

SIXTH FRAMEWORK PROGRAMME

PRIORITY 1.6



Enhanced Geothermal Innovative
Network for Europe



Project no 019760

ENGINE

Enhanced Geothermal Innovative Network for Europe

Instrument: Coordination Action

Thematic Priority: 1.6 Sustainable energy systems

1st Periodic activity report

Deliverable 2: six month and one year activity report

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Duration: 30 months

Project coordinator name: Patrick Ledru

Project coordinator organisation name: BRGM



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Table of contents

1.	Periodic activity report	5
1.1.	PUBLISHABLE EXECUTIVE SUMMARY	5
1.1.1.	Summary description of project objectives	5
1.1.2.	Contractors involved	10
1.1.3.	Work performed and results achieved so far	13
1.1.4.	Intention for use and impact	13
1.1.5.	Plan for using and disseminating knowledge	13
1.2.	SECTION 1 – PROJECT OBJECTIVES AND MAJOR ACHIEVEMENTS DURING THE REPORTING PERIOD	14
1.3.	SECTION 2 - WORKPACKAGE PROGRESS OF THE PERIOD	21
1.3.1.	Objectives, Exploitation, economic, environmental and social impacts	31
1.4.	SECTION 3 – CONSORTIUM MANAGEMENT	34
1.5.	SECTION 4 – OTHER ISSUES	41

1. Periodic activity report

1.1. PUBLISHABLE EXECUTIVE SUMMARY

1.1.1. Summary description of project objectives

The work programme of the FP6 priority thematic area 1.6, "Sustainable energy systems", defines a need for co-ordinating ongoing research and promoting the development and uptake of innovative methods and technologies to expand the exploitation of Unconventional Geothermal Resources, in particular Enhanced Geothermal Systems.

To summarise, by exploring Unconventional Geothermal Resources, research and development institutes face:

- a scientific challenge to understand the distribution of heat and permeability at depth in the uppermost crust. High amplitude and small wavelength anomalies, related to local high conductivity layers or highly radioactive sources, may develop on the large wavelength thermal anomalies and present a great interest for assessment of reservoirs for Hot Dry Rock energy systems.
- a technological and economic challenge to improve and render cost-efficient investigation and development technology in order to make these geothermal systems viable.
- a communication challenge to rally the support of policy makers and investors and, in certain cases, increase the social acceptance of a broader community.
- a challenge to integrate the different, yet parallel, research paths that currently exist, namely one for investigation and resource assessment and another for sustainable exploitation schemes, one for Hot Dry Rocks and another for High Energy Systems.

The Co-ordination Action, called "Enhanced Geothermal Innovative Network for Europe" (ENGINE) has been proposed in this framework. Its main objectives are to motivate the scientific community to face up to the above-mentioned challenges, to capitalise the know-how acquired in the framework of the Hot Dry Rocks Soultz experiment but also from the exploration and exploitation of Italy, Bouillante and Iceland geothermal fields, to define new integrated projects that will federate the scientific community working in the "geothermal field", in partnership with industry, in order to achieve the strategic objectives of the European Community. It will provide (1) an updated framework of activities concerning geothermal energy in Europe, including the integration of scientific and technical know-how and practices, the evaluation of socio-economic and environmental impacts; (2) the definition of innovative concepts for investigation and use of Unconventional Geothermal Resources and Enhanced Geothermal Systems; groups of experts will present a "Best Practice Handbook"; (3) a scientific and technical "European Reference Manual" including the information and dissemination systems developed during the Co-ordination Action. The links established between research and development teams, national development programmes, industrial partners and international agencies will be used to promote the geothermal energy as a major renewable and sustainable source of energy and to propose innovative high-level medium- to longer-term research projects

The structure of the project is based on 9 workpackages (Figure 1). The *Project management* activities are gathered in the Workpackage 1. A special attention is paid to the *Information and dissemination system of the Co-ordination Action* (WP2) as the potential

impact of the project will be related to the mobilisation of a large scientific and industrial community and to the establishment of a sustainable institutional and political support. It will provide (i) a working platform for exchanging general or specialised information, (ii) on-line exchange and dissemination of scientific and technical know-how and practices, (iii) access to a metadata base, specified database, open-source software and models, (iv) an interface with non-member institutes and the international geothermal community, (v) development and maintenance of a regular contact with the media's.

