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Deliverable D5.12
CGS Europe Spring School on CO_2 storage 1

Hosted by PGI-NRI at Leszcze near Bełchatów, Poland
March 12–18, 2012

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* **PU** = Public

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1 Introduction and description of the Spring School

Aim of the course
The purpose of the *CGS Europe Spring School on CO_2 Geological Storage* is to provide a full-week specialised training course on CO_2 geological storage (CGS), targeted in particular at young scientists and post-graduate students. The overall objective is to communicate knowledge and understanding of CGS aspects with a focus on the planned CCS demonstration projects and the implementation of the EU Directive on the geological storage on carbon dioxide (hereinafter called the EU Storage Directive) as well as of the Monitoring and reporting guidelines of the EU ETS directive.

It is planned to run the school twice within the project duration, and it should be ready for repetition with small adjustments in the following years.

1.1 Advanced course on geological storage of carbon dioxide

Raising public participation, awareness and societal anchorage is one of the main issues addressed by the CGS Europe project. The Carbon dioxide Capture and Storage (CCS) environment will change over the coming years with new projects and demo sites, many of them involving participants of CGS Europe. The deployment of CCS will, among other things, bring the need of new young specialists with a sound knowledge of the topic – geologists and engineers who will be active in both industry and research. As contributing to education in the field of CGS is a key objective of CGS Europe, this makes young scientists and students one of the main target audiences of the project's dissemination activities. From this point of view, the CGS Europe Spring School on CGS is the appropriate dissemination tool to be used to react to these needs.

Another aspect of the Spring School deals with the regulatory framework of CCS. Rules and guidelines were made available at the EU level to enable the implementation of CCS. Unfortunately, not all Member States have been able to implement this regulatory framework in their national legislation yet, and the awareness of this framework is relatively low in many countries. In this respect, the course aimed to disseminate and share the knowledge in the field of CGS regulations, monitoring and reporting guidelines to the target student group. This included thorough information on the EU Storage Directive, the related Guidance Documents, as well as the Monitoring and reporting guidelines of the EU ETS Directive.

1.2 Goal of the Spring School

The purpose of the CGS Europe Spring School is to offer the students a tool for learning about CO_2 geological storage from a group of professionals, researchers and scientists involved in international CCS programmes. In this manner, understanding and learning were conveyed of aspects relating to the sink (storage site) where the CO_2 can be stored safely for thousands of years – including the broader perspective of CO_2 capture and transport.

The overall objective of this CGS Europe Spring School was to communicate knowledge and understanding of geological storage aspects of CO_2 with a specific focus on "Monitoring" – an important aspect of CGS required in order to meet the coming years' challenges of new projects and demo sites. In this respect, special emphasis was put on the European context where the challenge of identifying, mapping and bringing into operation CO_2 geological storage sites is critical.

The goal was to provide students with diverse backgrounds a broad understanding of the issues surrounding CO_2 geological storage as an effective tool in a wide range of climate change mitigation options and encourage their active participation in this area. The overall approach was based on a series of lectures on the whole CCS chain, starting with climate change and ending with monitoring and legislation. In general, there were morning sessions with lectures and afternoon exercises based on the lectures. The exercises ended with a poster presentation where each team of students presented a poster designed by themselves on a CGS aspect, for instance, a demo storage site with a monitoring plan.

The course provided an introduction to the following topics:

- Global warming and climate change, greenhouse gasses (methane, CO_2...), sources, capture (focus on CO_2), transport, trap types & storage options, coal seams, depleted hydrocarbon structures, enhanced recovery, deep saline aquifers.
- Reservoir geology & rock properties, geological structure, rock type, cap rocks and reservoirs, mineralogy, porosity, permeability, capillary pressure and fluid distribution.
- Basic reservoir concepts: Reservoir pressure, reservoir temperature, storage capacity estimation, fluid flow through porous media.
- Storage concept and mechanism: CO_2 plume, dissolution, diffusion, CO_2 solubility rate, mineralization, geochemical aspects, injection, pressure build up.
- CO_2 Storage economics, cost.
- Monitoring, numerical modelling, leakage, verification, legislation and guidance documents.
- Environment, health & safety: Governing regulations, risk.

Figure 1: The students also visited the PGI –NRI core store at the Leszcze facilities.

1.3 Target group

The target group is basically post-graduate students, PhD students and Post Docs from Europe working on geological storage of CO_2. Participation of Master students is possible in the case of free chairs, but for this school, all chairs were filled by post-graduate students and young researchers.

