



Project no.  
ERAC-CT-2005- 016210

Project acronym  
FENCO-ERA

Project title  
Promotion of an Integrated European and National R&D Initiative for Fossil Energy Technologies  
towards Zero Emission Power Plants

Instrument: Coordination Action

Thematic Priority: ERA-NET: Energy Technology

**Laying the groundwork for Joint Transnational Research**

**Memo on general accepted approach and the developed framework for transnational  
cooperation**

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Organisation name of lead contractor for this working document:  
NL-Agency, the Netherlands

Start date of the project: 01/06/2005

Duration: 66 months

<b>Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)</b>		
<b>Dissemination Level</b>		
<b>PU</b>	Public	X
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## 1. Introduction

This Memo (4<sup>th</sup> draft) represents the deliverable 5.2.1 of Work Package 5 – Piloting of transnational research activities. This memo deals with the determined (1) general accepted approach and (2) the developed framework for transnational cooperation.

The European Member States and Third Countries have different clean fossil fuel policy programmes and subsidy schemes. Overlap partly occurs due to similarities and differences in interest. A **transnational cooperation project**, in the context of FENCO-ERA, can be described as follows. A transnational cooperation (pilot)-project represents the merge of (elements of) national programmes and is envisaged in one of the areas of fossil energy such as programme/project evaluation, calls, co-operation, budgets, etc. Main goal of WP5 is to establish areas of collaboration and getting experience on executing transnational cooperation.

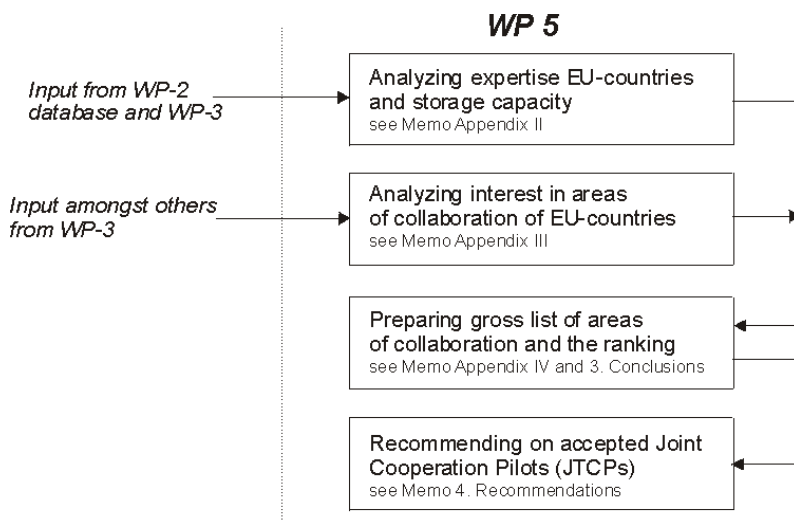
In WP3 and WP4 the present situation of fossil energy areas in the European Countries was determined. This memo goes further and summarizes and combines, at first, those findings. Secondly the evaluation and analysis of the findings are presented. It resulted in a first joint call including the determination of legal aspects, selection criteria, evaluation methods, etc.

In this memo the, so-called, “(1) *general accepted approach*” is presented in the form of a list of general areas (the topics) for transnational cooperation. Five general areas have been identified and selected. The “(2) *developed framework for transnational cooperation*” is also added to this memo. It starts with the ranking of the early mentioned five topics. This was based on several criteria. A major criterion for ranking was “*generic nature*” or “*level of degree of freedom*”. Finally, it has been decided to start with the transnational cooperation project that has fewer degrees of freedom and options to chose from because of the generic nature of the content of R&D. In this way specific experience on how to organize transnational cooperation projects can be gained in an early stage.

This memo first presents the approach of evaluating WP3 and WP4. Secondly, the main conclusions are presented: the five general areas of fossil fuel R&D. Finally, in the recommendation, the general areas are ranked and worked out in a proposal for joint calls.

## 2. Approach of the evaluation

In the figure below the approach of the evaluation and the undertaken steps in order to prepare Memo 5.2.1 are presented. In this part of the Memo only the conclusions and recommendations are presented. The data and references can be found in the Appendixes.



