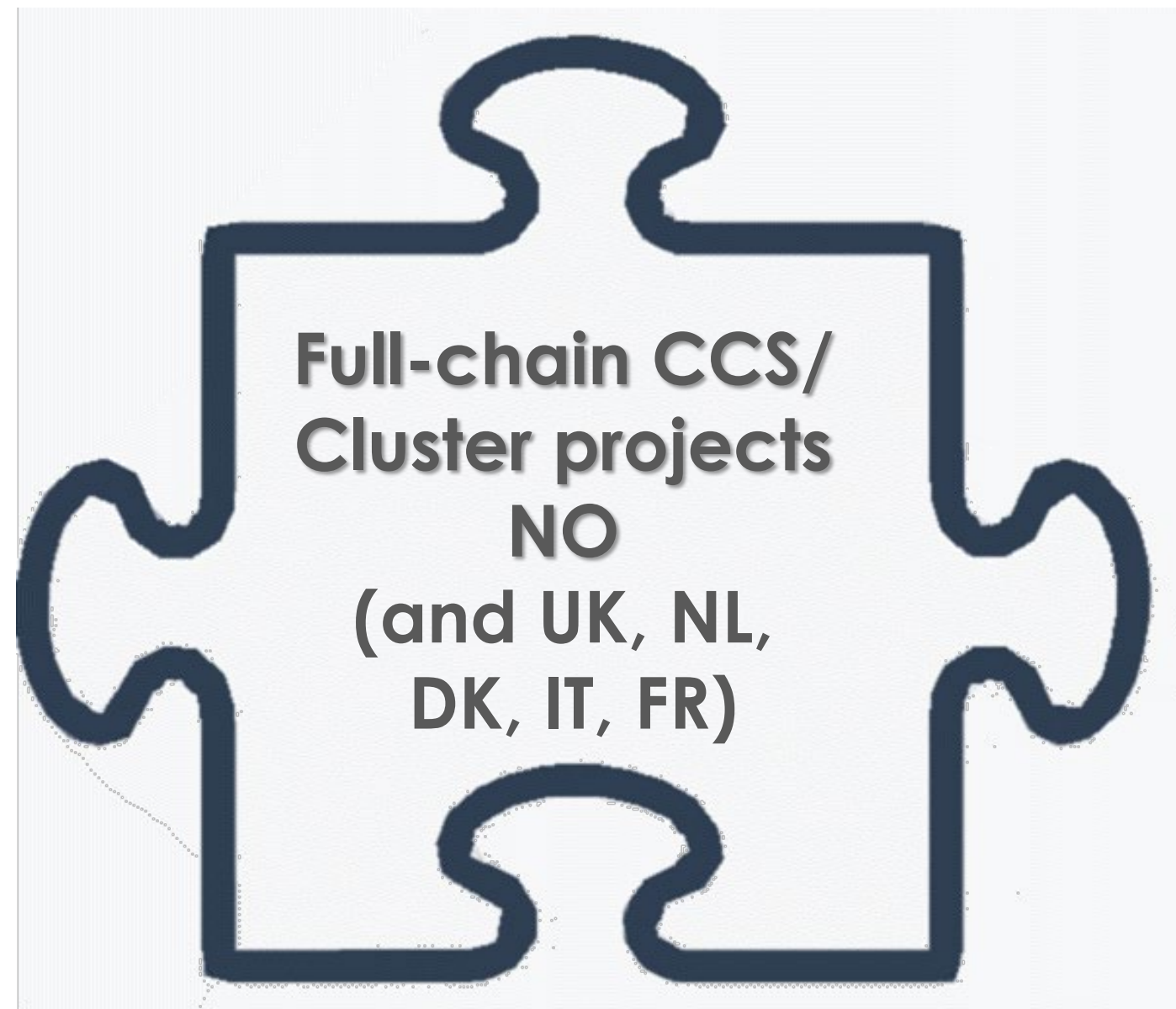
## PCI in Europe:

- (1) CO<sub>2</sub>-Sapling project (UK, in further phases NL and NO);
- (2) CO<sub>2</sub>TransPorts (Ports of Rotterdam and Antwerp, and transport in the Dutch P18 gas fields (Phase 1) and other North Sea storage sites (Phases 2&3);
- (3) Northern Lights project (Norway)
- (4) Athos project (Amsterdam-IJmuiden CO<sub>2</sub> Transport Hub & Offshore Storage)
- (5) Ervia Cork project (Ireland)

# Projects of different foci, scales and stages

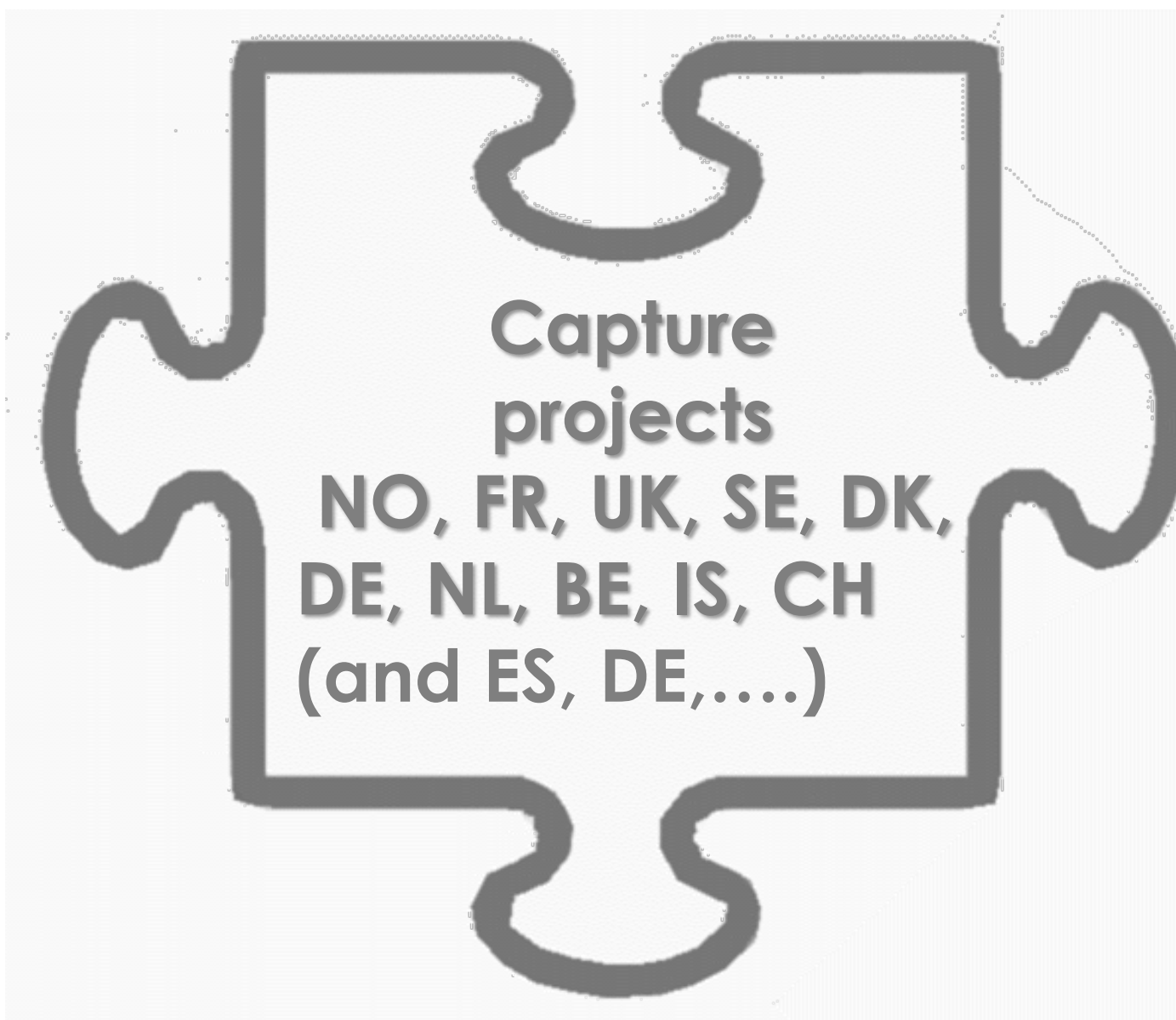