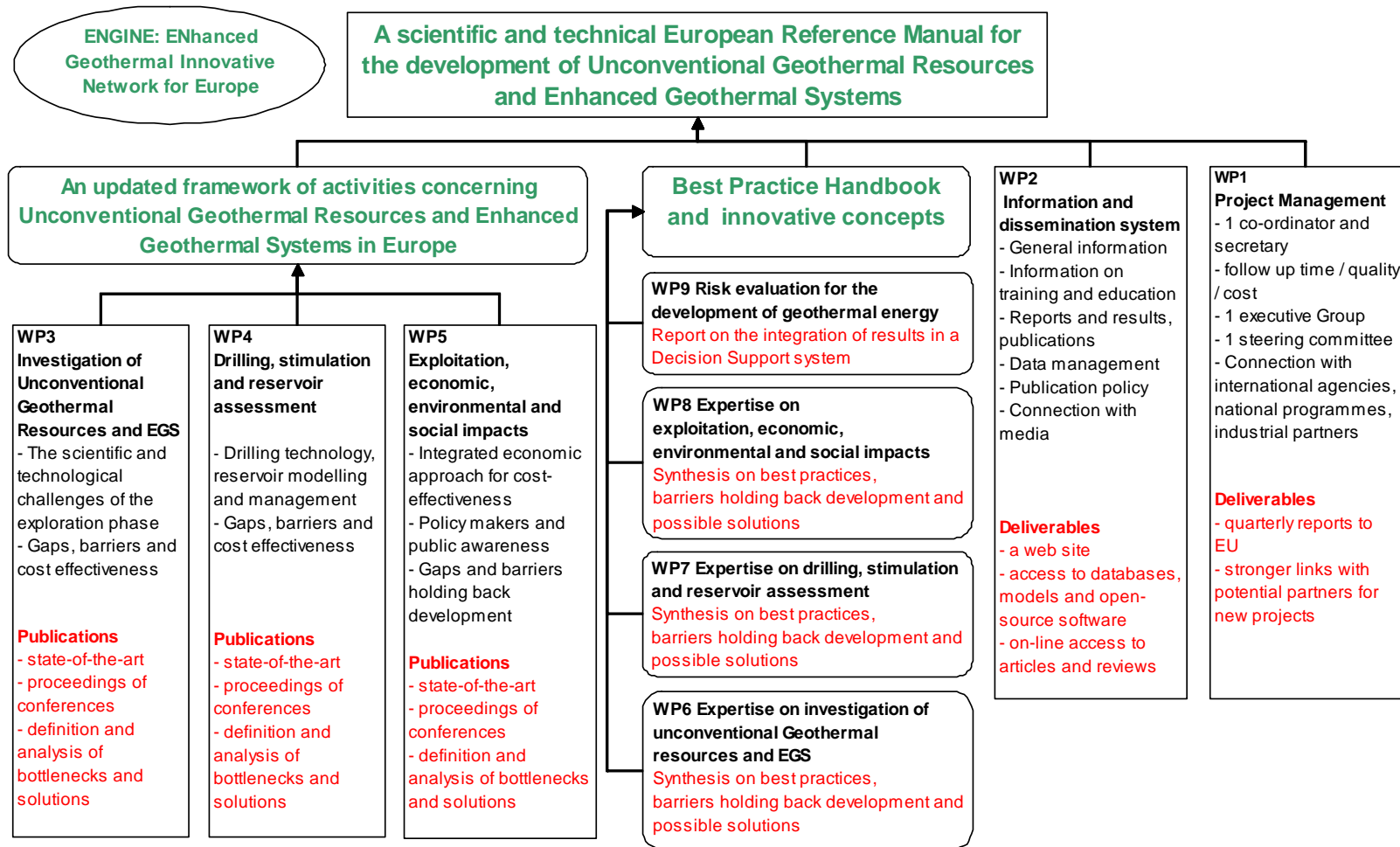


Figure 1: Breakdown structure of the ENGINE Coordination action

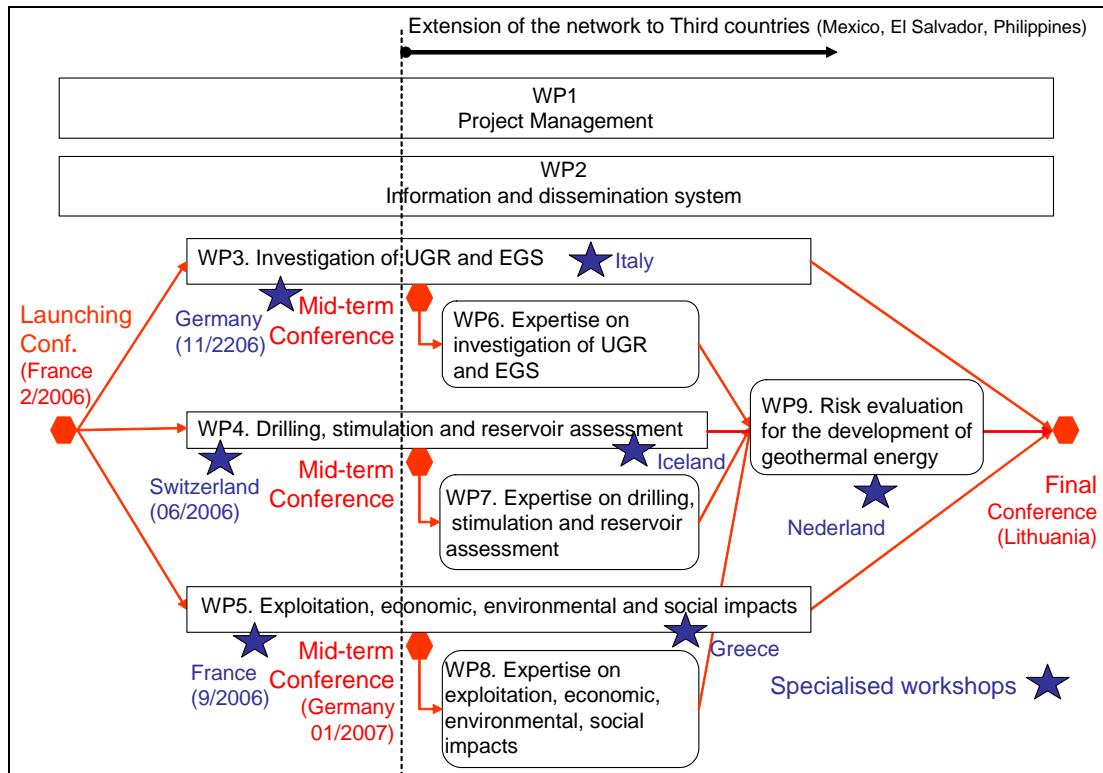


Figure 2: Project network of activity

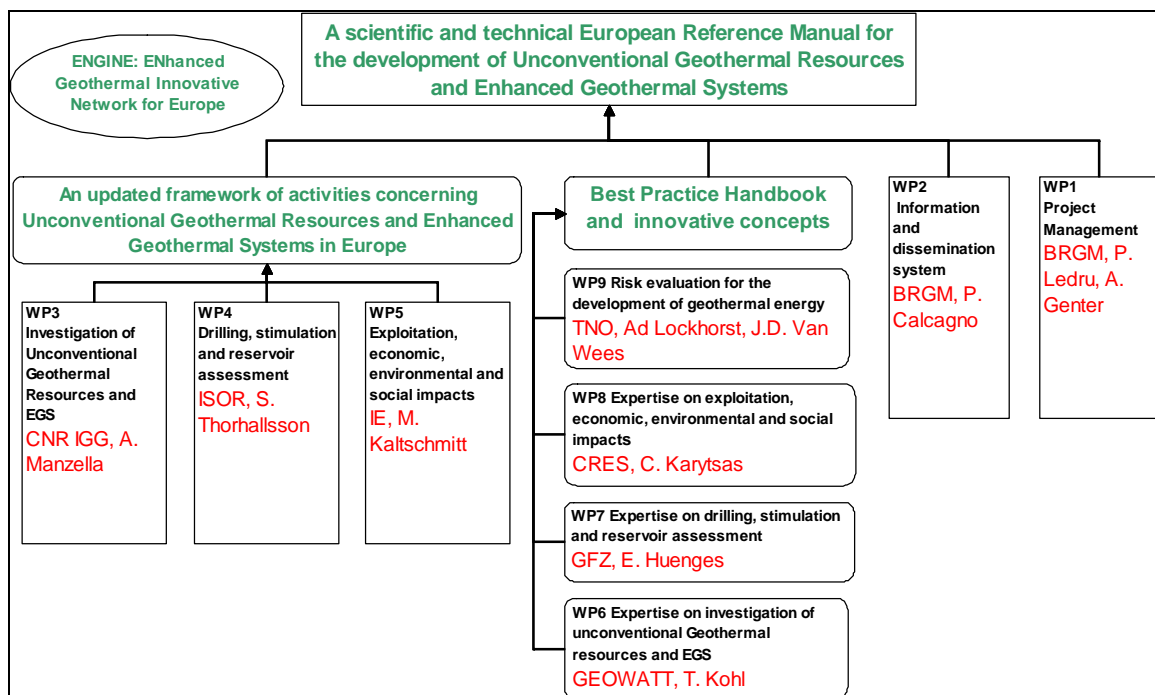


Figure 3: Breakdown of the ENGINE resources and Workpackage leaders

To promote an efficient network of geothermal activities, the Co-ordination Action will define, organise and manage joint and common initiatives through (Figure 2):

- an Integration Phase, i.e. a bottom-up and federative strategy to motivate the scientific community to face up to the scientific and technical challenges. Workshops and conferences will be regularly organised to ensure a smooth and streamlined flow of

exchanges and co-ordination. *This integration of scientific and technical know-how and practices will provide an updated framework of activities concerning geothermal energy in Europe. It will cover all initiatives and bottlenecks encountered during the Investigation of EGS and unconventional Geothermal resources (WP3), Drilling, stimulation and reservoir assessment (WP4) and Exploitation, economic, environmental and social impacts (WP5).* For each of these Workpackages, the co-ordination work will be aimed at (i) presenting the state-of-the-art, (ii) defining the most appropriate scientific and technological approaches, (iii) identifying the main gaps, barriers and unsolved questions; (iv) analysing how such know-how and procedures can be transferred and bottlenecks overcome. The economic factor and the cost-effectiveness of each scientific and technological approach will be systematically considered. The deliverables will mainly consist of publications providing access to the conclusions of these integration actions and, in particular, to the state-of-the-art.

- a Synthesis Phase; i.e. the creation of Expert Groups/panels in charge of defining priorities in the field of research investment and strengthening the links with the financial and political institutions. Four groups of experts, acting within WP 6-7-8, will perform an evaluation of the best practices and innovative concepts to be adopted on the different types of activities covered by the WP 3-4-5. WP9 on *Risk evaluation for the development of geothermal energy* is aimed at synthesising the main scientific and technical aspects, as well as economic and environmental constraints, resulting from the different expert groups. Deliverables will include a Best Practice Handbook and the definition of innovative concepts for geothermal investigation, reservoir stimulation and assessment and exploitation.

A scientific and technical European Reference Manual for the development of *Unconventional Geothermal Resources* will finally present this Best Practice Handbook and will include all publications, information, metadata base, database and models collected and compiled during the integration phase of the Co-ordination Action.

1.1.2. Contractors involved

The project involves 31 contractors. The workpackage leaders are presented on figure 3. The first group of partner has a broad knowledge covering large aspects of the geothermal energy. It comprises **BRGM** (France), co-ordinator of the ENGINE project, **CFG SERVICES** (France), **GeoForschungsZentrum Potsdam** (GFZ, Germany), **ISlenskar ORkurannsoknir** (ISOR, Iceland GeoSurvey), **Centre for Renewable Energy Source** (CRES, Greece), **the Geological Survey of Denmark and Greenland** (GEUS, Denmark), **Shell International Exploration and Production B.V.** (SIEP B.V., Netherlands).

The second group of partner has a knowledge covering mainly the exploration and drilling and reservoir assessment: the **Instituto di Geoscienze e Georisorse** (IGG, Italy), the **Department of Geophysics of the Eotvos University** (ELTE, Hungary), the Institute of Earth Sciences, Dept. of Tectonics, of the **Vrije Universiteit Amsterdam** (VUA, Netherlands), the **Groupement Européen d'Intérêt Economique "Exploitation Minière de la Chaleur"** (GEIE "EMC", an international consortium operating on the site of Soultz-sous-Forêts, France), the **Panstwowy Instytut Geologiczny** (PGI, Polish Geological Institute, Poland), **Tsentr geoelektromagnitnykh issledovaniy Instituta fiziki zemli Rossiskoi akademii nauk** (GEMRC IPE RAS, GEoelectromagnetic Research Center of the Institute of the Physics of the Earth, Russian Academy of Sciences, Russian Federation), the **Geologijos Ir Geografijos Institutas** (IGGL, Institute of Geology and Geography, Lithuania).

A large group of partners have a large experience in drilling and reservoir assessment, exploitation and impact of the geothermal energy. It is composed of the **Netherlands Organisation For Applied Scientific Research** (TNO, Netherlands), ten laboratories of the

French **CNRS** (France) involved in the HDR Soultz experiment, **Geoproduction Consultants** (GPC, France), the Chemical Process Engineering Research Institute (CPERI) of the **Center for Research and Technology-Hellas (CERTH)**, the Environmental Research Laboratory of the **National Centre for Scientific Research "Demokritos"** (NCSR-D, Greece), the **Institutt for Energiteknikk** (IFE, Institute for Energy Technology, Norway), the **Deep Heat Mining Association** (DHMA, International Consortium), The company **Geowatt AG**, the **Instituto Geológico y Minero de España** (IGME Geological and Mining Institute of Spain, Spain), the **Leibniz Institute for Applied Geosciences** (GGA-Institute, Germany)

Another group of partners are mainly involved in the development and management of exploitation and in impact studies of the geothermal energy: the **Institut für Energetik und Umwelt** gGmbH (IE, Institute for Energy and Environment, Germany), the **Institut vysokikh temperatur Rosyiskoi akademii nauk** (IVTRAN, Institute for high temperatures, Russian academy of sciences, Russian Federation), **the Institute for Geothermal Research of the Daghestan Scientific Centre of Russian Academy of Sciences** (IGR DSC RAS, Russian Federation) and 3 private firms, **ORME JEOTERMAL A.S.**, operating in Turkey, **Joint Stock Company "Intergeotherm"** (JSC "Intergeotherm", Russian Federation), involved in the construction of geothermal plants worldwide and **MeSy GeoMessSysteme GmbH** (MeSy, Germany) partner of the European HDR Soultz-sous-Forêts project, the **University of Oradea** (UOR, University of Oradea, Romania).

BRGM (France) is the co-ordinator of the ENGINE project. The Co-ordination is performed by Patrick Ledru, Project coordinator at the Research Division of the BRGM, with the support of Albert Genter, Project manager. Christian Fouillac, Research Director of the BRGM, is chairing the Executive group of this Coordination Action (see contact details in Table 1). The management structure is presented on figure 4.

