

Project no.:
308809

Project acronym:
IMPACTS

Project full title:
The impact of the quality of CO₂ on transport and storage behavior

Collaborative large-scale integrating project

FP7 - ENERGY.2012-1-2STAGE

Start date of project: 2013-01-01
Duration: 3 years

D 4.2.4 Plan on dissemination activities - 2015

Due delivery date: 2014-12-31
Actual delivery date: 2015-03-16

Organisation name of lead participant for this deliverable:
SINTEF Energi AS

Project co-funded by the European Commission within the Seventh Framework Programme (2012-2015)		
Dissemination Level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential , only for members of the consortium (including the Commission Services)	

Deliverable number:	D 4.2.4
Deliverable name:	Plan on dissemination activities
Work package:	WP 4.2 Project dissemination
Lead participant:	SINTEF ER

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Abstract
<p>This deliverable describes the dissemination activities for IMPACTS during the project period 2013-2015. The dissemination activities are organized under the work package (WP) 4.2 Project dissemination, but dissemination will also occur in other WPs, for example as journal publications, presentations, meetings and workshops or courses and summer schools.</p>

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1 INTRODUCTION

IMPACTS is a collaborative project co-funded by the European Commission under the 7th Framework Programme. The objective of IMPACTS is to develop the CO₂ quality knowledge base required for defining norms and regulations to ensure safe and reliable design, construction and operation of CO₂ pipelines and injection equipment, and safe long-term geological storage of CO₂. By this, IMPACTS supports the objectives of the Innovation Union and contributes to the implementation of large-scale CCS and the competitiveness of the European CCS industry.

The dissemination activities of IMPACTS are organized under work package (WP) 4.2 Project dissemination. Typical activities are development of the project website, newsletters, meetings and workshops, courses, summer schools, deliverables from the project and publications. Even though WP4.2 has the overall responsibility for dissemination in the project, many activities will also be performed by the other WPs, such as journal publications, presentations, meetings and workshops or courses and summer schools.

This deliverable gives an overview of the planned dissemination activities of IMPACTS for 2015.

2 WEBSITE

As a part of the running dissemination activities a website for the IMPACTS project has been established. The website is an information channel and a source of public project information and results. The web-address is <http://www.sintef.no/impacts>

Information about the project like objectives, project overview, activities and participants are given. The website will be continuously updated with public information about project news, reports and publications throughout 2015.

The front page of the website is shown in Figure 1



IMPACTS
The impact of the quality of CO₂ on transport and storage behaviour

Why IMPACTS?
Objectives
The project
Results
News and events
Partners
Key figures
Contacts
Publications and Dissemination

About IMPACTS
IMPACTS is a collaborative project co-funded by the European Commission under the 7th Framework Programme.
The idea of IMPACTS is to close identified knowledge gaps related to transport and storage of CO₂-rich mixtures from various CO₂ sources to enable realisation of safer and more cost-efficient solutions for CCS. IMPACTS is addressing the impact of impurities in captured CO₂ from power plants and other CO₂-intensive industries, on CO₂ transport and storage. This encompasses fluid properties, phase behavior and chemical reactions in the infrastructure complex and at the storage sites. Results from IMPACTS will help to ensure safe and reliable design, construction and operation of CO₂ pipelines and injection equipment, and safe long-term geological storage of CO₂.

News
Blog:
Why good models are important for safe and efficient CO₂ transport
The CLIMIT Summit 2015 took place 24–25 February in Oslo. CLIMIT is the Norwegian programme for research on, development of, and demonstration of technology for, CO₂ capture, transport and storage (CCS).
Blog:
IMPACTS and BIGCCS visit partners in Bochum in Germany
Late October this year, the IMPACTS project met for a technical workshop and board meeting in Bochum, and we had the opportunity to visit his very interesting laboratories.
Host for the visit was Professor Roland Span.
Blog:
Why is The EC Impacts Project Officer Mr. Petrov so engaged?
The equipment, he was shown in the SINTEF laboratory, holds "Rolls Royce standard" and is not possible to buy anywhere, it had to be developed by the researchers, and the hurdles to overcome to achieve the desired accuracy have been many and challenging.