# Large-scale full chain CCS projects



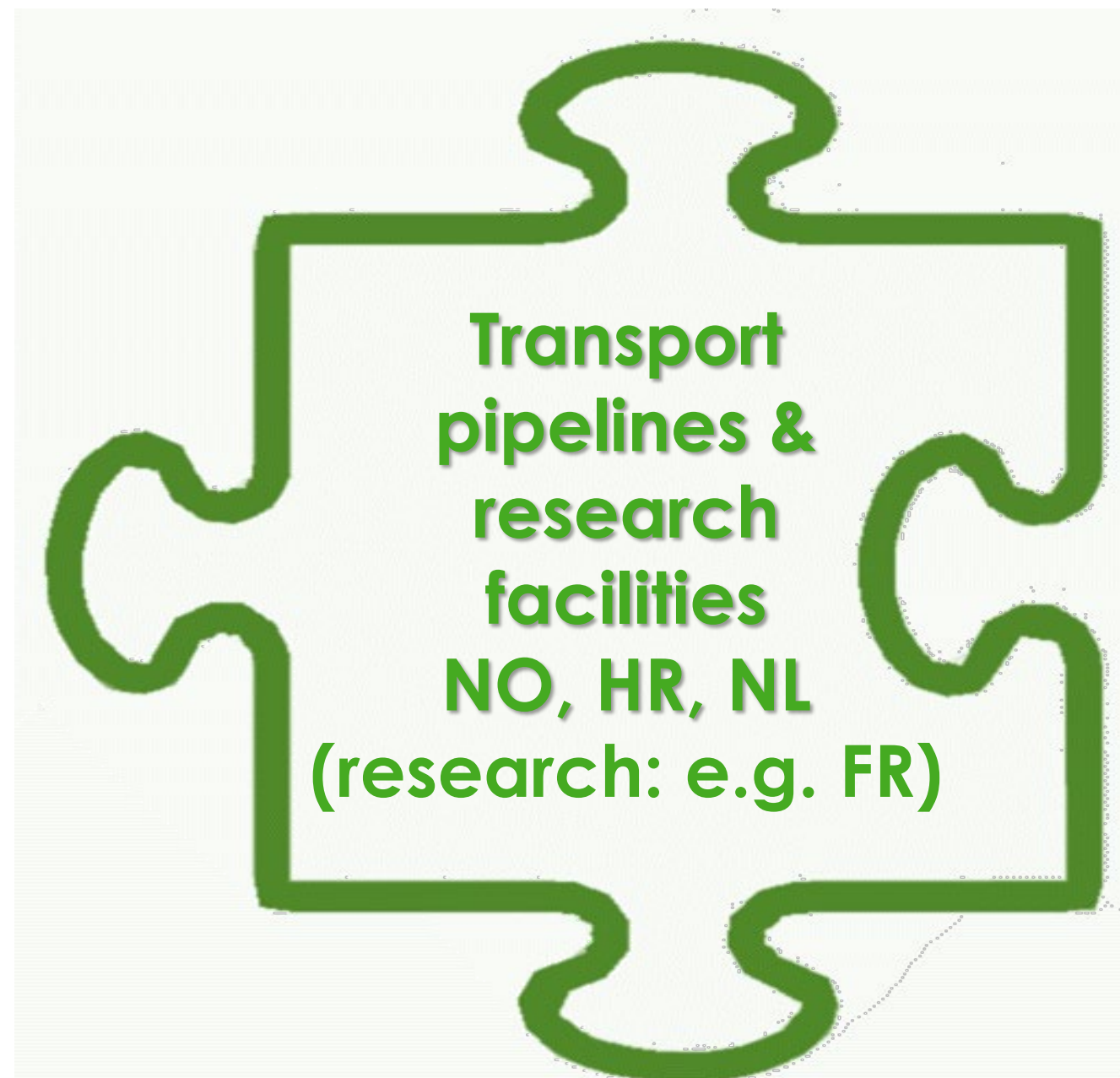
- The two well-known large-scale full-chain CCS projects in operation are Sleipner and Snohvit
- A couple of new projects are in various planning and implementation stages in different countries:
  - Scotland Net-Zero Infrastructure (UK)
  - The Northern Endurance partnership (UK)
  - The Greensand project (DK)
  - The Ravenna hub (Italy)