Name	Position	Telephon	Fax	e-mail
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Christian Fouillac	Chairman of the Executive Group	+33 2 38 64 36 90	+33 2 38 64 39 87	c.fouillac@brgm.fr
Philippe Calcagno	Project leader	+33 2 38 64 30 54	+33 2 38 64 33 34	p.calcagno@brm.fr
Annick Darcheville	Accounting manager	+33 2 38 64 32 10	+33 2 38 64 31 42	a.darcheville@brgm.fr

Table 1. Coordinator Contact details

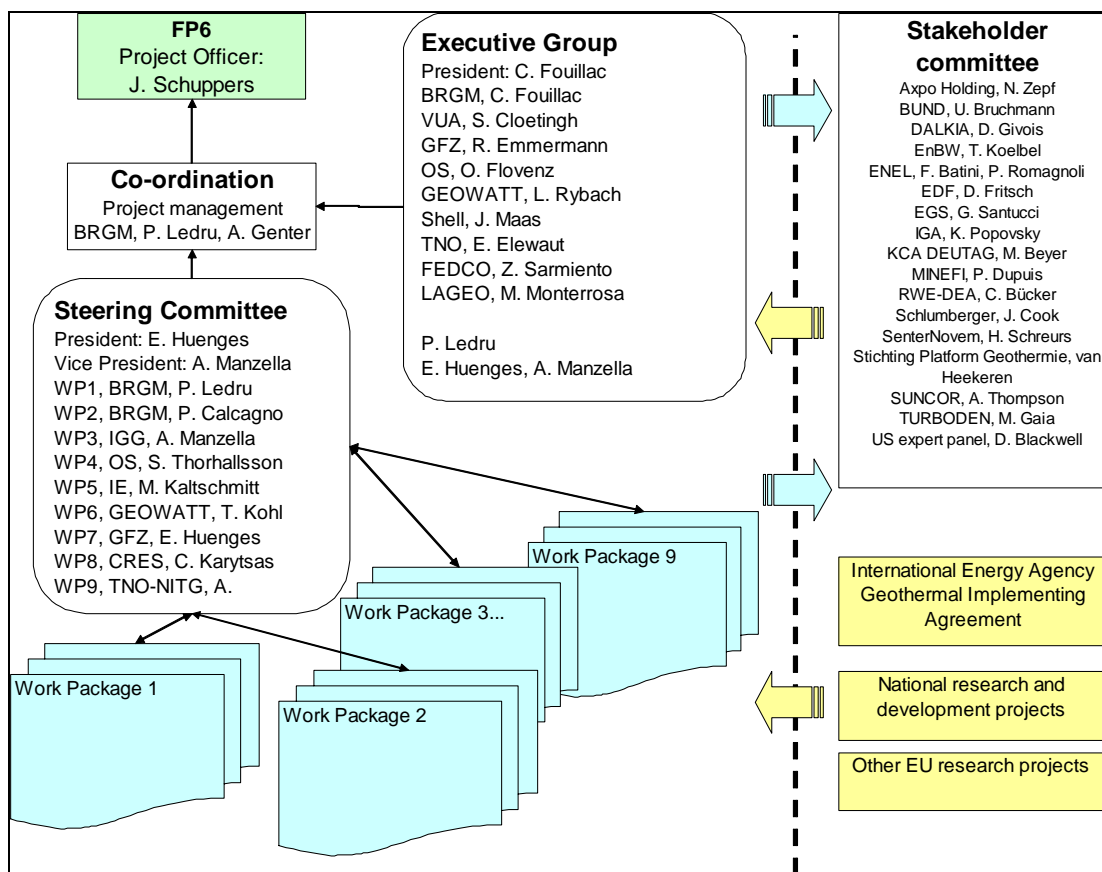


Figure 4: Management structure of the project

1.1.3. Work performed and results achieved so far

By mid-term, the project has organised 2 conferences and 3 specialised workshops, following what was defined in the work plan. CD-Roms and Newsletters have disseminated information resulting from each meeting and the web site <http://engine.brgm.fr> has had a constant growth of visits. All presentations, abstracts and articles can be downloaded from the web site through an appropriate software (INDICO) developed for management of conferences and workshops.

As an introduction to the main sessions of the mid term conference, work package leaders will present the main outcomes of the meetings and specialised workshops and from some elaborated synthesis (see <http://conferences-engine.brgm.fr/conferenceDisplay.py?confld=4>). These documents already provide a framework for some of the R&D issues that will result from the ENGINE project.

Several points about the impact of the Coordination Action have already been emphasized, such as the interest of partners to share their knowledge and practices, the progressive broadening of the community participating to these meetings and the definition of R&D's stakes for developing unconventional geothermal resources. The close and frequent relationship and exchanges between partners belonging to the conventional geothermal community and partner representing European EGS pioneers was also a major element of success for the meetings hold during the first year of ENGINE. A new step is also expected from the extension of the network to 4 new partners from Targeted Third Countries, i.e. Mexico, Salvador and Philippines. The settlement of a stakeholder committee is a next step in order to enhance links between R&D teams and stakeholders by providing strategic guidance to the Executive Group and to Contractors in general. This will coincide with the official start of the expert groups in charge of defining the best practices and priorities for research investment.

1.1.4. Intention for use and impact

The main potential impact expected from the Co-ordination Action is to re-establish the institutional and political support that is currently lacking to ensure that geothermal energy reaches its full efficiency and profitability thresholds at European scale. It is first of all necessary to structure the geothermal-energy community towards the definition of innovative research projects. The emergence of such projects requires a capitalisation of the knowledge of the different actors currently playing in the "geothermal field", which implies sharing experiences, exchanging best practices and clearly identifying the gaps and barriers. The expected impact of this Co-ordination Action is that a large scientific research community will be mobilised that is able to promote such spin-off projects with industrial partners. The Co-ordination Action also intends to play a "transmission role" and constitute an exchange platform. It will provide an opportunity to integrate and synthesise all information about know how, practices, innovations and barriers at the level of the Steering Committee and Expert Groups. This will be particularly helpful during discussions with Executive Directors of international funding agencies or National Policy makers.

1.1.5. Plan for using and disseminating knowledge

The knowledge acquired during through this Co-ordination Action will be disseminated and made available through the information and publication systems, and should arise the interest of other potential scientific and industrial partners. This dissemination will also contribute to the transfer of knowledge towards those requiring more information about the technical and socio-economic know-how for building up the geothermal industry, especially in

Central and Eastern Europe. This could speed up the exploitation of both conventional and unconventional geothermal resources in these countries and thus contribute considerably to the short- and long-term goals of the EU to reduce carbon dioxide emissions by increasing the share of renewable energy.

1.2. SECTION 1 – PROJECT OBJECTIVES AND MAJOR ACHIEVEMENTS DURING THE REPORTING PERIOD

By exploring Unconventional Geothermal Resources, research and development institutes face:

- a scientific challenge to understand the distribution of heat and permeability at depth in the uppermost crust. High amplitude and small wavelength anomalies, related to local high conductivity layers or highly radioactive sources, may develop on the large wavelength thermal anomalies and present a great interest for assessment of reservoirs for Hot Dry Rock energy systems.
- a technological and economic challenge to improve and render cost-efficient investigation and development technology in order to make these geothermal systems viable.
- a communication challenge to rally the support of policy makers and investors and, in certain cases, increase the social acceptance of a broader community.
- a challenge to integrate the different, yet parallel, research paths that currently exist, namely one for investigation and resource assessment and another for sustainable exploitation schemes, one for Hot Dry Rocks and another for High Energy Systems.

The Co-ordination Action, called “Enhanced Geothermal Innovative Network for Europe” (ENGINE) has been proposed in this framework. It has for main objective the co-ordination of the present research and development initiatives for Unconventional Geothermal Resources and Enhanced Geothermal Systems, from resource investigation and assessment stage through to exploitation monitoring and will provide (1) an updated framework of activities concerning geothermal energy in Europe, including the integration of scientific and technical know-how and practices, the evaluation of socio-economic and environmental impacts; (2) the definition of innovative concepts for investigation and use of Unconventional Geothermal Resources and Enhanced Geothermal Systems; groups of experts will present a “Best Practice Handbook”; (3) a scientific and technical “European Reference Manual” including the information and dissemination systems developed during the Co-ordination Action. The links established between research and development teams, national development programmes, industrial partners and international agencies will be used to promote the geothermal energy as a major renewable and sustainable source of energy and to propose innovative high-level medium- to longer-term research projects

The Co-ordination Action will provide an updated framework of activity that will co-ordinate currently scattered research and propose spin-off projects and new targets for investigation, assessment and exploitation. Its main objectives are

- to motivate the scientific community to face up to the above-mentioned challenges,
- to capitalise the know-how acquired in the framework of the Hot Dry Rocks Soultz experiment but also from the exploration and exploitation of Italy, Bouillante and Iceland geothermal fields,
- to define new integrated projects that will federate the scientific community working in the “geothermal field”, in partnership with industry, in order to achieve the strategic objectives of the European Community.

To promote an efficient network of geothermal activities, the Co-ordination Action will define, organise and manage joint and common initiatives through :

- an Integration Phase, i.e. a bottom-up and federative strategy aimed at providing an updated framework of activities concerning geothermal energy in Europe and developing

motivation within the scientific and technical community by exchanging experiences and sharing practices;

- a Synthesis Phase; i.e. an expertise strategy for defining the best practices and priorities for research investment. The expert groups will perform specific studies and strengthen links between the geothermal community and financial and political institutions.

For the reporting period, the main objectives were concerning the integration phase. During this phase of the Co-ordination Action, the state-of-the-art is assessed in order to identify and analyse the practices, the concepts applied for exploring Unconventional geothermal Resources, as well as the main gaps in knowledge and/or technology. Each Workpackage is supervised by one leader that is member of the Steering Committee.

The integration is performed according to the following guidelines.

- The setting up of a common information system including an original collaborative platform Web site and an electronic newsletter in order to exchange and share information. All presentations, abstracts and articles can be downloaded from the web site through an appropriate software (INDICO) developed for management of conferences and workshops.
- Organisation of two conferences (launching and mid-term) on Unconventional Geothermal Resource, common for all Workpackages, and 3 specialised workshops. Abstract book, CD-Roms and Newsletters have disseminated information resulting from each meeting and the web site <http://engine.brgm.fr> has had a constant growth of visits. Applications for additional funding have been successfully supported by the Co-ordination Action to support the organisation of the launching conference in Orléans.
- The work of past and present IEA-GIA international groups has started to be integrated within the tasks of the Workpackages, by direct representation of the ENGINE experts in these groups and meetings (T. Megel, L. Rybach, P. Ledru, R. Baria...). Of particular interest are the GIA Annexes I on “Environmental impacts of geothermal energy development” and III on “Enhanced Geothermal Systems”. Thus, valuable experience from the international community will be integrated more and more integrated within the ENGINE project as the BRGM, coordinator of the project will represent France within the IEA-GIA group from 2007.
- The exchange of personnel will be favoured as this is a highly efficient way of sharing experience, disseminating best practices and integrating information from different sources. Thus, a researcher from Amsterdam University (partner) has spent 6 months in GFZ Potsdam (Partner 3) for connecting different approaches of heat flow modelling.
- Definition of a policy to encourage the publication of the state-of-the-art, compilations and the results of studies and analyses performed during the Co-ordination Action. The conferences and workshop are dedicated to this aim. Since the very beginning, the focus has been on the quality of the organisation of the meetings. By mid-term, the project has organised 2 conferences and 3 specialised workshops, following what was defined in the work plan. CD-Roms and Newsletters have disseminated information resulting from each meeting and the web site <http://engine.brgm.fr> has had a constant growth of visits. All presentations, abstracts and articles can be downloaded from the web site through an appropriate software (INDICO) developed for management of conferences and workshops. As an introduction to the main sessions of the mid term conference, work package leaders will present the main outcomes of the meetings and specialised workshops and from some elaborated synthesis (see <http://conferences-engine.brgm.fr/conferenceDisplay.py?confid=4>). These documents already provide a framework for some of the R&D issues that will result from the ENGINE project.
- Informal meetings and contacts spontaneously organised between a limited number of partners and participants
- Information of all institutes that have expressed interest to be associated to this Co-ordination Action (more than 20) so that they can join the conferences and specialised workshops on their own funds or be associated as sub-contractors if necessary. Each

ENGINE meeting attracts participants that are not officially members of the network, some of them from non European countries. Thus, the second workshop, held in Strasbourg (14-16 September 2006) gathered together more than 57 participants, representing 15 countries. One of the particular aspects of this meeting was the participation of 10 private companies that are not ENGINE partners, but who wanted to benefit from the audience provided by the co-ordination action to present their results and projects. Such a meeting constitutes an exceptional opportunity to develop new contacts with industry and stakeholders that are concerned by the scope of the project.