1.4 Curriculum

The CGS Europe Spring School on CGS provided theoretical and practical knowledge on CO_2 geological storage and monitoring of storage sites, based on recent international research and development work. Vital elements were geological storage aspects; identification and mapping of sites, safety aspects, injection, monitoring and reporting. The thematic approach included lectures and exercises based on study groups, and field visits of two sites planned for geological storage of carbon dioxide. Most lectures were covered by compendia, articles and/or other material that were made

Figure 2: Excursion to a possible storage site of the Belchatów CCS demonstration project

available to the students during and after the course. The Spring School ran for a complete week – Monday to Sunday. The lecturers were available throughout the entire duration to meet student's requests and answer their questions, and the lecturers participated actively in discussions when appropriate.

Figure 3: CGS Europe first Spring School in Poland. Teachers and students visiting a possible storage site of the Belchatów CCS demonstration project

1.5 Language

The official language of the Spring School was English. All lectures were given in English.

1.6 Excursion

An integral part of the Spring School was an excursion to PGI-NRI's own test site and to one of the possible storage sites for the Bełchatów CCS demonstration project (Figs 2–3).

1.7 Practical exercises

The students were divided into 4 groups. A daily practical exercise formed part of an overall coherent aim. The practical exercise took place each afternoon based on the morning's lecture (Fig. 4). At the end of the week, each group presented a poster showing the results of their 1-week training (Fig. 5).

The poster designed by each group had to promote their choice of CO_2 geological storage scenario, including monitoring solutions, the best storage site and 'sink'. This involved the group team:

- Forming a 'carbon storage monitoring consortium'.

Figure 4: Students working on the daily exercise

- Using the knowledge gained during the lectures (and previously) and the materials provided in the sessions and exercises.
- Illustrating their poster with images selected from the sheets and materials provided and/or from the internet (if available).
- Using their manual skills – the poster had to be handmade (not computer made).

At the end of the Spring School, each group gave a 5-minute presentation of their poster to the rest of the class, explaining all technical terms and adapted to an audience unfamiliar with CCS (e.g. aquifer, storage container, why storage sites below a certain depth are preferable, etc.). The winning group were awarded a small prize for the most attractive poster.

1.8 Outcomes of the poster exercise

The students produced four excellent posters that nicely showed a high level of learning and understanding of storing CO_2 and monitoring the storage sites. This included the development of a monitoring plan for a storage site, as well as a good understanding of the EU Storage Directive and the Guidance Documents.