Contact IMPACTS
Mail to Research Manager Sigmund Ø. Størset
Newsletters:
• 2014-2
• 2014-1
• 2013-2
• 2013-1
Project information:
The project started on 1 January 2013 and has a duration of three years. It has 12 research performing partners and 5 funding partners. The budget: is € 5 573 856, with contribution from EU at € 4 000 764.

Partners:
SINTEF, RUB, ciudad de la energía, TNO, GFZ

Figure 1: IMPACTS website (start page) as per November 2013.

The website was launched in January 2013. An example from the website is shown in Figure 2. It is an example of the bi-weekly blog. This one from Svend Tollak Munkejord, SINTEF Energy

Why good models are important for safe and efficient CO2 transport

[Svend Tollak Munkejord](#) [CCS, Oil and gas / Subsea](#)

March 3, 2015 [BIGCCS, CCS, Centre for Environmentfriendly Energy Research, CO2 management, The Research Council of Norway](#) [0 Comment](#)

The [CLIMIT Summit 2015](#) took place 24–25 February in Oslo. CLIMIT is the Norwegian programme for research on, development of, and demonstration of technology for, CO₂ capture, transport and storage (CCS).



The CLIMIT programme celebrates 10 years this year. According to the International Energy Agency (IEA), CCS is the third most important measure to limit the global warming by 2°C.

“ The conference participants seemed to agree that CCS may be deployed tomorrow – if there is will to do so.

Norway is in the forefront of CCS development. For instance, since 1996, one million tonnes of CO₂ have been injected each year on the Sleipner field in the North Sea. It should be noted that it is done because it is profitable as a result of the Norwegian CO₂ tax. For the time being, there is no similar mechanism promoting CCS deployment.

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Figure 2: Example of content on IMPACTS web-page the biweekly blog- this one by Svend Tollak Munkejord, SINTEF Energy

2.1 Blog

A new addition to the IMPACTS web site during 2014 was the IMPACTS blog. The plan is for all the WP leaders in IMPACTS to contribute to the blog. During 2014 three IMPACTS blogs were published. For 2015 it is planned to do bi-weekly blogs as of March. The first blog of 2015 is shown in Figure 2.

The following schedule is planned for the rest of 2015:

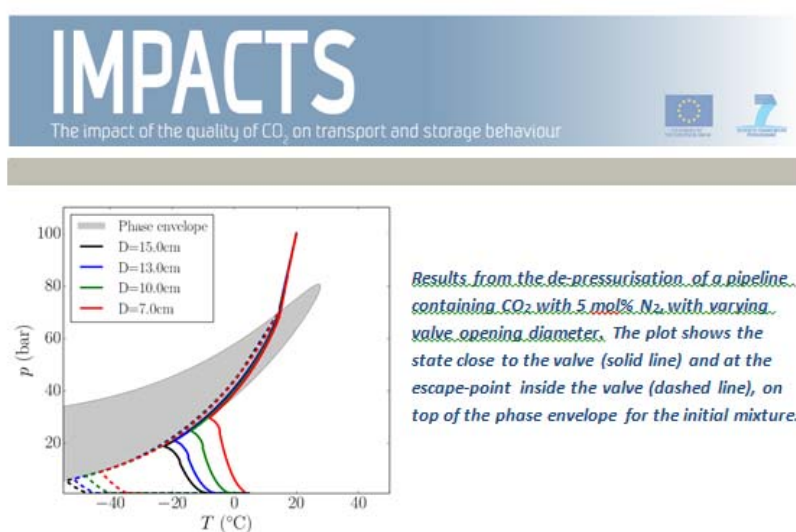
IMPACTS - website blog schedule

Week	WP	Comment
23.03.2015	WP1.1	
06.04.2015	WP1.5	
20.04.2015	WP2.2	
04.05.2015	WP1.4	
18.05.2015	WP2.3	
01.06.2015	WP1.2	
15.06.2015	WP3.3	Announce Summer school /workshop
29.06.2015	WP3.1	
10.08.2015	WP2.1	
24.08.2015	WP3.2	
07.09.2015	WP1.5	Add blog on TCCS8
21.09.2015	WP1.1	
05.10.2015	WP1.4	
19.10.2015	WP2.3	
02.11.2015	WP1.2	Add blog on TCCS8
16.11.2015	WP3.2	
23.11.2015	WP2.1	
30.11.2015	WP1.3	Add blog on TCCS8
07.12.2015	WP3.1	
14.12.2015	WP3.3	
21.12.2015	WP2.2	
21.12.2015	SINTEF	Final blog coordinator