Several facts have already revealed the positive impact of the Coordination Action. As mentioned above, the interest of partners to share their knowledge and practices, the progressive broadening of the community participating to these meetings and the definition of R&D's stakes for developing unconventional geothermal resources has shown the strong motivation to face up the scientific and technical challenges. The close and frequent relationship and exchanges between partners belonging to the conventional geothermal community and partner representing European EGS pioneers was also a major element of success for the meetings hold during the first year of ENGINE. The settlement of a stakeholder committee is a next step in order to enhance links between R&D teams and stakeholders by providing strategic guidance to the Executive Group and to Contractors in general. The composition of this group is given in Table 2. The first meeting of this stakeholder committee will coincide with the official start of the expert groups in charge of defining the best practices and priorities for research investment.

Name	Address	Telephone	Cell phone	Fax
BÜCKER Christian (Dr)	RWE-DEA AG Überseering 40 22297 Hamburg GERMANY	00 49 40 6375 2486	00 491622732486	00 49 40 6375 3590
COOK John (Dr)	Schlumberger Research Cambridge High Cross Madingley Road CB3 OEL Cambridge UK	0 44 1223.315.576		0 44 1223 327 019
BRUCHMANN Ullrich	Bundesministerium für Umwelt Naturschutz und Reaktorsicherheit Alexanderplatz 6 10178 Berlin GERMANY	01888 / 305-3621 +49 30 28550 2241		01888 / 305-3629/4375 +49 30 28550 2299
BEYER, Silke WERUM	Drilling Company KCA DEUTAG Drilling GmbH Deilmannstrasse 1 48445 Bad Bentheim GERMANY	00 49 5922 72 338		00 49 5922 72 123
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ZEPP Niklaus	Leiter Corporate Development Axpo Holding Parkstrasse 23 Postfach CH-5401 Baden SUISSE	00 41 56 200 31 71 056/200 3170 (intern 933 31 70) F 056/200 3175 M 079/423 28 28	0041 79 746 71 18	0041 56 200 31 75

Table 2. Composition of the stakeholder committee

The development of links with international funding agencies and associations constitute an objective of ENGINE. In this context, several initiatives have been taken:

- The European Community has offered possibilities to associate new partners from third countries with ongoing projects through INCO (International cooperation). This opportunity has been successfully taken up by inviting research institutes and private firms that have experience in stimulation of natural or provoked reservoirs in geothermal fields to join the consortium. This will be the case for Filtech Energy Drilling Corporation (Philippines), Instituto de Investigaciones Eléctrica (IIE, Mexico), Centro de Investigación Científica y Educación Superior de Ensenada (CICESE, Mexico), and LaGeo S.A. de C.V. (El Salvador) after negotiations before 13 October.
- The Executive Group is presently developing links with international agencies. Thus, L. Rybach, C. Fouillac and the co-ordinator have intended an action, supported by the President of the BRGM, P. Vesseron, to facilitate the adherence of France to the International Energy Agency-Geothermal Implementing Agreement (IEA-GIA) and to nominate the co-ordinator of the ENGINE project as France's Representative within this committee. The request is presently being processed by the ministry and a positive reply is expected within the next few weeks. The co-ordinator has already participated in the IEA-GIA's Executive Committee meeting in Paris (March 2006) and in San Diego (September 2006).
- ENGINE was presented at the Geothermal Research Council 2006 Annual Meeting. A session dedicated to EGS feasibility was chaired by J. Tester, president of a MIT-led interdisciplinary panel (see summary in Annex 2). Among others, it is recommended that the US should actively participate in ongoing international field projects, such as the EU project at Soultz (France). Taking this opportunity, the co-ordinator has proposed to the chairman a presentation of the main findings and recommendations during the ENGINE mid-term conference in January 2007.
- The ENGINE coordinator has been invited as an EU expert to participate to the meeting for an evaluation of the context for the international cooperation with Latin America. Several key issues have been identified on which the partnership between EU and LAC should be highly profitable for the development of geothermal energy and has been included in the final report (Table 3).

It can be considered that these initiatives, along with the information system of the project and the actions of the Executive Group and Steering Committee, have already made the ENGINE project visible and sparked at least the interest of the international community.

No important problems have been recorded during the period.

Identified key issues	Opportunities	Points of common interest	Proposed actions
Development of geothermal energy requires the undertaking of short-term projects demonstrating the use of cost-efficient geothermal energy (low-to-medium enthalpy, cooling and heating by GHP, etc.)	Exploration of resources, high potential in Chile, Bolivia, Nicaragua, El Salvador, Mexico, Costa Rica	Development of geothermal fields Promotion of existing methodologies for low-to-medium enthalpy, cooling and heating by GHP.	Co-ordination action Know-how transfer and development of links with industrial partners
Development of geothermal energy also requires medium-to-long-term projects that concern Enhanced Geothermal Systems. The Soultz experiment is considered as the international reference by Australian investors and American scientists for whom EGS is one of the few renewable energies that can provide continuous base-load power.	Interest of Chile Existing case histories and international projects (EGS Soultz, Basel, etc., stimulation methods from the Berlin field in El Salvador, Bouillante in Guadalupe, Larderello in Italy...)	The extension of existing geothermal fields	Research and development projects
The potential of geothermal recovery from oil and gas fields has been unexplored until now and has a relatively low-risk	Numerous existing oil and gas fields in Latin America	Identification of the potential of geothermal recovery from oil and gas fields is a key issue for the development of EGS	Research and development projects Specific International Cooperation Action
The co-ordination of such short- and long-term projects requires a well organised scientific community at international level, restored political support and good links with industry and stakeholders	Organisation of workshops and participation in existing international projects	The need for political support	Co-ordination action

Table 3. Proposal of international cooperation of EU with Latin America for geothermal energy

1.3. SECTION 2 - WORKPACKAGE PROGRESS OF THE PERIOD

For each active workpackage, an overview of the actions carried out in the reporting period is provided.

Workpackage number	2	Start date or starting event:					t1
Activity type	Co-ordination activity						
Participant ID	1 BRGM	3 GFZ	8 IGG	15 IGGL	23 GEUS	24 UOR	29 GEOWATT
Person-months per participant:	6	4	1	2	2	6	2

Objectives, Information and dissemination System

The setting up of the information system of the Co-ordination Action is a very important objective as it will play a major role in the exchange and dissemination of data, good practices and standards. As publications will be the main deliverable, the publication system is also indicated as a main item of the Co-ordination Action.

The breakdown of Workpackage 2 is as follow:

2.1. The information system

- 2.1.1. General information
- 2.1.2. Training and education
- 2.1.3. On-line reports and results, publications
- 2.1.4. Data and metadata base, models, open-source software

2.2. The publication system

- 2.2.1. Scientific publications (peer-review journals, proceedings of conferences and meetings, on-line on the Web site)
- 2.2.2. Reports (open file or with access restricted to Co-ordination Action members)

2.3. The dissemination system

- 2.3.1. The Web site and the electronic monthly newsletter of the Co-ordination Action
- 2.3.2. Connection to scientific Web site for dissemination of international scientific news
- 2.3.3. Participation to the national and international debates about sustainable development and renewable energy
- 2.3.4. General scientific dissemination (multimedia programmes, articles and information brochures)
- 2.3.5. Public relation through press releases and media contacts

Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved

The Information and Dissemination System led by P. Calcagno (p.calcagno@brgm.fr, BRGM) play a major role in the exchange and dissemination of information, data, good practices and standards within the Co-ordination Action. The WP2 work package intends to be the vector to share and to promote the action of the ENGINE community towards institutions, funding agencies and citizens.

In order to enhance the communication among the partners, a WP2 delegate was nominated by every work package leader: Catalina Mayorga (mayorga@igg.cnr.it, IGG) for WP3, Brynja Jonsdottir (brj@isor.is, ISOR) for WP4, Stephanie Frick (Stephanie.Frick@ie-leipzig.de, IE) for WP5, Clément Baujard (baujard@geowatt.ch, GEOWATT AG) for WP6, Angela Spalek (spalek@gfz-potsdam.de, GFZ) for WP7, George Lemonis (glemon@cres.gr, CRES) for WP8, Erik Simmelink (Erik.Simmelink@tno.nl, TNO) for WP9.

The following presents the progress of WP2 and the deliverables produced.

Preparation of the scientific and technical activity

The organization of the WP2 activity was presented by BRGM and discussed with the work package leaders during the [kick-off meeting of the Co-ordination Action \(Potsdam, Germany, 10-11/11/2005\)](#):

WP2 goals and deliverables (see ENGINE [Annex 1 - "Description of the Work" document](#))

ENGINE logo. Among several propositions the logo chosen is



ENGINE Web site. A provisional Web site for ENGINE was presented (**Deliverable n°3**, see 2. for details).

Conferences and workshops management. A review of the existing Internet tools was performed. The work package leaders accepted the Indico solution (see 3. for details).