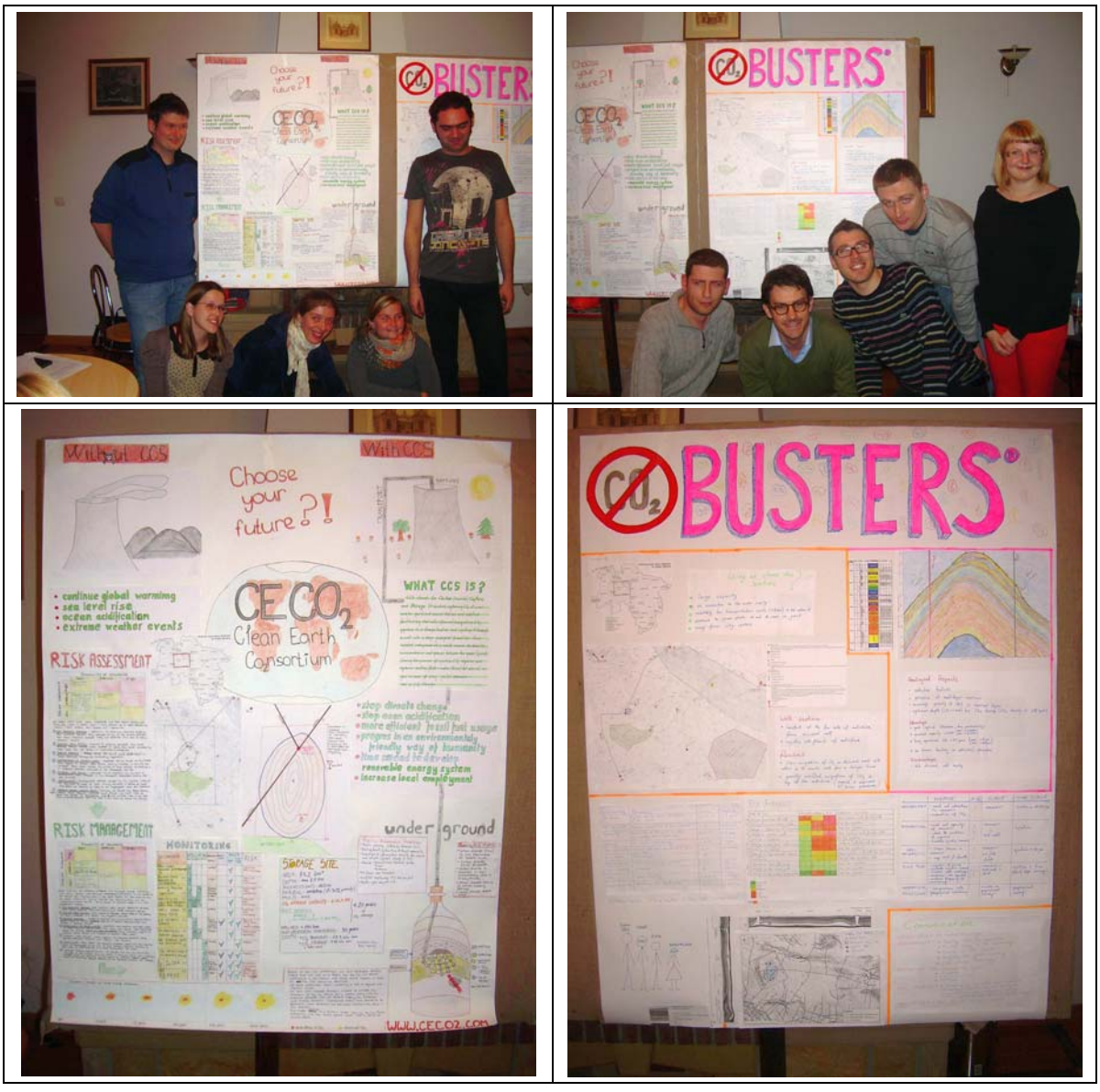

Figure 5: Poster session. The four groups of students and their posters.

2 Planning of the Spring School

Activity	**Period**
Preliminary teaching plan and setting teacher's team (Adjustment on length of lectures, titles of lectures, swift between lectures may be done later, but plan ready for first announcement of the spring school)	January – June 2011
Location	Leszcze – confirmed February 2011
Date for spring school	Decided October 2011
Sponsors	September 2011 to January 2012
Announcement on the CGS Europe website and at universities	November 2011
Applications from students	Deadline January 3rd, 2012
Selection of students upon qualifications for the Spring School	January 2012
Additional announcement	Not needed
Additional selection of students upon qualifications for the Spring School, apologies	January – March 2012
Teachers detailed planning of programme, involvement and responsibilities	January – March 2012
Actual event	March 2012

Table 1: The count-down plan for the spring school

The planning started in January 2011 (Table 1) by appointing the teachers for the Spring School and hereafter with discussions between the teachers on the programme, defining, for example, who is responsible for teaching the different subjects and preparing the exercises. The draft teaching programme with assigned lecturers and topics/exercises was ready just before the summer holidays of 2011.

During the planning phase, Ameena Camps of IEAGHG, who is a member of the CGS Europe Advisory Body, accepted the invitation to join the teachers' team (without any cost for CGS Europe) and to provide an introductory lecture on climate change and CCS.

After the outline of the programme was complete, applications for sponsor support were sent out in the early autumn. All former EU GeoCapacity industrial partners were asked to support the Spring School by a donation for the students' travel, board and lodging. Statoil was, however, the only company that replied positively and donated 3000 €. Also a number of airline companies were asked for support of the students' travel, but with no success.

The Zero Emission Platform (ZEP) supported the Spring School by providing:

- A number of useful reports on CCS (in particular on knowledge sharing and also on the costs of CCS)
- A CCS USB pen/stick containing a library of key CCS materials (not just from ZEP but also from other CCS stakeholders) as a gift for the students
- A presentation by Eric Drosin, ZEP's Director of Communications, on the public communications challenge of CCS. Unfortunately, the presentation had to be cancelled in the end due to overlapping commitments of the speaker.

PGI-NRI kindly offered to host the Spring School at PGI's facilities in central Poland at Leszcze, near the planned Polish demo storage site. This was decided as a good choice, especially because of budgetary reasons (cheap accommodation and meals for the students and the lecturers), and because the planned EEPR/NER300 demonstration project was expected to attract some additional interest in the course.

Figure 6: PGI-NRI facility in Leszcze in central Poland.

The venue was a PGI-NRI field base and drill core storage with laboratories (Fig. 1, 6–7), located in a former manor and around. It is located a few kilometres from a planned pilot injection site and not very far from the most likely demo storage site of the Bełchatów CCS project.

Figure 7: Location of the PGI-NRI facility at Leszcze in central Poland (source: Google maps).