# Capture projects and capture test facilities



- Capture projects and capture test facilities of various sizes are in operation in several countries with further capture demonstration and pilot plants in advanced planning stages.
- Nearly all these recent capture projects address CO<sub>2</sub> capture on industrial plants:
  - Dunkirk, FR;
  - PREEMS Lysekil refinery, SE;
  - Cement producer Aalborg, DK
  - NORCEM factory, Brevik, NO (as a few examples)
- But also waste incinerators (Fortum Varme, NO), geothermal plants or direct air capture (CarbFix – IS/CH)
- In the same line, a lot of research activities on adapting and advancing CO<sub>2</sub> capture processes have been reported during the last years.

# CO<sub>2</sub> transport pipelines



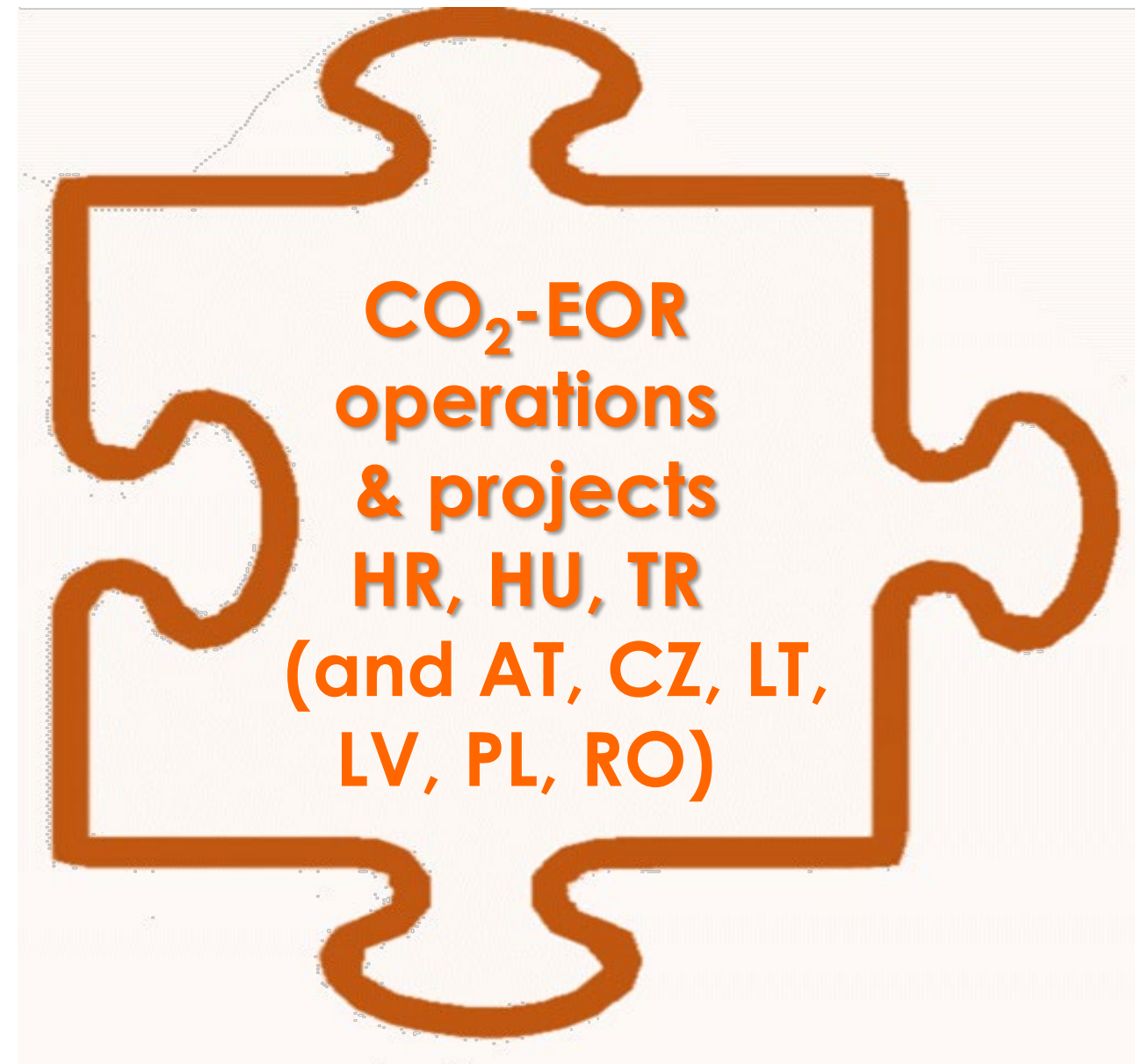
- CO<sub>2</sub> transport pipelines are operated already in three European countries:
- Snohvit (NO) – 150 km;
- Northern Lights (NO) – 110 km from the CO<sub>2</sub> hub to the designated storage field;
- OCAP (NL) - 97 km for CO<sub>2</sub> supply to greenhouse-based farming;
- EOR project (HR) – 88 km pipeline to transport CO<sub>2</sub> to the Ivanić and Žutica oil fields;
- Facilities for research on CO<sub>2</sub> transport are available in a few other countries.