Publication policy (see 4. for details)

The preparation of the scientific and technical activity was updated and presented during the [Launching Conference \(Orléans, France, 12-15/02/2006\)](#): [The information system of the ENGINE co-ordination action \(Calcagno and Ledru\)](#) (**Deliverable n°4**). Two special WP2 sessions were organized during the Launching conference ([13](#) and [15/02/2006](#)) to present and discuss the scientific and technical activity with the WP2 partners (see also 3.). A [special WP2 meeting \(Potsdam, Germany, 10-11/11/2006\)](#) was organized to sum up the progress of WP2 activity and plan the next steps (see also 3.).

Organisation and maintenance of the Web site (<http://engine.brgm.fr>)

The [ENGINE Web site](#) is designed to be the place where the ENGINE production is shared among the partner, related and public audience. It will be refined and completed during the Co-ordination Action to become a reference knowledge base on the Internet. It presents the [ENGINE Co-ordination Action](#), [partners activities](#), [press releases](#), [newsletters](#) (**Deliverable n°3**, see also 4.), [reference documents](#) and [links](#). Indico, a meetings management tool, allows work packages to organize the [conferences and workshops](#) they are in charge by using a dedicated part of the Web site (see 3. for details). A section of the Web site aims at [sharing restricted access to the partners](#) for implementing and exchanging documents by using eProjet. The Web site also uses RefShare from Refworks for displaying and exporting [ENGINE bibliography](#) including partners' EGS related papers and forthcoming ENGINE papers (**Deliverable n°8**). A section dedicated to EGS lighthouse project in Europe will be available soon (see 5. for details). A section dealing with the promotion of the geothermal energy through education and training will also be included in the ENGINE Web site (see 5. for details).

The Web site is fully managed by BRGM. The Web site <http://engine.brgm.fr> is hosted by BRGM except for Indico and RefShare. The respective hosts provide maintenance under BRGM control. The main sections of the ENGINE Web can be browse from the homepage or directly displayed by using the following links:

<http://engine.brgm.fr/beginners.asp> for general presentation

<http://engine.brgm.fr/partners.asp> for partners activities

<http://engine.brgm.fr/PressReleases.asp> for press releases

<http://engine.brgm.fr/newsletters.asp> for newsletters (**Deliverable n°3**, see also 4.)

<http://engine.brgm.fr/ref.asp> for reference documents

<http://engine.brgm.fr/Links.asp> for links

<http://conferences-engine.brgm.fr> for meetings management with Indico (see 3. for details, hosted by Ariantis)

<https://eprojet.brgm.fr/engine.htm> for sharing documents among the partners with eProjet (restricted access, hosted by BRGM using a commercial license, <http://www.egroupgen.com/en>)

<http://www.refworks.com/refshare/?site=016641120201200000/RWWS2A541197/001401154504508000> for ENGINE bibliography (**Deliverable n°8**) hosted by Refworks (<http://www.refworks.com>, BRGM uses a commercial license).

Meetings management (<http://conferences-engine.brgm.fr>)

One of the goals of the ENGINE Co-ordination Action is to organize conferences and workshops. BRGM provides tools and methodologies to the work packages for managing the 3 conferences and 7 workshops

of the project. The main need was a unique tool allowing by using the Internet to

- Find out past and future meetings
- Register for a meeting
- Submit abstract
- Review proposed abstracts by organizers
- Upload material (slides, papers, posters, etc.)
- Access the proceedings (abstracts and material) of past meetings

[Indico \(Integrated Digital COnference\)](#) solution was chosen during the ENGINE kick-off meeting as it

- Meets the requirements
- Was born from a EU funded project (2002-2004, IST-2001-34306)
- Uses an open-source GNU GPL licence
- Is still developed and maintained at [CERN](#) and in production at [different places](#)

Apart from the Internet organizing tool, BRGM helps the work packages to manage paper documentations and CD containing information and material of their meeting by defining the ENGINE publication policy (see 4. for details).

The following meetings have been organized during the reporting period:

[Kick-off meeting \(Potsdam, Germany, 10-11/11/2006\)](#) organized by GFZ. See the Web pages of the kick-off meeting at <http://conferences-engine.brgm.fr/conferenceDisplay.py?confId=10>

[Launching Conference \(Orléans, France, 12-15/02/2006\)](#) organized by BRGM. The book of abstract and the CD of the meeting are appended to this report. The Web pages of the conference are available at <http://conferences-engine.brgm.fr/conferenceDisplay.py?confId=0>

[A special meeting for WP2 and WP3 \(Potsdam, Germany, 10-11/11/2006\)](#) organized by GFZ. See <http://conferences-engine.brgm.fr/conferenceDisplay.py?confId=11> for the Web pages of the special meeting.

[Workshop 3 "Stimulation of reservoir and induced microseismicity" \(Ittingen, Switzerland, 29/06-01/07/2006\)](#) organized by GEOWATT AG. The book of abstract and the CD of the meeting are appended to this report. See <http://conferences-engine.brgm.fr/conferenceDisplay.py?confId=3> for the Web pages of the workshop.

[Workshop 5 "Electricity generation from Enhanced Geothermal Systems" \(Strasbourg, France, 14-16/09/2006\)](#) organized by IE and BRGM. The book of abstract and the CD of the meeting are appended to this report. The Web pages of workshop are available at <http://conferences-engine.brgm.fr/conferenceDisplay.py?confId=6>

Follow-up of the publications

As publications will be the main deliverable, the publication system is indicated as a main item of the Co-ordination Action. Contents of the publications are managed by the work packages but WP2 defines a publication policy in order to ensure a coherent look of the ENGINE production. For the reporting period, the publication policy focussed on:

[Bibliography of the partners' papers related to EGS \(Deliverable n°8\)](#). BRGM provides RefShare to manage the bibliography (see also 2.).

[Newsletters](#) to report about project activities to partners and related (*Deliverable n°3*, see also 2.). BRGM provides a template and manage the edition of newsletters. The 4 issues that came out during the reporting period ([January](#), [April](#), [August](#) and [October](#) 2006) are appended to this report.

Minutes of the [Executive Group](#) and the [Steering Committee](#) meetings to report about the project management. BRGM provides a template and manage the edition of the minutes. The minutes are referenced by BRGM to easily retrieve them.

Conferences and workshops electronic and paper material. BRGM provides Indico to manage the contents of the meetings (see also 2. and 3.). BRGM also prepared templates for the book of abstracts, programme, list of participants and CD of a meeting. The proceedings CD is an off-line version of the meeting Web pages generated by Indico including the material (slides, papers, posters, etc.). ISSN and ISBN numbers provided by the Bibliothèque Nationale de France (French National Library) reference the

CDs in order to easily retrieve them. Books of abstracts and CDs edited for the conference and workshops of the reporting period are appended to this report.

Dissemination and Education

A special attention is given to dissemination in order to strengthen the position of the geothermal energy among the other renewable energies. The main vector is the Web site that is dedicated to ENGINE partners, related and public audience. Newsletters play as well an important role in disseminating information (**Deliverable n°3**, see 2. and 4.). Every issue is sent to ENGINE partners and related and can be displayed by public on the Web site.

The experience of IGG was presented at the [Launching Conference \(Orléans, France, 12-15/02/2006\)](#) by Adele Manzella (manzella@igg.cnr.it, IGG): [Information and dissemination of knowledge in the field of geothermal energy](#). This review sump up the tools used in geothermal communities to promote and disseminate the knowledge in terms for scientists, stakeholders, media and large public. Another presentation by non-ENGINE partner Christian Boissavy (c.boissavy@geopetrol.mc, Geopetrol) added information on that topic from the European Federation of Geologists: [Capacity to Promote Geothermal Energy](#).

During the ENGINE steering committee and WP2 meeting in Potsdam (27/04/2006, [minutes](#)), it has been asked to Anders Mathiesen (anm@geus.dk, GEUS) to compile the lighthouse geothermal projects in Europe. He prepared a questionnaire that will be sent to the leaders of the main projects (Soultz, Basel, Larderello, Bouillante, etc.). The compilation will be completed with the help of Marcel Rosca (mrosca@uoradea.ro, UOR). The results will be presented at the [Mid-Term Conference \(Potsdam, Germany, 10-12 January 2007\)](#) and displayed on the Web site in order to promote geothermal energy. A prototype, done for the Bouillante project, is available at <http://engine.brgm.fr/PartnersReleases.asp>. The questionnaire is appended to this report.

Training and Education is an important objective of the Co-ordination Action. Marcel Rosca (mrosca@uoradea.ro, UOR) presented a state of the art of the existing education centres and degree courses in Europe during the [Launching Conference \(Orléans, France, 12-15/02/2006\)](#): [Promotion of the geothermal energy through education and training](#). An updated version will be presented by UOR at the [Mid-Term Conference \(Potsdam, Germany, 10-12 January 2007\)](#) combined with a review of what is missing concerning EGS in Europe and how it has been solved in other continents (America, Australia, etc.). The final step will be a proposition for an integrated route for students in Europe and guidelines for the creation of a European centre dedicated to geothermal education to be presented during the [Final Conference \(Vilnius, Lithuania, 13-14 February 2008\)](#). In parallel, the results of this work will be presented on the Web site.

Deviations from the project workprogramme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved

No deviation from the project workprogramme has to be mentioned for the reporting period. 3 adaptations can be reported:

- A change in the dates of the workshop 1 occurred without affecting the project progress.
- Newsletter issuing was originally scheduled every month. The project progress shown that the newsletter is more efficient if issued between the ENGINE meetings. The periodicity of the newsletters depends on the dates of the meetings but the average is about an issue every second month.
- As the contents of the Web site evolve with the project progress (meetings organization, bibliography, ENGINE papers, etc.), the finalized version of the Web site will be available at the end of the Co-ordination action (March 2008). However, a particular attention is and will be paid to maintain the Web site up-to-date.