### 3. Conclusions

After analyzing and combining the findings on WP2, WP3, and WP4, the following list of the five most fruitful areas for transnational cooperation (pilot)-projects on clean fossil energy can be indicated:

- 1) Study, R&D and pilot plant demonstration regarding advanced fossil plant and CO<sub>2</sub>-capture
- 2) R&D and pilot plant demonstration of CO<sub>2</sub> use and storage
- 3) R&D and pilot plant demonstration regarding infrastructure and transport
- 4) Studies and R&D regarding market regulation and policy development
- 5) Studies and R&D regarding communication and public acceptance

In order to define a proper ranking for starting-up areas of collaboration several criteria were used, namely:

- 1) Number and ranking of countries with expertise in the fossil fuel area of collaboration (see for details and analysis, appendix II)
- 2) Number and ranking of countries with interest in the fossil fuel area of collaboration (see for details appendix III and IV)
- 3) Ranking easiness to start-up transnational cooperation project in the fossil fuel area: The easiness is based on the following criteria<sup>1</sup>, namely:
  - a) Level of technological constraints or country preferences
  - b) Level of risks due to market disruption by commercial competition
  - c) Level of costs for studies and R&D
  - d) Level of common action that promotes the alignment and coordination of national programmes
  - e) Level of keeping flexibility and independency of the participating member states

In Table 1 the way the ranking is established is presented. Ranking "1" means: *most easy to start-up a Transnational Cooperation*. The ranking is based on qualitative data.

**Table 1, ranking topics for EU-FENCO-ERA transnational cooperation**

Only EU-FENCO-ERA participating member states	Number of countries with interest	Ranking most interest MS	Number of MS with expertise	Ranking expertise on topic	Ranking easiness to start-up TC
1. Communication and public acceptance	6	5	4	5	1
2. Market regulation and policy	8	3.5	8	2	2
3. CO <sub>2</sub> use and storage	10	2	6	3.5	3.5
4. Infrastructure and transport	8	3.5	6	3.5	3.5
5. Advanced fossil plant and CO <sub>2</sub> capture	11	1	9	1	5

TC Transnational cooperation  
MS Member states

N.B. Not all data has come available yet e.g. ad. 1. *Communication and public acceptance* only 6 of the 12 countries expressed whether they are interested or not! For details see Appendix II and III.

Figures do not always reflect reality. From the questionnaire the team learnt that the work on fossil fuel technologies varies in scope and significance between member states. This probably reflects a range of national factors such as the relative importance of fossil fuels within different contexts, differing levels of national resources for advancing the technologies, and the role perceived for zero emission fuel technologies within national climate change strategies. The questionnaires (WP2 database) have shown that the reasons are too detailed and varying to classify Member States within limited number of groups. Nevertheless it is tried to present a proper list of Fossil Fuel areas for transnational cooperation including lists of joining member states.

### 4. Recommendations

In the paragraph above, a list of five topics for transnational cooperation projects has been presented. The next step is to add the joining member states to the list. During bilateral and multilateral pilot-

<sup>1</sup> WP 4.1 Joint call on development of communication and public acceptance strategies concerning CCS technologies, 01/06/2005 page 2 and 3 of 3

related EU-workshops, the merging proposals are discussed, identified and chosen. Countries can contribute to the joint transnational cooperation in two ways namely, as a “leading member state” or as an “observing member state”.

The main Clean Fossil Fuels and research and development activities are now identified, and the next step is to bring them in line with the specific national policies.

As explained in earlier paragraphs the recommended approach is to start with the transnational cooperation (pilot)-project that has fewer degrees of freedom and options to choose from because of the generic nature of the content of R&D. Reason was: “it will be easier to get full agreement, which leads to faster pilot development”. In this way experience on transnational cooperation can be gained in an early stage. Below the Joint Transnational Cooperation Pilots (JTCPs) are presented in the earlier order.

### JTCP-I: Studies and R&D regarding communication and public acceptance

Title:	<b>JTCP-I: Communication and public acceptance strategies</b>		
Leading MS:	DE; EL; NL; PT; UK	Observing MS:	AT
Subjects:	1. Development public acceptance strategies 2. Development and implementation of communication schemes		
Type of action:	Studies; R&D; Sub-call B	Budget:	
Start:	00-00-2007	End:	00-00-2010
Tasks:	To be determined.		
<p>Public acceptance and communication is considered as a major barrier to the commercial deployment of carbon capture and storage (CCS). Understanding of public concerns over global warming and knowledge on CCS-technologies, as a climate change mitigation option, is crucial as a base for decision makers developing communication strategies with the public and deciding what information and policies would make CCS more acceptable.</p> <p>Increasing public awareness with communication could lead to public acceptance. The aim is to get also more public support and stimulate and facilitate national political commitment so as to encourage transnational co-operation and mutual opening in the short term at least.</p> <p>Up to now, a number of survey studies have been conducted on public attitudes towards climate issues as well as CCS technologies aimed at assessing levels of awareness and knowledge. The results generated indicate that the public is not well informed on the potential of CCS as climate change abatement option<sup>2</sup>.</p>			

JTCP-I seems to be an excellent example to test the principle of joint collaboration and identify barriers and enablers of how national priorities can successfully be co-ordinated through multilateral activities. There are several advantages to start with JTCP I, namely:

1. There are no technological constraints or country preferences
2. Risks due to market disruption by commercial competition and are not occurring
3. Costs for studies and R&D are limited
4. This common action promotes the alignment and coordination of national programmes
5. Participating member states keep flexibility and independency<sup>3</sup>

The other JTCP's will be developed in the next period. They can be found on the next page.