3 NEWSLETTERS

An electronic newsletter is distributed via email to the IMPACTS consortium and another 300 recipients in the SINTEF CCS email list every six months. The IMPACTS participants are also encouraged to further spread the newsletter in their networks. The first newsletter appeared in June 2013. The newsletters are prepared by TNO with input from all participants, and summarize the project progress, events, meetings and publications in the last six month period. An excerpt from the most recent newsletter as of December 2014 is shown in Figure 3.

For 2015 two IMPACTS newsletters #5 and #6 will be issued in June and December.



The second report contains a benchmark of three different simulation tools for CO₂ pipeline: The commercial simulator OLGA, ANSYS Fluent with CSM's thermodynamic library CO₂ GASMISC, and SINTEF Energy Research' in-house code. Both steady-state flow and depressurization and filling of a pipeline were considered, with impurities typical for various capture processes. Especially for depressurization and filling some discrepancies were found between the various tools. The report shows that simulation of two-phase flow of CO₂ with impurities still requires more research.

WP1.4 Corrosion potentials in CO₂ infrastructure

Corrosion and test corrosion tests are ongoing. Three different pipeline materials have been selected for the testing activity:

- Grade X60
- Grade X65
- Grade X70

The test corrosion testing activity will include measurements on samples cut out from a girth weld. All the samples have been machined. All the testing activity will finish in the first months of 2015.

WP1.5 Chemical and physical effects of impurities on CO₂ storage

Within the last months the work performed in WP1.5 made a great step forward towards understanding the physicochemical effects of an impure CO₂ stream in the deep subsurface during injection and subsequent storage. Reservoir engineering simulations were conducted, considering mixture of gases, like CO₂ and SO₂, and assessed the influence of the various impurity concentrations in the CO₂ stream on e.g. the pressure development and storage capacity. In addition, the presence of CO₂ and additional substances has varying influences on chemical fluid-rock interactions and results most notably in dissolution of primary minerals and the precipitation of newly formed phases, causing changes in porosity and permeability. By using geochemical modelling tools we showed that the presence of SO₂ may have a significant influence on the porosity evolution of the

Figure 3: IMPACTS newsletter # 4 - December 2014

4 PLANNED PUBLIC MEETINGS AND WORKSHOPS

4.1 Public Meetings

The following public meetings are planned:

4.1.1 Synthesis, implementation and dissemination workshop at TCCS-8

A synthesis, implementation and dissemination workshop will be arranged in WP3.3 as an independent event during the TCCS-8 conference (summer 2015). This workshop will focus on the main achievements from IMPACTS; the IMPACTS Toolbox and the IMPACTS Recommendations. The main objective of this arrangement is to make the results from IMPACTS available to the CCS community and secure short lead time from the generation to utilization of results.

The IMPACTS consortium will invite participants from other EU CCS projects, CCS demonstration projects, standardisation organisations, research organisations, regulators, public bodies, national authorities and other relevant stakeholders. The workshops will be open for participants outside of the IMPACTS consortium and also for those not participating in the above mentioned conferences. This task will ensure that information about the workshop is actively disseminated and reaches the right groups and people.

4.2 IMPACTS Meetings

4.1.2 Meeting with International Standards Organizations

A separate meeting will be arranged at TCCS-8 with NIST, ISO, CEN and/or IAPWS to present the final results. Invitations have been sent out for this meeting.

5 COURSES AND SUMMER SCHOOLS

5.1 Possible Nordic CCS Summer School, August 10-14th 2015

The Nordic CCS Summer School will possibly be organized August 10-14, 2015 if funding is awarded. It will be organized by the NORDICSS consortium with 30 participating CCS students. Nils A. Røkke, Chairman of IMPACTS Executive Board, will be the organizer of the summer school along with Marit Mazzetti who is also IMPACTS Project Manager. An Hilmo (IMPACTS project secretary) will help with the administration and organization.