Table 4a: Deliverables List

Del n°	Deliverable name	WP n°	Date due	Actual/Forecast delivery date	Lead contractor
3	A provisional Web site and an electronic monthly newsletter	2	t3	10/11/2005 (see 1.,	1

				2., 4. and 5. upper)	
4	Presentation and documentation of the provisional Web site and of the perspective of the information system at the Launching conference, Session 2	2	t3	15/02/2006 (see 1. upper)	1
5	Proceedings of the Mid term conference, Session 2. Information and Dissemination System	2	t14	February 2007	1
6	Proceedings of the Final conference, Session 2. Information and Dissemination System	2	t25	March 2008	1
7	A finalised Web site and an Information System (including an electronic monthly newsletter)	2	t14	March 2008	1
8	The bibliography of the Co-ordination Action	2	t14	Partly done, to be completed by the end of the project (see 2. and 4. upper)	1

Documents appended to the report:

- Book of abstracts of the Launching Conference (Orléans, France, 12-15/02/2006) online available at <http://conferences-engine.brgm.fr/getFile.py/access?resId=2&materialId=5&confId=0>
- Book of abstracts of the Workshop 3 “Stimulation of reservoir and induced microseismicity” (Ittingen , Switzerland, 29/06-01/07/2006) online available at <http://conferences-engine.brgm.fr/getFile.py/access?resId=5&materialId=9&confId=3>
- Book of abstracts of the Workshop 5 “Electricity generation from Enhanced Geothermal Systems” (Strasbourg, France, 14-16/09/2006) online available at <http://conferences-engine.brgm.fr/getFile.py/access?resId=2&materialId=9&confId=6>
- CD of the Launching Conference (Orléans, France, 12-15/02/2006) ISBN 978-2-7159-2984-5. Orleans, BRGM Editions. Collection Actes/Proceedings. ISSN 1773-6161.
- CD of the Workshop Workshop 3 “Stimulation of reservoir and induced microseismicity” (Ittingen , Switzerland, 29/06-01/07/2006) ISBN 978-2-7159-0993-9. Orleans, BRGM Editions. Collection Actes/Proceedings. ISSN 1773-6161.
- CD of the Workshop 5 “Electricity generation from Enhanced Geothermal Systems” (Strasbourg, France, 14-16/09/2006) ISBN 978-2-7159-0992-2. Orleans, BRGM Editions. Collection Actes/Proceedings. ISSN 1773-6161.
- Newsletter #1 January 2006 online available at http://engine.brgm.fr/bulletins/ENGINE_Newsletter1_012006.pdf
- Newsletter #2 April 2006 online available at http://engine.brgm.fr/bulletins/ENGINE_Newsletter2_042006.pdf
- Newsletter #3 August 2006 online available at http://engine.brgm.fr/bulletins/ENGINE_Newsletter3_082006.pdf
- Newsletter #4 October 2006 online available at http://engine.brgm.fr/bulletins/ENGINE_Newsletter4_102006.pdf

Workpackage number	3			Start date or starting event:	t1									
Activity type	Co-ordination activity													
Participant ID	1	3	5	8	11	12	13	14	15	16	17	18	22	25
Person-months per participant:	4	4	1	6	3	3	1	1	4	2	3	3	3	6

Objectives, Investigation of Unconventional Geothermal Resources and EGS

The objective of Workpackage 3 is to integrate scientific and technical know-how and practices related to the investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.

The breakdown of Workpackage 3 is following the main scientific issues:

- 3.1 *Integration of recent progress in knowledge concerning the European lithosphere*
- 3.2 *Mechanical behaviour of the upper crust and its response to stress, fluid circulation and heat-flow gradients*
- 3.3 *Exploring different types of geothermal reservoir*
 - 3.3.1 High-energy geothermal fields (active/recent volcanism and peripheral zones)
 - 3.3.2 High-temperature / low-permeability reservoirs (hot dry rocks)
 - 3.3.3 New deep, and possibly supercritical, geothermal reservoirs
 - 3.3.4 Multipurpose geothermal reservoirs
- 3.4 *Technological challenge of the investigation phase*
 - 3.4.1 Improved exploration methods for deep geothermal resources
 - 3.4.2 Combined geological and geophysical imaging methods for defining and assessing reservoirs for potential heat exchange
 - 3.4.3 3D modelling and imaging of permeable systems

For each of the above, the state-of-the-art must be established in order to identify and analyse the best practices to be adopted, the innovative concepts to be applied or developed, as well as the main gaps in knowledge and/or technology.

Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved

Three meetings took place with all partners involved in the WP3, including the WP6 leader that will lead the expert group on the same topic after the mid-term conference: 2 meetings were organized during the Launching Conference in Orléans (13 and 15 February 2006), 1 in Potsdam on April 2006. The organization of activity was discussed during these meetings and the related minutes were sent to all participants and listed as available documents on the website. Each partner institution defined a representative and the WP leader remained in contact with them. The institutions provided lists of people, expertise, laboratories and papers related to WP3, as requested.

A list of actions, i.e. activity requested and to be performed in defined period, was also sent to the partners. Most of the documents requested have been received, and will be the base for preparing both the review presentation to the conferences (Deliverables 10-11) and the review papers (Deliverables 14-17). Moreover they will contribute to Deliverable 19 (Reports of study and analysis).

Workshop 1 has been held in Potsdam on 8-10 November. 68 participants attended representing 15 partners of the network and 13 countries. It is worth noting that participants representing 15 non-partner institutes attended to the workshop on their own funds. Priority has been given to discussion around posters followed by debate in plenary session. A synthesis has been prepared and presented for discussion during the closure session. It has been considered that this workshop has provided an excellent contribution toward the objectives of this workpackage.

Deviations from the project workprogramme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved

The only deviation from the planned activity has been the period of Workshop 1, which was foreseen to take place on April 2006 and took place instead on November 2006. WP3 is the workpackage with the highest number of person/month and participants, and April was considered too early to obtain the best from the workshop that was supposed to be the main occasion to present contribution for WP3. This way the partners participating to the workpackage had more time to meet, to discuss about the organization of the Workpackage, to coordinate their research a little better before providing their contribution to the Workshop. All other planned activity was achieved in due time.

Table 4b: Deliverables List

Del n°	Deliverable name	WP n°	Date due	Actual/Forecast delivery date	Lead contractor
9	Proceedings of the Launching conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.	3	t3	13-15 February 2006	8
10	Proceedings of the Mid term conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.	3	t14	t15	8
11	Proceedings of the Final conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.	3	t25	t25	8
12	Guide to the Workshop 1 "Defining, exploring, imaging and assessing reservoirs for potential heat exchange"	3	t6	8-10 November 2006	8
13	Guide to the Workshop 2 "Exploring Supercritical fluid reservoir: a new challenge for geothermal energy"	3	t18	t18	8
14	A Review article about recent progress in knowledge concerning the European lithosphere and the exploration of EGS	3	t25	t25	8
15	A review article about Mechanical behaviour of the upper crust and its response to stress, fluid circulation and heat-flow gradients	3	t25	t25	8
16	A review article about Exploring different types of geothermal reservoir	3	t25	t25	8
17	A review article about Technological challenge of the investigation phase	3	t25	t25	8
13	Guide to the Workshop 2 "Exploring Supercritical fluid reservoir: a new challenge for geothermal energy"	3	t18	t14	8
14	A Review article about recent progress in knowledge concerning the European lithosphere and the exploration of EGS	3	t25	t16	8
15	A review article about Mechanical behaviour of the upper crust and its response to stress, fluid circulation and heat-flow gradients	3	t25	t18	8
16	A review article about Exploring different types of geothermal reservoir	3	t25	t20	8
17	A review article about Technological challenge of the investigation phase	3	t25	t25	8
18	An inventory of database, maps and models concerning the distribution of heat within the upper crust	3	t25	t25	8
19	Reports of study and analysis	3	t25	t25	8
20	General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems	3	t25	t25	8

Table 5a: Milestones List

M. no	Milestone name	WP no.	Date due	Actual/Forecast delivery date	Lead contractor
4	Workshop 1	3	t6	8-10 November 2006	4
8	Workshop 2	3	t18	t18	8

Workpackage number	4			Start date or starting event:								t1					
Activity type	Co-ordination activity																
Participant ID	1	3	4	5	8	9	12	13	14	16	19	20	21	23	28	31	32
Person-months per participant:	3	3	6	1	2	1	2	3	1	4	2	2	2	2	3	3	3

Objectives, Drilling, stimulation and reservoir assessment

The objective of Workpackage 4 is to integrate scientific and technical know-how and practices related to the drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems.

The breakdown of Workpackage 4 is following the main scientific issues:

4.1 *Dynamics of the geothermal field, stimulation and reservoir assessment*

- 4.1.1 Stress pattern
- 4.1.2 Stimulation and improvement of the permeability of a geothermal field
- 4.1.3 Dynamics of the fissured horizons and induced microseismicity
- 4.1.4 Reservoir physics and physical properties of rocks and hydro fracturing group
- 4.1.5 Fluids, rock-fluid interaction, tracer and geochemistry, scaling factor

4.2 *Drilling*

- 4.2.1 Drilling cost effectiveness and feasibility of high-temperature drilling
- 4.2.2 Micro-drilling and laser drilling

For each of the above, the state-of-the-art must be established in order to identify and analyse the best practices to be adopted, the innovative concepts to be applied or developed, as well as the main gaps in knowledge and/or technology.

Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved

2 meetings were organized during the Launching Conference in Orléans (13 and 15 February 2006) with all partners involved in the WP4, including the WP7 leader that will lead the expert group on the same topic after the mid-term conference. These meetings were aimed at organising the work and preparing the first workshop of the ENGINE project. The Workshop 3: "Stimulation of reservoir and microseismicity" was organized from 29 June – 1st July 2006 in the Kartause Ittingen, a former monastery next to Zürich, Switzerland. The meeting was attended by a large number of scientists of the geothermal community; 52 registrants came from 12 countries and 4 continents. During the 2 days of the meeting, 3 sessions have been held with a total of 25 contributions.

The talks were mostly documented by Extended Abstracts (88 pages). The final contributions have been published in December 2006 on a CD-ROM. The sessions were grouped as "Review of stimulation techniques" (chaired by Ernst Huenges, GFZ), "Case studies on reservoir stimulation" (chaired by Sverrir Thorhallsson, ISOR) and "Reservoir characterization during stimulation" (chaired by Thomas Kohl, GEOWATT). The participants came from industry and universities, and the interaction between major companies such as Shell or TNO with institutions (BRGM, Tohoku University...) was found to be very fruitful.

The conference highlighted the importance of the in-situ stress-field. Examples from mechanical stimulations identified the hydraulic interactions in the coupled processes. Important microseismicity can be created and adequate measures need to be defined to reduce seismic hazard. Most important

contributions have been presented from SHELL, GEOWATT, GFZ et EEIG "Exploitation Minière de la Chaleur"

Deviations from the project work programme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved

No deviation from the project work programme has to be mentioned for the reporting period.