<sup>2</sup> WP 4.1 Joint call on development of communication and public acceptance strategies concerning CCS technologies, 01/06/2005 page 2 and 3 of 3

<sup>3</sup> WP 4.1, page 2 and 3 of 3

**JTCP-II: Studies and R&D regarding market regulation and policy development**

Title:	<b>JTCP-II: Market regulation and policy development</b>		
Leading MS:	DK; DE; EL; NL; PT; UK; NO	Observing MS:	AT
Subjects:	<ol style="list-style-type: none"> <li>1. CO<sub>2</sub> legal issues &amp; liabilities</li> <li>2. Monitoring and regulation</li> <li>3. Long term ownership and liability</li> <li>4. Financial in general</li> </ol>		
Type of action:	Studies; R&D; Sub-call B	Budget:	
Start:	00-00-2008	End:	00-00-2011
Tasks:	To be determined.		
To be determined.			

**JTCP-III: R&D and pilot plant demonstration of CO<sub>2</sub> use and storage**

Title:	<b>JTCP-III: CO<sub>2</sub> use and storage</b>		
Leading MS:	DE; ES; EL; NL; AT; PT; UK; NO	Observing MS:	LV; PL
Member states with storage capacity:	DK; DE; EL; NL; UK; NO		
Subjects:	<ol style="list-style-type: none"> <li>1. EOR; EGR; &amp; ECBM</li> <li>2. CO<sub>2</sub> storage in general</li> <li>3. Enabling technologies in general</li> </ol>		
Type of action:	R&D/DEMO; Sub-call A/B	Budget:	
Start:	00-00-2009	End:	00-00-2012
Tasks:	To be determined.		
To be determined.			

**JTCP-IV: R&D and pilot plant demonstration regarding infrastructure and transport**

Title:	<b>JTCP-IV: Infrastructure and transport</b>		
Leading MS:	DK; DE; EL; NL; PT; UK; NO	Observing MS:	AT
Subjects:	<ol style="list-style-type: none"> <li>1. Transport of hydrogen, syngas, carbon dioxide</li> <li>2. Use of existing infrastructure</li> </ol>		
Type of action:	R&D/DEMO; Sub-call A/B	Budget:	
Start:	00-00-2010	End:	00-00-2013
Tasks:	To be determined.		
To be determined.			

**JTCP-V: Study, R&D and pilot plant demonstration regarding advanced fossil plant and CO<sub>2</sub>-capture**

Title:	<b>JTCP-V: Advanced fossil plant and CO<sub>2</sub>-capture</b>		
Leading MS:	DK; DE; ES; EL; NL; AT; PT; UK; NO	Observing MS:	LV; PL
Subjects:	To be determined.		
Type of action:	R&D/DEMO; Sub-call A/B	Budget:	
Start:	00-00-2010	End:	00-00-2013
Tasks:	To be determined.		
To be determined.			

**5. General accepted methodology for joint transnational pilots**

See Memo Work Package 4: Working Document WD\_4.2 Memo on Model of Cooperation.

## **Appendix I, the approach of the evaluation**

### ***1.1 Introduction***

Starting point of preparing WP-5.2.1 was the review of the present situation (amongst WP3 and WP4). As an input are used WP2 database<sup>4</sup>, WP3 analysis, the draft strategy document WP3<sup>5</sup>, WP 4.1 joint call<sup>6</sup>, WP 4.2 memo<sup>7</sup>, the minutes of Utrecht Meeting January 29/30<sup>th</sup> 2007<sup>8</sup> and all inputs on the website<sup>9</sup>. During the Utrecht workshop, the extended Management Board Meeting Participants agreed that this memo would deal with general areas (the topics) and a general proposed methodology for transnational cooperation.

### ***1.2 General accepted approach to select FENCO-ERA-topics***

In order to assess the areas for transnational cooperation for joint calls, the following approach has been proposed/conducted:

1. *Information exchange* (WP2):
  - a. Preparing questionnaire for EU-member states
  - b. Developing and completing database
2. *Defining EU-member state strategic activities* (WP3):
  - a. National positioning with regard to energy and development
  - b. Rationalizing and determining objectives for national activities and programming
3. *Piloting of transnational research activities* (WP 5):
  - a. Establishing a list of EU fossil ERA-topics (Concept memo 5.1.2)
  - b. Developing general approach and methodology for transnational cooperation (Concept memo 5.1.2)
  - c. Reviewing and deciding on the EU fossil ERA-topics (September 2007 meeting)
  - d. Reviewing and deciding on the approach and methodology (September 2007 meeting)
  - e. Merging into pilots, implementation of pilots, evaluation and set-up of recommendations
4. *Dissemination and communication activities* (WP6)

This memo concerns 3a and 3b.

