

**SIXTH FRAMEWORK PROGRAMME
PRIORITY [1.6]
[Sustainable energy systems]**



Contract for:

COORDINATION ACTION

Annex I - "Description of Work"

Project acronym: ENGINE

Project full title: ENhanced Geothermal Innovative Network for Europe

Proposal/Contract no.: 019760

Related to other Contract no.: *(to be completed by Commission)*

Date of preparation of Annex I:

Start date of contract: *(to be completed by Commission)*

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1. Project summary

The contribution of geothermal energy is a key factor to the successful achievement of the objectives of the European Commission concerning the development of renewable and sustainable energy. The concept of Unconventional Geothermal Resources and in particular Enhanced Geothermal Systems examines ways of increasing the potential of geothermal power generation through (i) exploring new types of reservoirs for heat exchange (Hot Dry Rock, supercritical fluids..), (ii) enlarging the extent of productive geothermal fields by stimulating permeability, (iii) enhancing the viability of current and potential hydrothermal areas by stimulation technology and improving thermodynamic cycles.

The main objective of the proposed action is 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. The Co-ordination Action 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.

An extended partnership has been proposed and accepted with 4 new partners from Targeted Third Countries in line with the ongoing project. This extension is aimed at (i) gaining additional knowledge and experience from third party countries like the Philippines, Mexico and El Salvador through participation of experts bringing critical information and practices that complement what is available from Europe, (ii) promoting the concept of Enhanced Geothermal Systems in these countries and favour the definition of spin-off projects, (iii) broadening the international impact of the Co-ordination Action. This extension will contribute to develop links between research and development teams, national development programmes, industrial partners and international agencies, promote the geothermal energy as a major renewable and sustainable source of energy and propose innovative high-level medium- to longer-term research projects

2. Project objective(s) and state of the art

State of art

The work programme of the 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. The ENGINE Co-ordination Action has been proposed in this framework.

Considering that 70% of the World's energy needs can be met with water at temperatures less than 200°C and that power plants are becoming increasingly efficient, the geothermal energy may represent a major renewable and sustainable source of energy for Europe. Large wavelength thermal anomalies are characterised at the scale of Europe and within Ultra Peripheric Regions (Caribbean Island, Canaries). The 200°C isotherm is reached between 2 and 5 km depth in zones of present or recent lithospheric extension like in France, Greece, Iceland, Italy, offshore Spain, Turkey or even in intracontinental settings like in Hungary, Lithuania, Romania... These thermal anomalies constitute a source of energy potentially available throughout Europe. However, the use of geothermal energy is limited by the fact that it relies on the relatively uncommon geological concurrence of rocks being simultaneously water-bearing, hot and permeable, and lying at economically accessible depths. Different ways have been tested or are imagined for enhancing and broadening geothermal energy reserves which can be classified into Unconventional Geothermal Resources, i.e. mainly Enhanced Geothermal Systems (EGS) and Supercritical Reservoirs:

- stimulating reservoirs in Hot Dry Rock systems,
- enlarging the extent of productive geothermal fields by enhancing/stimulating permeability in the vicinity of naturally permeable rocks
- enhancing the viability of current and potential hydrothermal areas by stimulation technology and improving thermodynamic cycles,
- defining new targets and new tools for reaching supercritical fluid systems, especially high-temperature downhole tools and instruments,

- improving drilling and reservoir assessment technology,
- improving exploration methods for deep geothermal resources.

Among these projects, several Hot-Dry-Rock (HDR) sites have been investigated around the globe by the international community. These HDR sites, existing or under development, include Fenton Hill (USA), Rosemanowes (UK), Bad Urach (Germany), Fjällbacka (Sweden), Soultz (EU), Hunter Valley (Australia), Hijiouri and Opachi (Japan), Hannover (Germany), Basel and Geneva (Switzerland) and Cooper Basin (Australia). They all provide valuable experience input to the proposed Co-ordination Action.

Geothermal production levels must also be designed to comply with resource sustainability constraints. Major cost-reduction must be accomplished to achieve the objectives of the EU for the use of renewable energies. The development of unconventional geothermal resources may also be linked in an "unconventional way" to other industrial activities such as CO₂ storage or hydrogen production. In parallel, the environmental and social aspects of the development of geothermal energy is of great importance as the image of this renewable and sustainable energy must be improved not only in terms of awareness of decision makers, but also acceptance of the general public.

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.

Under the concept of unconventional geothermal resource, a scientific, technical and methodological interdependence and continuum exists between these research paths, and the geothermal community has a lot to learn from an integration of these approaches. Moreover, the manpower within the scientific and industrial community working in the "geothermal field" is limited and dispersed, resulting in insufficient communication and sharing of experience, despite numerous valuable efforts supported by academic and professional associations. Following up this state of art, there is an urgent need for a Co-ordination Action about Unconventional Geothermal Resources in order to achieve the objectives defined by the EU directive for the contribution of renewable energy and in particular geothermal energy.