Table 4c: Deliverables List

Del n°	Deliverable name	WP n°	Date due	Actual/Forecast delivery date	Lead contractor
21	Proceedings of the Launching conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems	4	t3	13-15 February 2006	4
22	Proceedings of the Mid term conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems	4	t14		4
23	Proceedings of the Final conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems	4	t25		4
24	Guide to the Workshop 3 "Stimulation of reservoir and induced microseismicity"	4	t17	29 June–1 July 2006	4
25	Guide to the Workshop 4 "Drilling cost effectiveness and feasibility of high-temperature drilling "	4	t19		4
26	A review article about recent progress in knowledge concerning the Dynamics of the geothermal field	4	t25		4
27	A review article about Drilling	4	t25		4
28	Reports of study and analysis	4	t25		4
29	General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems	4	t25		4

Table 5b: Milestones List

M. no	Milestone name	WP no.	Date due	Actual/Forecast delivery date	Lead contractor
5	Workshop 3	4	t17	29 June–1 July 2006	4
9	Workshop 4	4	t19		4

Workpackage number	5		Start date or starting event:				t1							
Activity type	Co-ordination activity													
Participant ID	1	3	6	7	8	9	10	18	22	23	26	27	30	31
Person-months per participant:	2	3	1	3	1	5	6	4	3	2	3	3	5	1

1.3.1. Objectives, Exploitation, economic, environmental and social impacts

The objective of Workpackage 5 is to integrate scientific and technical know-how and practices related to the development and management of exploitation. It will also identify and analyse the environmental and socio-economic barriers that hamper the development of the geothermal industry.

The breakdown of Workpackage 5 is following the main scientific issues:

5.1. Exploitation

- 5.1.1. Unconventional exploitation systems
- 5.1.2. Development of innovative tools for exploitation
- 5.1.3. State-of-the-art of down-hole fluid treatments
- 5.1.4. Plant and reservoir monitoring
- 5.1.5. Re-injection

5.2. A global economic approach of geothermal energy

- 5.2.1. Sustainability of geothermal energy
- 5.2.2. Multiple integrated uses group
- 5.2.3. Socio-economic benefits of geothermal exploitations
- 5.2.4. Energy-economic placements

5.3. Environmental impacts

- 5.3.1. Barriers to development
- 5.3.2. Microseismicity and risk assessment related to stimulation and exploitation
- 5.3.3. Conditions for a 100% clean exploitation of geothermal energy

5.4. Increasing policy makers awareness and public acceptance

- 5.4.1. Building a network for political support
- 5.4.2. Societal needs and public requirement
- 5.4.3. Communication policy

For each of the above, the state-of-the-art must be established in order to identify and analyse the best practices to be adopted, the innovative concepts to be applied or developed, as well as the main gaps in knowledge and/or technology.

Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved

▪ During the first **work package meeting** at the launching conference 13 February 2006 the co-ordination and contribution of the attendant partners to the different deliverables and milestones has been defined according to the person months in Annex I:

Deliverable	Co-ordinator	Contributors
D30, Proceedings Launching Conf.	IE (10)	
D31, Proceedings Mid-term Conf.	IE (10)	
D32, Final Conf.	IE (10)	

D33, Guide to workshop 5	BRGM (1)	IE (10)
D34, Guide to workshop 6	CRES (18)	IE (10)
D35, Article about economics	ORME (30)	IE (10), GFZ (3), CFG (9), IVTRAN (26)
D36, Article about socio-economics	CFG (9)	IE (10), TNO (6), CRES (18), IGME (31)
D37, Article about environmental impacts	IE (10)	GFZ (3), PGI (22), CRES (18)
D38, Article about awareness and acceptance	CRES (18)	IE (10), TNO (6), BRGM (1)
D39-D41 Reports and general dissemination	all WP5 partners	all WP5 partners

All agreements have been written down as minutes and were approved.

Attending WP5 partners: BRGM (1), GFZ (3), TNO (6), CFG (9), IE (10), CRES (18), PGI (22), IVTRAN (26), ORME (30), IGME (31)

Absent WP5 partners: IGR (7), IGG (8), GEUS (23), JSC (27)

▪ **Workshop 5.** The location of workshop 5 was moved from Guadeloupe to Strasbourg in order to enable an easier access for speakers and participants. The workshop was organised by BRGM and IE. Over 20 speakers and 50 participants led to a successful meeting in September 2006. All respective material and presentations as well as a summary of the workshop have been put on the Engine-website; a CD containing the off-line version of the workshop website will be distributed by IE soon. During the workshop the **2nd work package meeting** took place.

Attending WP5 partners: BRGM (1), GFZ (3), TNO (6), CFG (9), IE (10), CRES (18), IGME (31), JSC (27)

Absent WP5 partners: IGR (7), IGG (8), GEUS (23), PGI (22), IVTRAN (26), ORME (30)

▪ **Article about economics.** The article was discussed during the 1st work package meeting at the launching conference. Supported by IE, ORME sent afterwards as agreed the outline of the article to all partners. The aim of the article was clarified by IE as a comparison between different European countries concerning their current situation of energy production from geothermal resources. Within this comparison power as well as heat production are addressed in order to analyze the driving respectively prohibiting forces. To get the needed contributions from the WP5 partners to this article, a questionnaire has been prepared by IE and sent to all partners. This questionnaire was filled out by CRES, IGR, IGG, JSC, CFG and IE. Because not all important information could be obtained to realise a European comparison, IE decided to gather further information also by contacts outside of ENGINE. Respective contacts have started to be established by IE.

▪ **Article about socio-economics/Article about non-technical barriers.** The article about socio-economic benefits was discussed for the first time during the 2nd work package meeting in Strasbourg. In agreement with the attending partners, the title was changed to non-technical barriers which are more appropriate to consider on a European scale. IE is co-ordinating this article. A questionnaire covering the non-technical barriers of different European countries has been prepared by IE and sent around to all partners. This questionnaire was filled out by IGR and IE, but also some information of the questionnaires for the economic approach covered this topic. A draft version of the article was presented during the **3rd work package meeting** at the mid-term conference.

Attending WP5 partners:, GFZ (3), TNO (6), IE (10), CRES (18), IGME (31), PGI (22)

Absent WP5 partners: BRGM (1), IGR (7), IGG (8), GEUS (23), IVTRAN (26), ORME (30), CFG (9), JSC (27)

▪ **Article about environmental impacts.** The article about environmental impacts will be co-ordinated by IE. Based on the paper authored by CRES “Environmental Impact of the Geothermal Industry” (see Launching Conference) and a study made for the Federal Ministry of Environment in Germany by IE this article will be composed. The partners are asked to provide further possible information about the environmental impacts of geothermal energy use.

▪ **Workshop 6.** Workshop 6 will be organised by CRES. The location of this workshop was moved to Athens in order to enable an easier access to speakers and presenters. During the 3rd work package meeting the possible workshop programme was discussed.

▪ **Article about awareness and acceptance.** This article will be co-ordinated by CRES. The article will be based on the experiences and information of workshop 6.

Reports of study and analysis. General reports of study and analysis have been provided by the WP5 partners CRES, IVTRAN, JSC, IGR, IGG and IE. These reports have been put on the shared space on the ENGINE site and are now accessible for all WP5 partners.

Deviations from the project work programme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved

Deviations from the project work programme are:

Workshop 5 was carried out in September 2006 instead of June 2006

Deliverable 36 about socio-economic benefits is - in agreement with all workpackage partners - changed to an article about non-technical barriers which are more appropriate to consider on a European scale.

Workshop 6 will be delayed to September 2007; the location was moved to Athens

As not all WP5 partners have either the expertise or the time to contribute to WP5 according to their person months it is suggested to either reorganise their contributions within the ENGINE project or totally cancel some person months of these partners scheduled for WP5. A partner with missing expertise for WP5 is IGME (31); partners not having participated in WP5 (no participation in WP-meetings and no answering to e-mails) or not having contributed according to their scheduled person months so far are: ORME (30), GEUS (23), CFG (9) and PGI (22).

Instead other partners contributed more than actually planned for WP5. It is suggested that these partners get more person months than scheduled in Annex I: IE (10).

Table 4d: Deliverables List

Del n°	Deliverable name	WP n°	Date due	Actual/Forecast delivery date	Lead contractor
30	Proceedings of the Launching conference, Session 5. Exploitation, economic, environmental and social impacts	5	t3	13-15 February 2006	10
31	Proceedings of the Mid term conference, Session 5. Exploitation, economic, environmental and social impacts	5	t14		10
32	Proceedings of the Final conference, Session 5. Exploitation, economic, environmental and social impacts	5	t25		10
33	Guide to the Workshop 5 "Electricity generation, combined heat and power"	5	t21	14-16 September 2006	10
34	Guide to the Workshop 6 "Increasing policy makers awareness and the public acceptance"	5	t10		10
35	An article about Economic approach of geothermal energy	5	t25		10
36	An article about Socio-economic benefits of geothermal exploitations	5	t25		10
37	An article about Environmental impacts	5	t25		10
38	An article about Increasing policy makers awareness and	5	t25		10

	public acceptance				
39	Reports of study and analysis	5	t25		10
40	General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about the development and management of exploitation	5	t25		10
41	General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about economic, environmental and social impacts	5	t25		10

Table 5c: Milestones List

MI n°	Milestone name	WP no.	Date due	Actual/Forecast delivery date	Lead contractor
6	Workshop 5	5	t21	14-16 September 2006	10
10	Workshop 6	5	t10		10

1.4. SECTION 3 – CONSORTIUM MANAGEMENT

This section presents the status of the project, its management and follow-up activities, including information on:

- Consortium management tasks and their achievement; problems which have occurred and how they were solved
- Contractors: Comments regarding contributions, changes in responsibilities and changes to consortium itself¹, if any. The schedule of the ENGINE coordination activity is presented in figure 5.

Other information about the ENGINE consortium management activities are presented within the periodic management report.

Workpackage number	1	Start date or starting event:	t1
Activity type	Management activity		
Participant ID	1		
Person-months per participant:	10		

Objectives, the project management

The objectives of the project management are (i) the preparation, start up and closure of the project administration and organisation, (ii) the reporting with the Authorities of the 6th Framework, (iii) the smooth and streamlined information flow within the consortium, (iv) the controlling duties of the project.