<sup>4</sup> Fenco 4 + supp.mdb version 4 of 2005-6

<sup>5</sup> Paper WP3 on Strategy Version 2 2nd ExCo 22/23 June 06 Trondheim

<sup>6</sup> WP 4.1 Joint call on development of communication and public acceptance strategies concerning CCS technologies, 01/06/2005

<sup>7</sup> WP 4.2 Memo on model of cooperation, 01/06/2005

<sup>8</sup> Extended coordination working meeting of Fenco-Era, Utrecht , The Netherlands, 29/30th January 2007

<sup>9</sup> <http://www.fenco-era.net>

## Appendix II, Establishing a list of EU-FENCO-ERA-topics

### II.1 Introducing methodology to establish a list

In order to benchmark the expertise of the EU-FENCO-ERA participating member states three steps were undertaken:

- *First outline benchmark:* to get a brief insight into areas member states are active in
- *Second outline benchmark:* to get more insight into member states' availability of storage opportunities and capability to design, supply, operate and monitor complex fossil projects
- *Third benchmark: focusing on five general topic areas:* in depth assessment of expertise within member states regarding defined fossil topics. Based on inputs of the above

### II.2 First outline benchmark

In the project proposal<sup>10</sup> the first indication was given concerning the activities or “fossil topics” of the EU-FENCO-ERA participating countries. Based on four types of activities the following outlines of interest were determined, see Table 2.

**Table 2, the first outline benchmark of EU fossil ERA-topics**

Criteria	Denmark (DK)	Germany (DE)	Estonia (EE)	Spain (ES)	Greece (EL)	Latvia (LV)	Netherlands (NL)	Austria (AT)	Poland (PL)	Portugal (PT)	(UK) United Kingdom	Norway (NO)
Strategic analysis	0	+	0	0	+		+			+	+	+
Technical development (conversion technology, power production)	+	+		+	+	0	+	0	+	+	+	+
CO <sub>2</sub> -Storage	+	+	0	+			+	0	+	0	+	+
Non-technical		+		0		0	+	0	+	0	+	+

Level of involvement: + Major activity on first outline topics  
0 Some activity on first outline topics  
- No activity on first outline topics

Learning from the “*first outline benchmark*”, the participating countries can be divided into three groups. The criteria set, was the intensity of activity regarding the four main fossil topics:

1. *Full covering first outline topics:* Germany, the Netherlands, Norway and the United Kingdom
2. *Average covering first outline topics:* Denmark, Greece, Poland, Portugal and Spain
3. *Less covering first outline topics:* Austria, Estonia and Latvia

The “*first outline benchmark*” was just a general description and the FENCO-ERA-net-partners felt that a more detailed breakdown was required.

The breakdown-activity was conducted in WP2 and WP3.

### II.3 Second outline benchmark

The “*second outline benchmark*” is based on the data input from the WP3 deliverable Memo<sup>11</sup>. During the WP3 analysis the following criteria were used:

1. Capability to design and supply fossil fuel plants
2. Capability to operate and monitor CO<sub>2</sub> store site
3. Availability of CO<sub>2</sub> storage sites (Mt per year)

All mentioned 25 EU member states (plus Norway) conduct fossil fuel power generation. The trend for 2020 is an increase<sup>12</sup> of CO<sub>2</sub> emissions related to electricity generation.

<sup>10</sup> Promotion of an Integrated European and National R&D Initiative for Fossil Energy Technologies towards Zero Emission Power Plant, ERAC-CT-2005-016210, January 24, 2005, see page 7 of 72.

<sup>11</sup> FENCO Project –Work Package 3 – Strategic Activities: table 1, summary of the present energy and environmental position of EU25 Member States plus Norway, page 3, 06\_27\_WG3 paparev2.doc, page 3

<sup>12</sup> Only for the countries Estonia, Denmark, and Czech Republic a decrease in CO<sub>2</sub> emissions is expected



**Table 3, second outline benchmark on EU-FENCO-ERA-topics for participating EU-member states**

Topics/criteria <sup>13</sup>	DK	DE <sup>14</sup>	EE	ES	EL	LV	NL <sup>15</sup>	AT	PL	PT	UK <sup>16</sup>	NO
1. Capability to design and supply fossil fuel plants	-	+	-	?	-	-	-	-	?	-	+	-
2. Capability to operate and monitor CO <sub>2</sub> store site	+	+	-	+	-	-	+	+	-		+	+
3. Availability of CO <sub>2</sub> storage sites (Mt) <sup>17</sup>	16k	25k	?	?	2k	?	11k	5k	?		25k	26k
Level of involvement:	+	Yes, country is capable										
	-	No, country is not capable										
	?	Information not supplied yet whether the country is capable (ad. 1 and 2) or has CO <sub>2</sub> storage capacity (ad. 3)										