An application has been submitted to host the summer school where IMPACTS will participate with lecturers if the proposal is awarded funding.

5.2 IEAGHG International CCS Summer School

IMPACTS will aim at being present with lecturers at the IEAGHG International CCS Summer School, which takes place in August every year.

In 2015, the Summer School will be held in Australia in December. IMPACTS is staying in touch with IEAGHG regarding the organization and lecturers of the summer school.

5.3 CCS course in Romania

A CCS course at Master level will be arranged by ISPE in Romania (WP3.3) and be open for students and people from industry outside of IMPACTS. IMPACTS researchers will be invited to give lectures at the course. This task will help to spread information about the workshop to relevant industrial, research and student groups.

6 DELIVERABLES

In order to disseminate the results from the project, all deliverables will be published on the project website: <http://www.sintef.no/Projectweb/IMPACTS/Results/>

Restricted deliverables will be published with title, authors and public introduction only, whereas the full public deliverables will be made available on the website. All deliverables are available for the IMPACTS consortium on the IMPACTS eRoom.

7 PUBLICATIONS

IMPACTS is encouraging popular science articles, conference presentations and journal publications from the project and gives this topic high priority in the PMT meetings.

7.1 Planned Conference Presentations and Abstracts

7.1.1 Submitted for 2015

CO2QUEST CCS workshop, Athens, March, 2015

International Forum on Recent Developments of CCS Implementation, Athens, Greece, 26th – 27th March 2015,

1. Thermophysical Properties for Transport and Storage of CO₂-rich Mixtures – Contributions by IMPACTS, R. Span
2. Measurements on Volumetric Properties of binaries and ternaries of Carbon dioxide, Nitrogen, and Argon at Supercritical State by Single Sinkers Densimeter Xiaoxian Yang*, Zhe Wang, and Zheng Li, *Xiaoxian Yang
3. IMPACTS: Economic Trade-offs in Establishing CO₂ Impurity Specifications C.Eickhoff*¹ and F.Neele², *Presenting author's email: charles@progressive-energy.com

14th Annual Carbon Capture, Utilization and Storage Conference, Pittsburgh, Pennsylvania from Tuesday, April 28 – Friday, May 1, 2015.

- IMPACTS: The Impact of the Quality of CO₂ on Transport and Storage Behaviour- Presentation Sigmund Ø. Størset^a, Marit J. Mazzetti^a, Morten Hammer^a Charles Eickhoff^b, Filip Neele^c, Daniël Loeve^c. ^aSINTEF Energy Research, Norway. ^bProgressive Energy, UK. ^cTNO, Netherlands.

TCCS-8, Trondheim Norway, June 17-19, 2015

- Impact of CO₂ Quality on Transport and Storage- IMPACTS Marit Jagtøyen Mazzetti¹, Sigmund Østtveit Størset¹, Morten Hammer¹, Charles Eickhoff², Filip Neele³, ¹SINTEF Energy Research, Norway, ²Progressive Energy, UK, ³TNO, Netherlands. (*Oral Presentation and paper*)
- Hydraulic characterization tests at Hontomin Technology Development Plant for CO₂ Storage. Experiences with brine, CO₂ and tracer injection; Daniel Fernandez-Poulussen (1), J. Carlos de Dios (1), Juan A. Marin, Fundación Ciudad de la Energía (CIUDEN). Avenida del Presidente Rodríguez Zapatero, 24492 Cubillos del Sil (León), Spain.
- Effects of impurities in a CO₂ transport experimental installation. First results and experiences at CIUDEN. Ruth Diego (1), Abraham Fernández (1), Miguel Ángel Delgado (1), Rosana González (1) (1) Fundación Ciudad de la Energía (CIUDEN). Avenida del Presidente Rodríguez Zapatero, 24492 Cubillos del Sil (León), Spain.