The Bełchatów CCS demo project is one of six EU EEPR projects intended to test the full chain of CCS technology at a scale almost as big as future commercial projects. At the time of the Spring School, the new CCS-ready 858 MW block was completed and officially connected into national grid by end of September 2011. The CCS plant is expected to start operation by 2015, depending on results of the NER300 competition and several other factors. CO_2 storage will be based on injection of CO_2 into deep saline aquifers for permanent storage.

2.1 Announcement

The announcement of the Spring School was posted on the CO_2GeoNet and CGS Europe websites by the end of November 2011 and further announcements were distributed to project partners and to a comprehensive mailing list (about 2000) of CCS stakeholders used for the CO_2GeoNet Venice Open Forum annual event. Further e-mails were sent to all universities where the EAGE / CO_2GeoNet Student Lecture Tour presentations were given. Moreover, CGS Europe project participants also used their national distribution channels to distribute the announcement.

2.2 Selection and grants

Students eligible to attend the CGS Europe Spring School on CGS were selected upon qualifications that had to be duly documented in the application forms.

The attendance was free of charge. However, in order to receive the CGS Europe Studies Diploma, students had to attend all the classroom sessions and practical exercise sessions (all students of the Spring School 2012 received their diploma). Expenses for travel and subsistence were covered by the students or their institutions. The sponsor grant by Statoil, however, substantially lowered the students' expenses.

Thirty-six applications for the Spring School were received before the deadline. Nineteen students were selected by the teachers' team, based on the qualifications documented in their applications (Fig. 8). The choice was then approved by the CGS Europe Management Board.

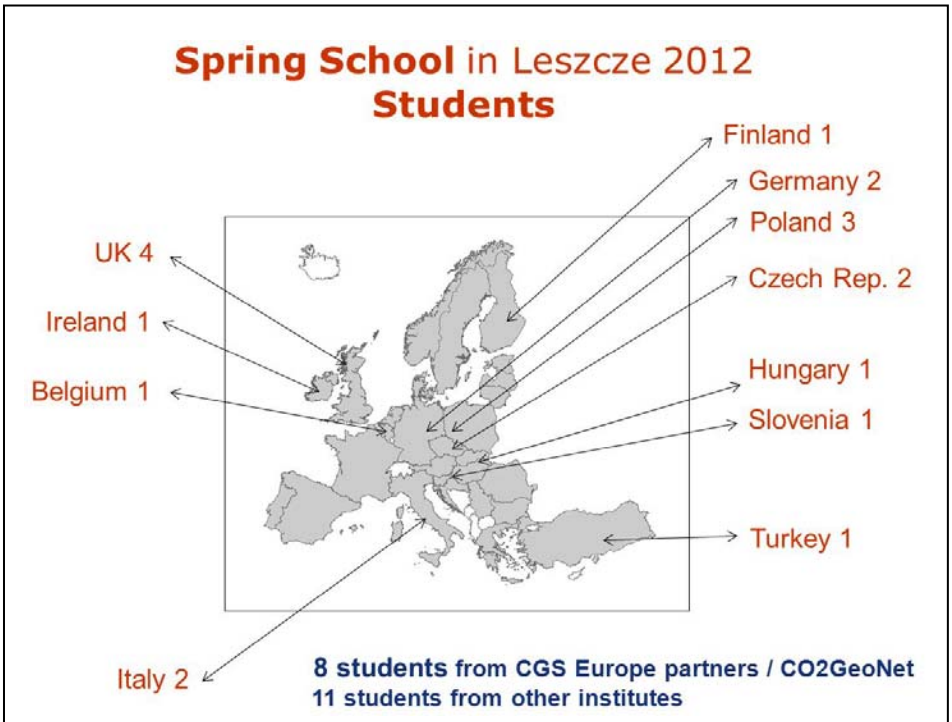

Figure 8: Home countries of students selected for the Spring School

The selection criteria included level of education (Master student, Master degree, PhD student, PhD degree, and young researcher's position), research objective, the quality of the application, CV, letter of recommendation. Attendance was limited to nineteen students because the Leszcze facility could accommodate 25 persons (19 participants and 6 teachers) only. The unsuccessful applicants were informed to apply for the next Spring School in 2013, and were put on a waiting list in the case of cancelation. Two students withdrew only one week before the start of the Spring School, and both places were filled with applicants from the waiting list.

3 Evaluation

An evaluation form was prepared by the teachers and distributed to the students to receive immediate feedback on the quality and perception of the course. Within the last point of the form - "Summarising and concluding the Spring School on CCS", the students expressed a common opinion that they, in general, were very satisfied with the Spring School. Some of them returned an evaluation form showing a high level of satisfaction (Fig. 9). The evaluation also shows that some felt that the information provided before the Spring School was insufficient; there is a very large dispersion of answers to this question (Fig. 9). Also, concerning coherency of the sessions, a large dispersion of answers is noted (Fig. 10).