From the “second outline benchmark for participating EU-member states” we have learned, regarding to opportunities for transnational cooperation, the following:

1. *Opportunity group I:* Germany and the United Kingdom have the capability to design and supply fossil fuel plants
2. *Opportunity group II:* Denmark, Germany, The Netherlands, Norway, Spain and the United Kingdom have the capability to operate and monitor CO<sub>2</sub> store sites
3. *Opportunity group III:* Denmark, Germany, Greece, The Netherlands, Norway and the United Kingdom have the possibility to store CO<sub>2</sub>

In Table 4, the “second outline benchmark” is conducted, but only for the other, not participating, EU-member states.

**Table 4, second outline benchmark on EU-FENCO-ERA-topics for non-participating EU-member states**

Topics/criteria	Belgium (BE)	Czech Rep. (CZ)	Ireland (IE)	France (FR)	Italy (IT)	Cyprus (CY)	Lithuania (LT)	Luxembourg (LU)	Hungary (HU)	Finland (FI)	Malta (MT)	Sweden (SE)	Slovenia (SI)	Slovakia (SK)
1. Capability to design and supply fossil fuel plants	-	?	-	+	+	-	-	-	?	+	-	-	-	?
2. Capability to operate and monitor CO <sub>2</sub> store site	?	?	-	+	+	-	-	-	?	?	-	?	?	?
3. Availability of CO <sub>2</sub> storage sites (Mt per year)	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Level of involvement:	+	Yes, country is capable												
	-	No, country is not capable												
	?	Information not supplied yet whether the country is capable (ad. 1 and 2) or has CO <sub>2</sub> storage capacity (ad. 3)												

<sup>13</sup> See abbreviations appendix “EU-countries: names, codes and protocol order”

<sup>14</sup> Source COORETEC: Oilfields: 0.11 Gt; Gas fields: 2.56 Gt; Saline Aquiferes (SA): 23-43 Gt (source GESTCO: SA 12-28 Gt)

<sup>15</sup> Gas fields: 9000 Mton; Coal : 300 Mton; Aquifers: 1600 Mton

<sup>16</sup> Depleted oil fields 2.6GT, depleted gas fields 4.9 GT, closed aquifers 8.6GT, open aquifers 240GT, all offshore.

<sup>17</sup> FENCO Project –Work Package 3 – Strategic Activities: table 1, summary of the present energy and environmental position of EU25 Member States plus Norway, page 3, 06\_27\_WG3 paparev2.doc, page 3



From the “second outline benchmark for non-participating EU-member states” we have learnt, that the following countries can be added to:

1. *Opportunity group I:* Finland, France and Italy have the capability to design and supply fossil fuel plants
2. *Opportunity group II:* France and Italy have the capability to operate and monitor CO<sub>2</sub> store site

From the “second outline benchmark” was learnt that: there are, at this moment, still numerous question marks in the Table 3 and Table 4. Further research should be conducted in order to complete the above mentioned opportunity groups for transnational cooperation.

## II.4 Third benchmark: focusing on five general topic areas

After determining global outlines for topics for transnational cooperation (Memo 5.2.1 chapter I. and II.), a further break down of the topics, as presented under II. has been conducted. The “third benchmark” used as criteria<sup>18</sup> therefore the following topics for transnational cooperation:

1. Advanced fossil plant and CO<sub>2</sub>-Capture
2. CO<sub>2</sub>-use and -storage
3. Infrastructure and transport
4. Market regulation and policy
5. Communication and public acceptance

The “third benchmark” only focuses on the participating FENCO-ERA-countries. The input comes from WP3 and the SenterNovem evaluation of the FENCO-ERA-net database as produced during WP2-activities.

The third benchmark is conducted in two ways, namely:

1. What are the expertise fields (also national programming) of the participating member states regarding actions on zero emission power plants? See from Table 5 till Table 9
2. What is the interest of the participating member states regarding actions on zero emission power plants? See Table 10.