- Numerical modelling of physicochemical effects of discrete CO₂-SO₂ mixtures; potential cost effects for injection and storage of impure CO₂ in a sandstone aquifer, Svenja Waldmann, Cor Hofstee, Daniël Loeve, Mariëlle Koenen, Filip Neele, TNO, Princetonlaan 6, 3584 CB Utrecht, the Netherlands.
- IMPACTS: Effect of CO₂ impurities on storage opportunities, Hanstock, D.J. & Eickhoff C.E., Progressive Energy Limited, UK

The international Thermophysical Properties Symposium in Boulder, Colorado (June, 2015)

- Accurate vapor-liquid phase equilibrium measurements on the binary CO₂-O₂ system, Snorre F. Westman, H. G. Jacob Stang, Sigurd W. Løvseth

7.1.2 Conference Papers and Presentations planned for 2016

- 2 presentations by Roland Span's group at Bochum

WP3.1

Public deliverable D3.1.1 'Framework for IMPACTS recommendations' (*report on website*)

Public deliverable D3.1.2 'IMPACTS recommendations' (*report on website*)

Conference paper: GHGT13 paper on IMPACTS recommendations, 2016

WP3.2

Public deliverable D3.2.1 'New standard property model for CO₂ mixtures' (*Software available on website, as well as from website at RUB, NIST, ...*)

Public deliverable D3.2.2 'IMPACTS Toolbox' (*report available on our website*)

Conference paper: at least one paper on the standard property model at a relevant conference (RUB to select)

Conference paper: a GHGT13 paper on the Toolbox, 2016

WP3.3

GHGT13 *Conference paper:* - result from the workshop and the CCS course. Topic to be decided.

7.2 Journal publications Planned

7.2.1 Planned For publication in 2015

1. **EOS-CG: A Helmholtz Energy Mixture Model for Humid Gases and CCS Mixtures** Johannes Gernert^{a,b} and Roland Span^{a,1} Thermodynamics, Ruhr-Universität Bochum, D-44801 Bochum, Germany

Abstract

An equation of state for the thermodynamic properties of humid gases, combustion gases and CO₂-rich mixtures typical for CCS processes, the EOS-CG mixture model, is presented in this work. This model uses the mathematical approach of the GERG-2008 equation of state by Kunz and Wagner [J. Chem.Eng. Data 2012, 57, 3032–3091] and presents new mixing parameters for mixtures of carbon dioxide,

Submitted to Journal of Chemical Thermodynamics, 2014

2. Phase equilibria measurements of CO₂-N₂ and CO₂-O₂ system
H. G. Jacob Stang, Sigurd W. Løvseth, Anders Austegard, Ingrid Snustad, Snorre F. Westman.
3. Accurate vapor-liquid phase equilibrium measurements on the binary CO₂-O₂ system,
Snorre F. Westman, H. G. Jacob Stang, Sigurd W. Løvseth, Fluid Phase Equilibria
4. Journal publication by Tsinghua
5. Journal publication by Bochum with Xiaoxian Yang as first author
6. Journal publicaiton by Bochum

7.2.2 Planned for publication in 2016

WP1.2

2 journal publications by Bochum

8 COLLABORATION WITH OTHER PROJECTS

The [CO2QUEST project](#) coordinated by University College London (UCL), can be regarded as IMPACTS' sister project. Svend Tollak Munkejord, SINTEF ER, has been asked to join the advisory board of CO2QUEST, composed of members from industry and academia.

IMPACTS was working with CO2QUEST during 2014 planning meetings in 2015.

A second workshop is arranged by CO2QUEST in March 2015.

International Forum on Recent Developments of CCS Implementation, Athens, Greece, 26th – 27th March 2015,

IMPACTS will contribute with 3 presentations:

1. Thermophysical Properties for Transport and Storage of CO₂-rich Mixtures – Contributions by IMPACTS, R. Span
2. Measurements on Volumetric Properties of binaries and ternaries of Carbon dioxide, Nitrogen, and Argon at Supercritical State by Single Sinkers Xiaoxian Yang*, Zhe Wang, and Zheng Li, *Xiaoxian Yang
3. IMPACTS: Economic Trade-offs in Establishing CO₂ Impurity Specifications C.Eickhoff*¹ and F.Neele², *Presenting author's email: charles@progressive-energy.com