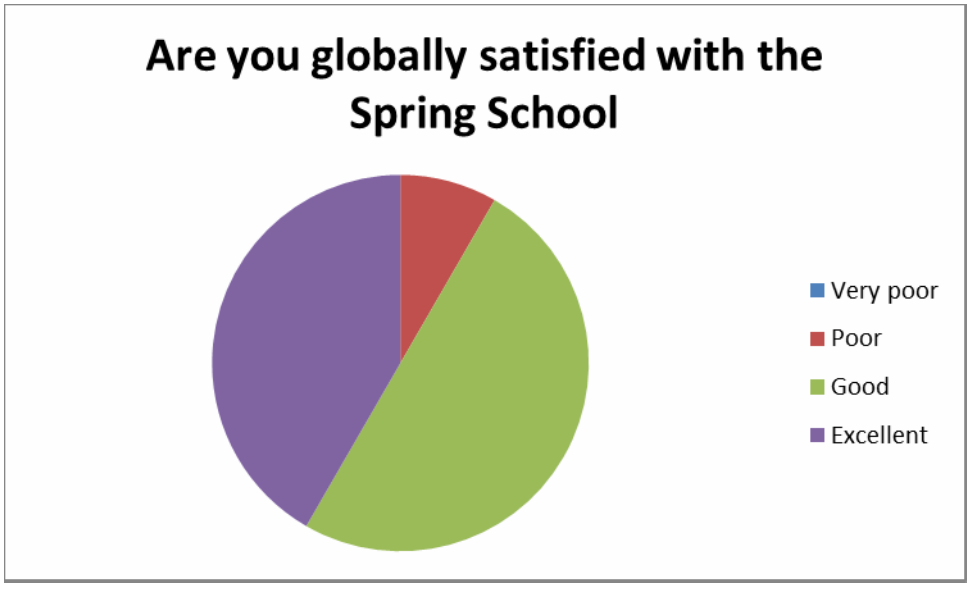

Figure 9: Overall satisfaction with the Spring School expressed in percentages.

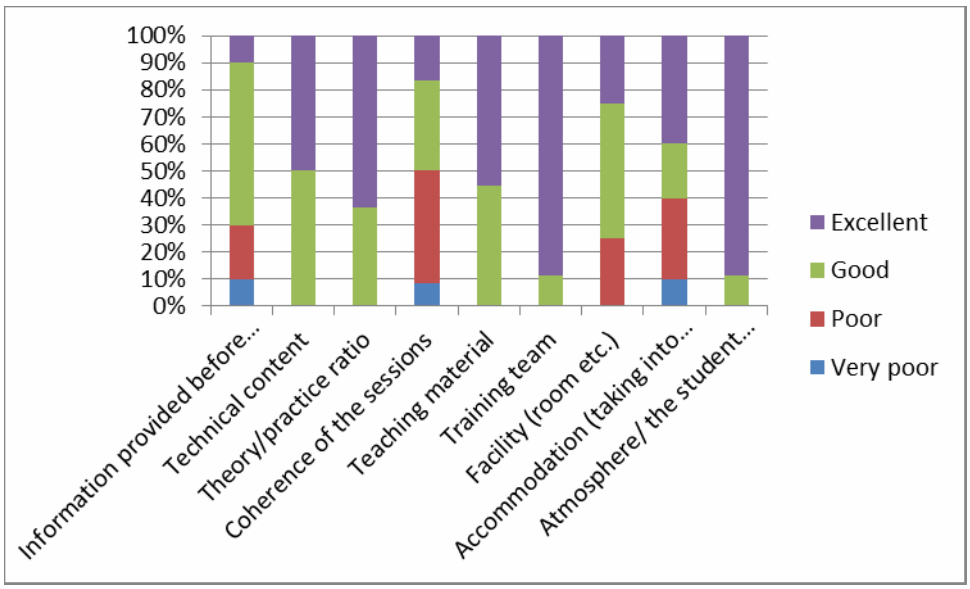

Figure 10: Answers to questions of the evaluation form expressed in percentages.