**Table 5, summary of member state's expertise considering advanced fossil plant and CO<sub>2</sub> Capture (WP2/5)**

Topics/criteria	DK	DE	EE	ES	EL	LV	NL	AT	PL	PT	UK	NO
<b>1. Advanced fossil plant and CO<sub>2</sub> capture</b>												
a. Conversion technology in general <sup>19</sup>	+ <sup>20</sup>	+	?	+	+	-	+	+ <sup>21</sup>	-	+	+	+ <sup>22</sup>
b. CO <sub>2</sub> capture in general <sup>23</sup>	-	+	?	+	+	-	+	-	-	+	+	+ <sup>24</sup>
c. Fuel extraction <sup>25</sup>	-	+ <sup>26</sup>	?	+	-	-	+ <sup>27</sup>	-	-	-	+ <sup>28</sup>	-

Level of expertise: + Expertise  
- No expertise  
? Information regarding the expertise of the country is not supplied yet

<sup>18</sup> The criteria were set during ExCo-meetings and worked out in WP2 and WP3 (table 2 of 06\_27\_WG3 paperv2.doc, page 5)

<sup>19</sup> **Subtopic 1a.** consists of the following categories: (1) Novel concepts; (2) Oxyfuel; (3) USC; (4) Coal Gasification; (5) Combustion; (6) Biomass co-firing, multifuel

<sup>20</sup> Denmark: subtopic 1a. only expertise on (5) and (6)

<sup>21</sup> Austria: subtopic 1a. only expertise on (5) and (6)

<sup>22</sup> Norway: subtopic 1a. only expertise on (1), (2) and (5)

<sup>23</sup> **Subtopic 1b.** consists of the following categories: (1) advanced coal plus CO<sub>2</sub> capture; (2) CO<sub>2</sub> capture - pre/post combustion and chemical looping; (3) STEG IGCC; (4) ZERO-emission; and (5) In-progress CO<sub>2</sub> capturing with steam reforming

<sup>24</sup> Norway: subtopic 1b. only on (1) and (3) NO expertise

<sup>25</sup> **Subtopic 1c.** consists of the following categories: (1) Underground coal gasification (UCG); (2) Coal mine methane (CMM) extraction /utilisation; (3) Coal bed methane extraction/utilisation; (4) Abandoned mine methane

<sup>26</sup> Germany: subtopic 1c. only on (4) expertise

<sup>27</sup> The Netherlands: subtopic 1c. only on (1) NO expertise

<sup>28</sup> United Kingdom: subtopic 1c. only on (1) expertise

**Table 6, summary of member state's expertise considering CO<sub>2</sub> use and storage (WP2/5)**

Topics/criteria	DK	DE	EE	ES	EL	LV	NL	AT	PL	PT	UK	NO
<b>2. CO<sub>2</sub> use and storage</b>												
a. EOR; EGR; & ECBM	-	+	?	+	-	-	+	-	-	-	+	+
b. CO <sub>2</sub> storage in general	-	+	?	+	-	-	+	+	-	-	+	+
c. Enabling technologies in general <sup>29</sup>	+ <sup>30</sup>	+ <sup>31</sup>	?	+	+	-	+ <sup>32</sup>	+ <sup>33</sup>	-		+ <sup>34</sup>	+

Level of expertise:

- No expertise
- ? Information regarding the expertise of the country is not supplied yet

**Table 7, summary of member state's expertise considering infrastructure and transport (WP2/5)**

Topics/criteria	DK	DE	EE	ES	EL	LV	NL	AT	PL	PT	UK	NO
<b>3. Infrastructure and transport</b>												
a. Transport of hydrogen, syngas, carbon dioxide	-	+	?	+	-	-	+	-	-	+	-	+
b. Use of existing infrastructure	-	+	?	+	-	-	+	-	-	+	+	+

Level of expertise:

- + Expertise
- No expertise
- ? Information regarding the expertise of the country is not supplied yet

**Table 8, summary of member state's expertise considering market regulation and policy (WP2/5)**

Topics/criteria	DK	DE	EE	ES	EL	LV	NL	AT	PL	PT	UK	NO
<b>4. Market regulation and policy</b>												
a. CO <sub>2</sub> legal issues & liabilities	-	+	?	?	+	?	+	+	?	+	+	-
b. Monitoring and regulation	-	+/-	?	?	+	?	+	-	?	-	+	+
c. Long term ownership and liability	-	-	?	?	-	?	-	-	?	-	+	-
d. Financial in general <sup>35</sup>	+	-	?	?	+ <sup>36</sup>	?	+ <sup>37</sup>	+ <sup>38</sup>	?	+ <sup>39</sup>	+ <sup>40</sup>	+

Level of expertise:

- + Expertise
- No expertise
- ? Information regarding the expertise of the country is not supplied yet

<sup>29</sup> **Subtopic 2c.** consists of the following categories: (1) material research; (2) system analysis; (3) geological research on CO<sub>2</sub> storage; (4) CO<sub>2</sub> capture chemicals; (5) CO<sub>2</sub> injection; (6) mineralization; (7) directional drilling technologies