Progress towards objectives – tasks worked on and achievements made with reference to planned

¹ Changes to the consortium membership must be addressed in a specific request for an amendment to the contract

objectives, identify contractors involved

The management activity of the coordination action has mainly consisted in:

1. Preparation and start up of the project administration and organisation

- Settlement of administrative and organisation procedures in BRGM
- Preparation, negotiation and achievement of the Document work (29 November 2005)
- Preparation and achievement of the Consortium agreement
- Signature of the contract (6 February 2006)
- Transfer the pre-financing budget to all the partners (April 2006)
- Settlement of Executive Group and Steering Committee
- Support to work package leader for settlement of work package activities
- Organisation of the meetings of the Executive Group (11 November 2005, 13 February 2006) and Steering Committee (10 November 2005, 15 February, 27 April, 29 June, 8 November, 11 December 2006)
- Organisation of the Launching conference: 103 registered participants, involvement of 29 partners of the ENGINE network, participation of 15 non-partner research institutes, 46 presentations that can be downloaded from the [Website](#), 19 European countries represented, presentation of the other geothermal energy FP instruments (EGS Pilot Plant, I-GET, LOWBIN).
- Presentation of communications at the Launching conference:
 - o P. Vesseron, Welcome from the Chairman Philippe Vesseron - BRGM
 - o C. Fouillac, Geothermal energy and strategies to reduce greenhouse gas emissions
 - o P. Ledru, A. Genter, Why a co-ordination action about Enhanced Geothermal System?
- Contacts for the settlement of the Stakeholder Committee. A letter of invitation and a short list of possible members have been prepared. The first meeting is planned on the 10 January 2007 in Potsdam.
- Preparation of a synopsis of the project
- Preparation and achievement of the proposal for Targeted Third Countries extension of the network, negotiation of extension of the network after acceptance of the proposal (final version submitted 27 October 2006)
- Preparation and achievement of the intermediate report

Reporting with the Authorities of the 6th Framework

- Participation of Scientific Officer to the Executive Group
- Communication of the reports of the meetings of the Executive Group and Steering Committee and of the Newsletters
- Summary of the ongoing Coordination Action presented in the proposal for Targeted Third Countries extension of the network

Smooth and streamlined information flow within the consortium

- Preparation of reports of the meetings of the Executive Group and Steering Committee
- Conception of the Newsletters (January, April, August, October 2006)
- Distribution of all official documents (signed contracts and consortium agreement)

Controlling duties of the project

Promotion of the ENGINE coordination action at an international level (expenses were charged on ENGINE project for the scientific communication in San Diego, following authorization of the Project Officer, all other expenses being covered by the inviting institution or by other funds).

Invited speaker in international panels:

- P. Ledru. Renewable energy. Electricity generation and Direct use, Geothermy. EU workshop, Mexico city, Mexico, 26-27 September 2006
- P. Ledru. Climate change and resource depletion: geological answers. French-Serbian European Summer University, Belgrade, 22 October 2006

Scientific communication:

P. Ledru et al. ENhanced Geothermal Innovative Network for Europe (the ENGINE Co-ordination Action). GRC meeting, San Diego, USA, 11-13 September 2006.

Working group:

Information on ENGINE project and involvement of new TTC partners. IIE office, Cuernavaca, Mexico, 25 September 2006.

Executive Committee International Energy Agency, Geothermal Implementing agreement, IEA Headquarters, Paris, France, 16-17 March 2006

Executive Committee International Energy Agency, Geothermal Implementing agreement, San Diego, USA, 7-8 September 2006.

Presentation of the ENGINE project to Peter Reid from Petratherm (Australia) during an informal meeting in BRGM Orleans and a Soultz site visit on March 2006.

Deviations from the project workprogramme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved

A six months report was planned as the deliverable n°2. The preparation of this report has been delayed because of the busy agenda. Moreover, it was difficult to prepare this report after six months taking into account that the main activity, i.e. the workshops, just started after 6 months. The information of the Project Officer of the EU Commission has been done through streamlined information flow: reports of the meetings of the Executive Group (11 November 2005, 13 February 2006) and Steering Committee (10 November 2005, 15 February, 27 April, 29 June, 8 November, 11 December 2006), Newsletters (January, April, August, October 2006), summary of ongoing activities in the proposal for the extension of the ENGINE network to TTC. All these documents are available on the web-site. In case a report should be needed, an edition of all these documents will be done. Otherwise, this formal report will be considered as the deliverable n°2.

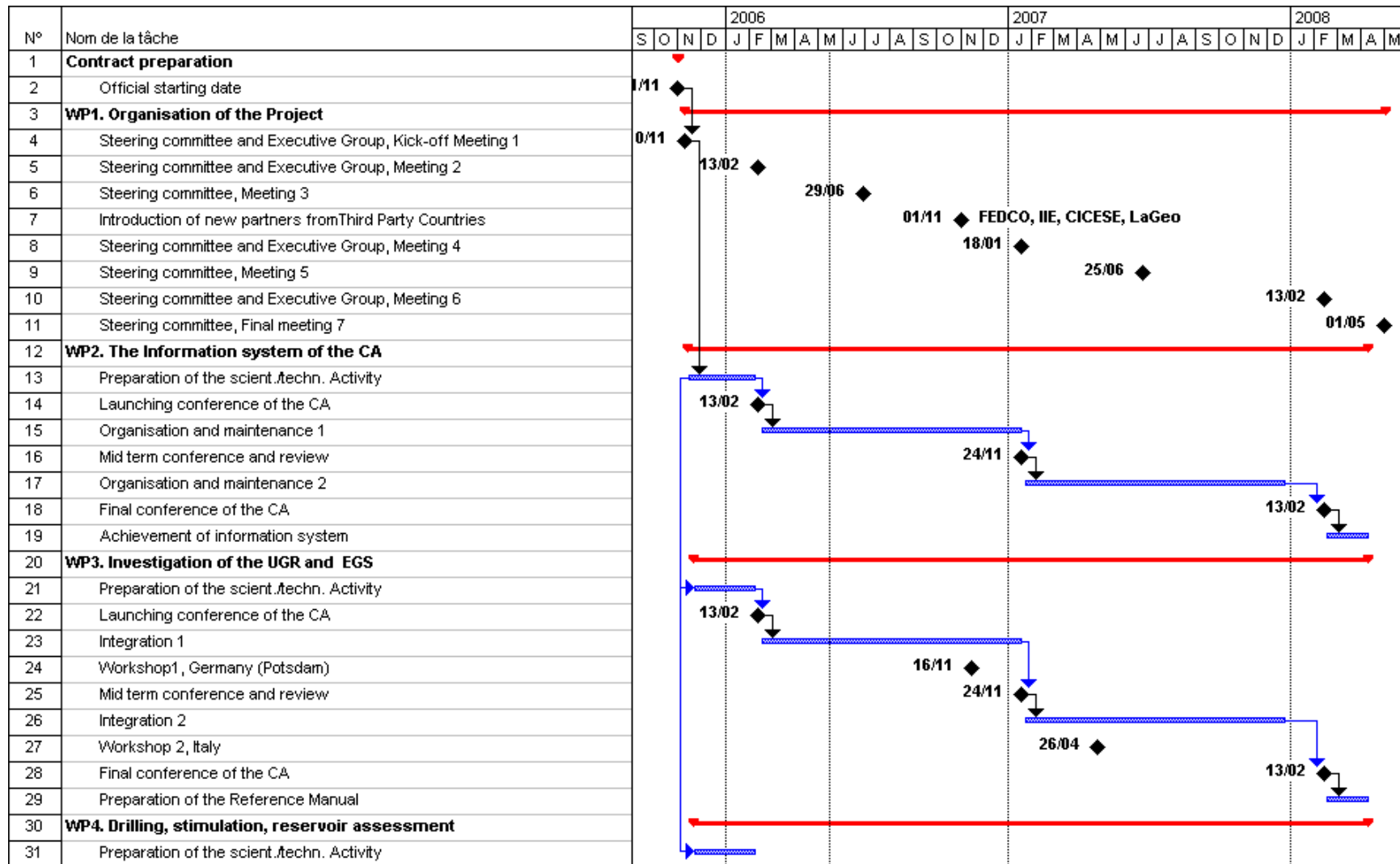
Deliverables List

Del n°	Deliverable name	WP n°	Date due	Actual/Forecast delivery date	Lead contractor
1	A project Manual, defining the guidelines of the Co-ordination Action, submitted for approval to the Executive Group, presentation at the Launching conference, Session 1	1	t3	29 November 2005	1
2	Six-months reports to the EU Commission	1	t3	15 December 2006	1

Milestones List

M. no	Milestone name	WP no.	Date due	Actual/Forecast delivery date	Lead contractor
1	Kick off meeting	1	t1	10-11 November 2005	1
2	Six-months reports to the EU Commission	1	t6, 12, 18, 24, 30	15 December 2006	1
3	Launching conference	1	t3	12-15 February 2006	1
7	Mid Term conference	1	t14	10-12 January 2007	

11	Final conference	1	t25		
13	Achievement of the Best Practices Handbook	1	t30		
14	Achievement of the European Reference Manual	1	t30		
15	Final meeting	1	t30		



1.5. SECTION 4 – OTHER ISSUES

The ENGINE project was not subjected to requirements and/or recommendations concerning ethical issues.

APPENDICE : List of deliverables

Deliverable 1: A project Manual, defining the guidelines of the Co-ordination Action, submitted for approval to the Executive Group, presentation at the Launching conference, Session 1

Deliverable 2: six month and one year activity report (this report)

Deliverable 3: A provisional Web site (<http://engine.brgm.fr>) and an electronic monthly newsletter

Deliverable 4: Presentation and documentation of the provisional Web site and of the perspective of the information system at the Launching conference, Session 2

Deliverable 9: Proceedings of the Launching conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems

Deliverable 12: Guide to the Workshop 1 "Defining, exploring, imaging and assessing reservoirs for potential heat exchange"

Deliverable 21: Proceedings of the Launching conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems

Deliverable 24: Guide to the Workshop 3 "Stimulation of reservoir and induced microseismicity"

Deliverable 30: Proceedings of the Launching conference, Session 5. Exploitation, economic, environmental and social impacts

Deliverable 33: Guide to the Workshop 5 "Electricity generation, combined heat and power"



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