3.1 Some representative comments from the evaluation forms

About your sessions:
What you would change for next time:

- *The Monday afternoon is to be completely reviewed (too many changes of speakers, my session was too short and incoherent).*
- *Geochemical modelling: I am not sure it was clear.*
- *Expand the geological introduction a little bit; to add maybe an introduction to geo-scientific methods*
- *Give some results from real storage capacity assessments (e.g. GeoCapacity, CO2Stop /will be finished next year/, Storage Atlas of the USA and Canada,...) and compare them.*
- *Different teachers, different topics, interesting concept.*
- *Many examples from other projects*
- *Good points, getting students working during team work, good location, good food, study and accommodation on the same place.*
- *Initial lectures important for setting the scene.*
- *Exercises in the afternoon following the morning lectures. Added better understanding.*
- *Great amount of interesting information covering a wide range of storage aspects.*
- *Practical examples*
- *Teachers – experts in their fields*
- *Good idea with the exercises with posters*

Coherence of the sessions:
How can the agenda be improved (order, length of the different sessions):

- *Change the succession of lectures: First a lecture on screening and then on site characterization.*
- *Better cohesion of first two days lectures*
- *Add a short session: introduction to the agenda: to present the student with how the things will go and how the sessions will interact.*
- *Add a geomechanics session?*
- *Globally have a bit longer session (by speakers and not like the Monday afternoon).*
- *Work on the exercise.*
- *Find small interactive exercises to give during the lecture?*
- *Review the whole agenda.*
- *Keep an open session on last to fill according to students' needs? (like we did with the models)???*
- *Harmonise the succession of the lectures. Overlapping is O.K., but should not have nearly exactly the same information in two lectures.*
- *I would change the order of some lessons*
- *For me, it was too much legislation*
- *More suggestions for papers*
- *More information before course*
- *Add more on capture and modelling*
- *Better structure on legislation part*
- *Add about CCS step by step, a general development plan, and about funding of CCS projects*
- *Make legislation part a little shorter and add more technical issues*

How was the group of students (involvement, capabilities…)?
Do you have suggestion for the selection?

- *There was nice diversity in age and profile.*
- *Ask whether vegetarian or special diets (no pork…).*
- *Perfect*
- *Good selection from different countries and types of institutes.*
- *More students from outside Europe in the future.*
- *Well balanced groups*

4 Programme

Sunday March 11th
Arrival, registration

Monday March 12th
9.00 Welcome by Adam Wójcicki (hosting institution) and Niels Poulsen
9.15 Climate change and CCS as an international carbon abatement technology policy, regulations and financial issues for implementation, international status of CCS development by Ameena Camps (IEA Greenhouse Gas R&D Programme)
11.15: Introduction to colloquium and exercises (students to teams) by Niels Poulsen
11.30 Students colloquium (expectations) by Niels Poulsen and all teachers
12.30 Introduction to exercises by Niels Poulsen
13.00 Lunch
14.00 Introduction to geology and geological storage of CO_2, CCS and EOR by Stefan Knopf & Alexandra Dudu
Site characterisation & reservoir modelling. Screening and capacity estimates by Stefan Knopf & Marie Gastine
16.00 Introduction to Exercise 1 by Stefan Knopf & Marie Gastine
16.30 Exercise 1, rest of day
19.00 Dinner
20.00 Short introduction to geology for non-geologists (30 minutes)

Tuesday March 13th
9.00 Summarising the previous day. Student report/presentation - one per group
9.30 The whole CCS chain - Industrial scale CO_2 storage since 1996 – Experiences by Niels Poulsen
Storage capacity calculations, EOR and CO_2 storage screening and capacity estimates, economic risks by Niels Poulsen
Seismic data, well data by Niels Poulsen
Modelling by Marie Gastine
12.00 EU Storage Directive relating to the implementation of CCS by Alexandra Dudu & Adam Wójcicki
Greener energy technologies. CCS costs by Alexandra Dudu & Adam Wójcicki
12.45 Introduction to Exercise 2 on site selection, characterization and capacity estimates (directive / economy) by Alexandra Dudu, Marie Gastine , Niels Poulsen
13.00 Lunch
14.00 Exercise 2, rest of day
19.00 Dinner

Wednesday March 14th
9.00 Summarising the previous day. Student report/presentation - one per group
9.30 Risk assessment: Safety criteria by Alexandra Dudu
Risk assessment: Legislation, regulations and guidelines by Niels Poulsen
Monitoring methods and EU legislation by Rob Arts
12.00 Status report on CCS and monitoring by Adam Wójcicki & Alexandra Dudu
12.45 Introduction to Exercise 3 on risk assessment and monitoring by Alexandra Dudu, Niels Poulsen, Rob Arts
13.00 Lunch
14.00 Exercise 3 – rest of day