<sup>30</sup> Denmark: subtopic 2c. only on (1) and (2) expertise

<sup>31</sup> Germany: subtopic 2c. only on (7) NO expertise

<sup>32</sup> The Netherlands: subtopic 2c. on (7) NO expertise

<sup>33</sup> Austria: subtopic 2c. only on (3) expertise

<sup>34</sup> United Kingdom: subtopic 2c. on (6) and (7) NO expertise

<sup>35</sup> **Subtopic 4d.** consists of the following categories: (1) CO<sub>2</sub> tax and (2) CO<sub>2</sub> trade and credits

<sup>36</sup> Greece: subtopic 4d. only on (1) expertise

<sup>37</sup> The Netherlands: subtopic 4d. only on (1) expertise

<sup>38</sup> Austria: subtopic 4d. only on (1) expertise

<sup>39</sup> Portugal: subtopic 4d. only on (1) expertise

<sup>40</sup> The United Kingdom: subtopic 4d. only on (1) expertise

**Table 9, summary of member state's expertise considering communication and public acceptance (WP2/5)**

Topics/criteria	DK	DE	EE	ES	EL	LV	NL	AT	PL	PT	UK	NO
<b>5. communication and public acceptance</b>												
a. Communication in general	?	?	?	?	+	?	+	+	?		?	?
b. Social acceptance programme	-	-	?	?	+	?	+	-	?	-	+	-

Level of expertise: + Expertise  
 - No expertise  
 ? Information regarding the expertise of the country is not supplied yet

From Table 5 until Table 9 the expertise fields of the subtopics of the participating EU-FENCO-ERA member states are presented. Based on those outcomes the concluding remarks are written in the chapter IV on recommendations.

### Appendix III, Determination of member states' interest

After determining the "Expertise" in Appendix II, the "Interest" of the countries is identified.

Below, in Table 10, the topics of "interest" of each EU-FENCO-ERA member state are presented<sup>41</sup>.

**Table 10, summary of member state's interests being considered for action on zero emission fossil fuel technology (WP 3/5)**

Topics/criteria <sup>42</sup>	DK	DE	EE	ES	EL	LV	NL	AT	PL	PT	UK	NO
1. Advanced fossil plant and CO <sub>2</sub> capture	++	++	?	++	+	0	++	+	0	++	++	++
2. CO <sub>2</sub> use and storage	?	++	?	++	+	0	++	+	0	+	++	++
3. Infrastructure and transport	+	+	?	?	+	?	+	0	?	+	+	+
4. Market regulation and policy	+	+	?	?	+	?	+	0	?	+	+	+
5. Communication and public acceptance	?	+	?	?	+	?	+	0	?	+	+	?

Level of interest: ++ R&D plus demonstration interest  
 + R&D interest  
 0 Interested in topic, no involvement in the sense of + or ++  
 - Not interested in topic  
 ? The information regarding the involvement of the country is not supplied yet

<sup>41</sup> SenterNovem analysis 1<sup>st</sup> draft Memo 5.2.1 and WP3: table 5 of 06\_27\_WG3 paperv2.doc, page 5.

<sup>42</sup> See abbreviations appendix "EU-countries: names, codes and protocol order"

## Appendix IV, gross list of topics for transnational cooperation

Only EU-FENCO-ERA participating member states	# countries with expertise	Joining the transnational cooperation's		Type		
		Interested to be leading member state <sup>43</sup>	Interested to be observing MS <sup>43</sup>	Study	R&D	DEMO
<b>Topics for transnational cooperation</b>						
<b>1. Advanced fossil plant and CO<sub>2</sub> capture</b>		DK; DE; ES; EL; NL; AT; PT; UK; NO	LV; PL		X	X
<i>a. Conversion technology in general</i>						
(1) Novel concepts	6					
(2) Oxyfuel	6					
(3) USC	5					
(4) Coal Gasification	5					
(5) Combustion	8					
(6) Biomass co-firing, multifuel	7					
<i>b. CO<sub>2</sub> capture in general</i>						
(1) advanced coal plus CO <sub>2</sub> capture	5					
(2) CO <sub>2</sub> capture - pre/post combustion and chemical looping	6					
(3) STEG IGCC	5					
(4) ZERO-emission	6					
(5) In-progress CO <sub>2</sub> capturing with steam reforming	6					
<i>c. Fuel extraction</i>						
(1) Underground coal gasification (UCG)	3					
(2) Coal mine methane (CMM) extraction /utilisation	3					
(3) Coal bed methane extraction/utilisation	3					
(4) Abandoned mine methane	4					
<b>2. CO<sub>2</sub> use and storage</b>		DE; ES; EL; NL; AT; PT; UK; NO	LV; PL		X	X
<i>a. EOR; EGR; &amp; ECBM</i>	5					
<i>b. CO<sub>2</sub> storage in general</i>	5					
<i>c. Enabling technologies in general</i>	8					
<b>3. Infrastructure and transport</b>		DK; DE; EL; NL; PT; UK; NO	AT		X	X
<i>a. Transport of hydrogen, syngas, carbon dioxide</i>	5					
<i>b. Use of existing infrastructure</i>	6					
<b>4. Market regulation and policy</b>		DK; DE; EL; NL; PT; UK; NO	AT	X	X	
<i>a. CO<sub>2</sub> legal issues &amp; liabilities</i>	6					
<i>b. Monitoring and regulation</i>	5					
<i>c. Long term ownership and liability</i>	1					
<i>d. Financial in general</i>	7					
<b>5. Communication and public acceptance</b>		DE; EL; NL; PT; UK	AT	X	X	
<i>a. Communication in general</i>	0					
<i>b. Social acceptance programme</i>	3					