# CO<sub>2</sub> storage sites



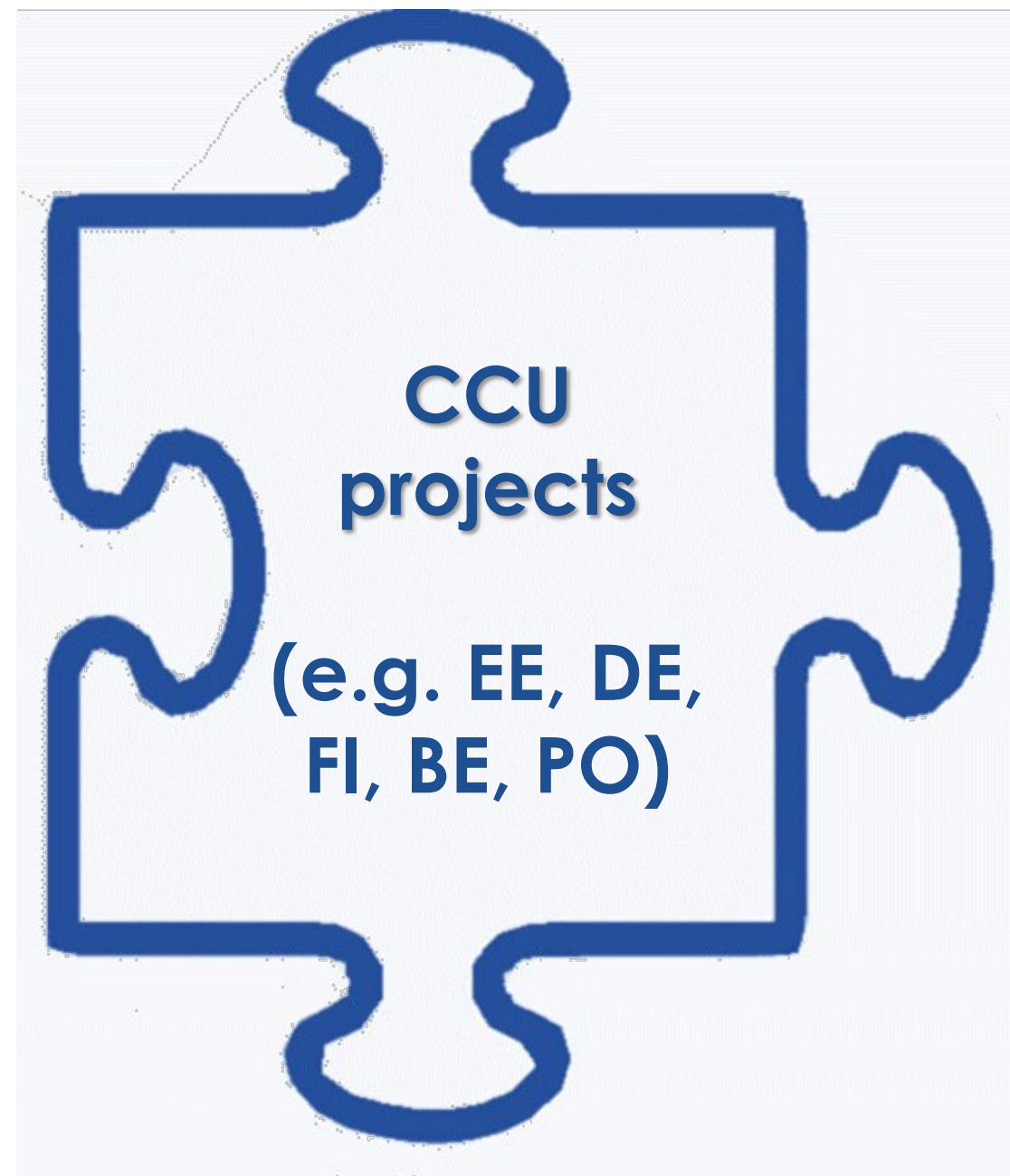
- CO<sub>2</sub> storage sites are in operation in Norway as part of the Sleipner and Snohvit projects.
- CO<sub>2</sub> injection in basalts for in situ mineralisation is ongoing in Iceland on a smaller scale.
- The re-injection of CO<sub>2</sub> from geothermal energy production is tested in Turkey and should be also considered here.
- Different new storage sites are under development as part of full-chain or cluster projects in UK, NL, DK.

# CO<sub>2</sub> in EOR - Enhanced oil recovery



- The use of CO<sub>2</sub> to enhance oil recovery is already practiced in
  - Hungary (since 1970s)
  - Turkey (since 1980s)
  - Croatia (since 2010s)
- The ACT-project ECO-BASE has clearly demonstrated a lower carbon footprint for CO<sub>2</sub>-EOR produced oil.
- Implementation of CO<sub>2</sub>-EOR is also considered in a couple of other countries as a mean to kick-start a broader implementation of CCS.

# CO<sub>2</sub> utilisation



- In some European countries activities focus on advancing CO<sub>2</sub> utilisation instead of storage.
- However, it should be noted that the potential for CO<sub>2</sub> emission reduction of any type of CCU strongly depends on the permanence of CO<sub>2</sub> “fixation” in the final product, the scale of applicability and the overall lifetime carbon footprint of the technology.

Altogether, all the different projects are pieces that we need to re-puzzle our energy system and the production processes in order to reduce Europe’s CO<sub>2</sub> emissions.



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# Thank you for your attention.

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