19.00 Dinner

Thursday March 15th

9.00 Summarising the previous day. Student report/presentation - one per group
9.30 Monitoring methods by Rob Arts
Optimizing storage or EOR production by Rob Arts
Remote sensing methods by Alexandra Dudu
Fluid/rock geochemistry by Marie Gastine
12.00 Policy recommendations and road mapping by Adam Wójcicki & Alexandra Dudu
12.45 Introduction to Exercise 4 on geochemistry by Marie Gastine
13.00 Lunch
14.00 Exercise 4 – rest of day
19.00 Dinner

Friday March 16th

9.00 Summarising the previous day. Student report/presentation - one per group
9.30 Dealing with uncertainties: Analytical models by Marie Gastine
Scenario analysis for the Schweinrich structure: A probabilistic approach by Rob Arts
Public opinion and acceptance by Alexandra Dudu
Leakage events. Case stories (Weyburn, Sleipner, Hungary, and natural leakage) by Niels Poulsen
12.00 Public awareness, NGOs, information strategies by Adam Wójcicki & Alexandra Dudu, *et al.*
12.45 Introduction to Exercise 5 on developing a site application by Niels Poulsen
13.00: Lunch
14.00 Exercise 5 – rest of day
19.00 Dinner

Saturday March 17

9.00 Summarising the previous day. Student report/presentation - one per group
9.30 Polish national programme on safe CO_2 geological storage by Adam Wójcicki
10.00 Storage site visit.
15.00 Exercise 1–5
18.00 Poster session. All students and teachers
19.00 Dinner
20.00 Summarising and concluding the Spring School on CGS. All students and teachers
20.30 Students evening (Fig. 11)

Sunday March 18

9.30 Departure

Figure 11: Games at the students evening. The last evening was dedicated to a social event, where the students prepared some games and entertainment.

5 Participants

5.1 Students

Name	Country	Institution	Position
Ágnes Szamosfalvi	Hungary	Eötvös Loránd Geophysical Institute, ELGI	PhD student
Aleš Havlín	Czech Republic	Czech Geological Survey	PhD student
Chijioke Nwankwor	UK	University of Nottingham side of NCCCS	PhD student
Dominika Brulińska	Poland	University of Gdansk	PhD student
Gemma Purser	UK	BGS	Analytical Geochemist
Jennifer Ziesch	Germany	Leibniz Institute for Applied Geophysics	PhD student
Luca Mancinelli	Ireland	Department of Geology Trinity College Dublin	PhD student
Lukasz Klimkowski	Poland	AGH University of Science and Technology Cracow, Drilling, Oil& Gas Faculty, Natural Gas Department	Research Assistant - PhD student
Madeleine Golding	UK	Department of Applied Mathematics, University of Cambridge	PhD student
Magdalena Gil	Germany	German Research Centre for Geosciences (GFZ)	PhD student
Magdalena Mäkelä	Finland	Åbo Akademi University Department of Natural Sciences Geology and Mineralogy	PhD student
Maria Chiara Tartarello	Italy	Dipartimento di Scienze Della Terra "La Sapienza" University of Rome	Postdoc
Oytun Örs	Turkey	Petroleum and Natural Gas Engineering Department at Middle East Technical University, METU	Research assistant
Pietro Sacco	Italy	Dipartimento di Scienze Della Terra "La Sapienza" University of Rome	Researcher
Piotr Bałazy	Poland	Institute of Oceanology Polish Academy of Sciences	PhD student
Rindert Janssens	Belgium	Geological Survey of Belgium Department of the Royal Belgian Institute of Natural Sciences	Researcher
Shane Murphy	UK	School of Environmental Sciences University of Ulster	Postdoc
Tanja Tajnik	Slovenia	University of Ljubljana, Biotechnical Faculty, IOP - Institute of the environment and spatial planning	PhD student
Veronika Vrbova	Czech Republic	Waste Disposal Department NRI Rez plc.	PhD student

5.2 Teachers

Name	Country	Institution	Position
Adam Wojcicki	Poland	PGI-NRI	Teacher
Alexandra Dudu	Romania	GeoEcoMar	Teacher
Ameena Camps	UK	IEAGHG	Teacher
Marie Gastine	France	BRGM	Teacher
Niels Poulsen	Denmark	CO_2GeoNet-GEUS	Teacher
Rob Arts	The Netherlands	CO_2GeoNet-TNO	Teacher
Stefan Knopf	Germany	BGR	Teacher
Teresa Adamczak-Bialy	Poland	PGI-NRI	Assistant

6 Count-down plan for the next Spring School

The next Spring School will be held in Romania in April 2013, hosted by GeoEcoMar. Following the experience of the first Spring School, a planning table for the next edition has been prepared:

Activity	**Status**
Programme & teachers	Teaching plan and teacher's team ready from Leszcze. Some adjustments needed.
Location	Romania
Date for spring school	Thursday 18 April 2013 to Wednesday 24 April 2013 (Wednesday 17 April – arrival)
Sponsors	Approaching to be started August 2012
Announcement (web and universities)	October 2012
Applications from students	Early December 2012
Selection of students upon qualifications for the Spring School	Mid December 2012
Eventually additional announcement	End of December 2012
Final selection of students	January 2013
Detailed planning of programme, adjustment of teaching plan	January – March 2013
The Spring School 2013	18–24 April 2013

Table 2: Planning table for next Spring School

7 Summary of the Spring School

One of the key deliverables of the CGS Europe project's dissemination activities is organisation of two editions of the Spring School, the first one in spring 2012 and the second one in spring 2013. The 2012 Spring School was organised on March 12–18, 2012 at Leszcze near Bełchatów, central Poland.

The course targeted in particular young scientists and postgraduate students (PhD and Post Doc), and focused on CO_2 geological storage with special attention paid to the requirements included in the EU Storage Directive as well as in the Monitoring and reporting guidelines of the EU ETS directive. The activity was led by CO_2GeoNet-GEUS, with contributions from CO_2GeoNet-TNO, BRGM, BGR, PGI-NRI and GeoEcoMar. The first Spring School was financed from the project budget, own resources of the participants and a sponsor grant. The course is planned to be repeated one more time within the project (Year 3), and is ready for repetition in the following years.

The first run of the Spring School was hosted by the Polish project partner PGI-NRI. 19 students from 11 countries participated, forming a true international student community. The teachers came from the above-mentioned partner institutions; a guest teacher was also kindly provided by the IEAGHG programme. The Zero-emission platform (ZEP ETP) provided valuable study materials, and Statoil contributed by a small sponsorship grant. The course was positively valuated by the students, as can be documented by the feedback forms they provided.

The purpose of the *CGS Europe Spring School on CO_2 Geological Storage* is to offer an advanced course on geological storage of carbon dioxide, allowing for knowledge-sharing and learning about near zero-emission power generation from CGS Europe and CO_2GeoNet researchers and scientists.

The first one-and-a-half days were dedicated to an overview of climate change and CCS as an international carbon abatement technology, policy, regulations and financial issues for implementation, international status of CCS development and the whole CCS chain, industrial scale CO_2 storage since 1996, and a short introduction to geology for non-geologists.

The following days focused on the geological storage of CO_2 in Europe, with overview of storage capacity calculations, economic risks, seismic data, well data, modelling, risk assessment (safety criteria and legislation, regulations and guidelines), monitoring methods, geochemistry, public opinion, leakage events and the Polish national programme on safe CO_2 geological storage. Within as many of these aspects as possible, the EU perspective and the EU Storage Directive were incorporated both in lectures and in exercises.

The students had lectures in the morning until lunch, starting with discussion of the previous day's lectures and exercise. The daily exercise was part of an overall Spring School exercise, where student teams had to prepare a poster and present it on the last evening.

On the next-to-last day, there was an excursion where the students visited two future storage sites. The last evening was also dedicated to a social event, where the students had the opportunity to prepare some games and entertainment. The students were also asked to fill in an evaluation form on the Spring School.

Study Programme: The *CGS Europe Spring School on CO_2 Geological Storage* provided the theoretical and practical knowledge on CCS based on recent international research and development work. Vital elements were:

- *Climate change*
- *CO_2 geological storage aspects*
  - *identifying, mapping and completing geological storage sites for CO_2*
  - *aquifers, enhanced oil and gas recovery*
  - *multiple underground usage, storage without compromising other operations*
- *Assessment of storage capacity*
- *Safety precautions and considerations, information strategy*
- *Injection*
- *Numerical and Analytical Modelling approach*
- *Monitoring, legislation and reporting guidelines*
- *Public awareness and involvement in research and deployment*

The teaching approach was based on lectures and exercises in study groups and a storage site visit. Most lectures were covered by compendia, articles or other material that were made available to the students during the course.

The attendance of the course was free of charge. However, direct expenses for travel and board were carried by the students themselves, with partial sponsorship support. The students received the *CGS Europe Studies Diploma* confirming their attendance. The diploma is based not only on the presence at the classroom sessions, but also on active participation in resolving of all exercises.

8 Final remarks

In retrospect, we can consider the first CGS Europe Spring School to be a successful event. The feedback provided by students was generally positive. Moreover, it helped us to identify several weak points in both the organisation and content of the course. These comments, together with lessons learned by the organisers themselves, have created a good basis for improving the course for its second edition to be held in 2013.