**N.B. All countries have to express their interest in the above mentioned table!**

**N.B. “# countries with expertise” figure has to be checked before approving to final version**

<sup>43</sup> See abbreviations appendix “EU-countries: names, codes and protocol order”

The five most fruitful areas for transnational programming on clean fossil energy would be:

1. Study, R&D and pilot plant demonstration regarding advanced fossil plant and CO<sub>2</sub>-capture
2. R&D and pilot plant demonstration of CO<sub>2</sub> use and storage
3. R&D and pilot plant demonstration regarding infrastructure and transport
4. Studies and R&D regarding market regulation and policy development
5. Studies and R&D regarding communication and public acceptance

The above mentioned five topics that are suitable for transnational cooperation were selected and first described in a WP3-Memo<sup>44</sup>. All five general topics have a different character. This can be expressed in the number of countries that are interested in the topic, have expertise (also national programming) on the topic, and the easiness to get an agreement on the technology/research content of the transnational cooperation. In **Fehler! Verweisquelle konnte nicht gefunden werden.**, the overview is presented.

If looking at a full-scale demonstration, all the above mentioned transnational programming will have to come together. Nevertheless, just a few subtopics will be of relevance. For example, if a full-scale demonstration is considered; a type of conversion technology, a type of CO<sub>2</sub>-capture, and a type of fuel extraction should be chosen.

Elements like market regulation, policy building, communication and public awareness depend less of chosen technology and are therefore more generic of nature.

The European Technology Platform's Strategic Deployment Document (SDD) has recommended that 10-12 full-scale demonstration of advanced fossil fuel plant and CO<sub>2</sub> capture projects should be developed. The SDD says that "European early mover funding mechanisms" involving national and EU levels will be key to achieving this target. Important issues to address are how to deal with intellectual property rights and commercial competitiveness<sup>45</sup>.

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<sup>44</sup> The topics were set during ExCo-meetings and worked out in WP2 and WP3 (table 2 of 06\_27\_WG3 paperv2.doc, page 5)

<sup>45</sup> WP 4.1 and WP 4.2

**Appendix V, EU-countries: names, codes and protocol order**

Short name (source language)	Short name (English)	Official name	Code <sup>(1)</sup>
Belgique/België	Belgium	Kingdom of Belgium	BE
България (*)	Bulgaria	Republic of Bulgaria	BG
Česká republika	Czech Republic	Czech Republic	CZ
Danmark	Denmark	Kingdom of Denmark	DK
Deutschland	Germany	Federal Republic of Germany	DE
Eesti	Estonia	Republic of Estonia	EE
Éire/Ireland	Ireland	Ireland	IE
Ελλάδα (*)	Greece	Hellenic Republic	EL
España	Spain	Kingdom of Spain	ES
France	France	French Republic	FR
Italia	Italy	Italian Republic	IT
Κύπρος/Kıbrıs (*)	Cyprus	Republic of Cyprus	CY
Latvija	Latvia	Republic of Latvia	LV
Lietuva	Lithuania	Republic of Lithuania	LT
Luxembourg	Luxembourg	Grand Duchy of Luxembourg	LU
Magyarország	Hungary	Republic of Hungary	HU
Malta	Malta	Republic of Malta	MT
Nederland	Netherlands	Kingdom of the Netherlands	NL
Österreich	Austria	Republic of Austria	AT
Polska	Poland	Republic of Poland	PL
Portugal	Portugal	Portuguese Republic	PT
România	Romania	Romania	RO
Slovenija	Slovenia	Republic of Slovenia	SI
Slovensko	Slovakia	Slovak Republic	SK
Suomi/Finland	Finland	Republic of Finland	FI
Sverige	Sweden	Kingdom of Sweden	SE
United Kingdom	United Kingdom	United Kingdom of Great Britain and Northern Ireland	UK

(ISO 3166 alpha-2)

Short name (source language)	Short name (English)	Official name	Code
Norge	Norway	Kingdom of Norway	NO