Project objectives

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, additional knowledge and experience is expected from the new partners from Philippines, Mexico and El Salvador,
- 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 the European know-how about Enhanced Geothermal Systems at an international level through the extension of the network to Third Targeted Countries and the linkage with national and international agencies representing countries involved in the development of the geothermal energy.

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.

A simplified organisation of the Co-ordination Action is presented defining **specific and timed objectives**.

The *project management* will be included in the Workpackage 1 (*WP1*) and will cover all activities of organisation of meetings, conferences and workshops, reporting, relationships between the different management structures...

The Information and dissemination system of the Co-ordination Action (WP2) will be based on : (i) an original collaborative platform Web site designed for different users, (ii) an electronic monthly newsletter providing information about meetings, workshop and conferences, (iii) the existing Internet tools developed in the framework of former EU research projects, (iv) the experience of the associate members. The Web site will be developed with tools such as Twiki, SPIP or Plone in order to gather information from the members of the project and to share them inside and outside the project. This Workpackage 2 (*WP2*) is intended to play a major role in the management of common initiatives and in the achievement of the goals of the project. This information dissemination system and its associated Web site and monthly newsletter will constitute a deliverable that will (i) provide a working platform for exchanging general or specialised information, (ii) enable on-line exchange and dissemination of scientific and technical know-how and practices, (iii) provide access to a metadata base, specified database, open-source software and models, (iv) constitute an interface with non-member institutes and the international geothermal community, (v) develop and maintain a regular contact with the media's. It will be active throughout the entire project duration and, depending on the future of the Co-ordination Action, could be extended for further development. Under no circumstances will the information system be in charge of building exhaustive databases.

Phase 1 – Integration

During the integration phase of the Co-ordination Action, the state-of-the-art will be 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 will be supervised by one leader that will be member of the Steering Committee. The result of this integration phase, i.e. an updated framework of activities concerning geothermal energy in Europe, will in all cases refer to the geography within Europe, with due attention paid to new members and candidate countries, the members from Hungary, Lithuania, Poland, Romania and Turkey being already involved in the Co-ordination Action. It will integrate information concerning all national projects within each European country, as well as projects connected with international programmes and in particular with International Energy Agency agreements.

The integration will be performed according to the following guidelines.

- The setting up of a common information system including an original collaborative platform Web site and an electronic monthly newsletter in order to exchange and share information, and provide access to a metadata base, specified database and open-source software.
- Organisation of three conferences (launching, mid-term and final) on Unconventional Geothermal Resource, common for all Workpackages, and a few specialised workshops for which a preliminary scheduling is presented. The Co-ordination Action will support applications on request for additional funding to organise other conferences and workshops, especially in the framework of Specific Support Actions.
- Additional knowledge and experience will be obtained from the new partners from TTC. Thus current technologies adopted in exploring, exploiting and managing geothermal fields in the Philippines, Mexico and El Salvador as well as strategies focusing on sustaining and optimizing production will be integrated on the Best Practices Handbook and the European Reference Manual.
- The work of past and present IEA-GIA international groups will be integrated within the tasks of the Workpackages, by direct representation of the ENGINE experts in these groups and meetings, and/or by close collaboration with the European Commission representative in these groups. Of

particular interest are the GIA Annexes III on "Enhanced Geothermal Systems" and IV on "Deep Geothermal Resources". Thus, valuable experience from the international community will be integrated within the ENGINE project.

- The promotion of the European know-how about Enhanced Geothermal Systems will be done by stating the art and valorising the EGS experience available in Europe (the pioneer Hot Dry Rock sites, Soultz-sous-Forets and Gross Schönebeck experiments, stimulation and extension of the Larderello and Bouillante geothermal fields...). The ENGINE project will provide an updated framework of activities, an unique network of research institutes gathering the most qualified and expert groups presently active in Europe and stakeholders that may be interested by medium to long-term investment for the development of geothermal energy in third countries.
- 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. These exchanges will be organised by the steering committee. Priority will be given to the establishment of contacts between experts and young researchers and/or personnel from candidate countries. The participation of women in these exchanges will be strongly encouraged in the aim of contributing to gender equality. The Co-ordination Action will support applications on request for additional funding to organise longer personnel exchanges, especially in the framework of the Marie Curie mobility programme.
- 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.
- 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.

The main issue of the integration phase is the delivery of an updated framework of activities concerning Unconventional Geothermal Resources and Enhanced Geothermal Systems in Europe. *This integration of scientific and technical know-how and practices 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. Links with the Information and dissemination system WP2 will be strong and regular. Scientific and technical know-how and practices will be disseminated through scientific publications (in peer review journals, in proceedings of conferences and meetings, available on-line through the Web site), reports (open file or access restricted to members of the Co-ordination Action) and general scientific documents (multimedia programmes, articles and information brochures). These less specialised publications aimed at a wider audience will contribute to the promotion of geothermal energy in terms of policy makers and public opinion.

Phase 2 - Synthesis

The synthesis phase will be performed by expert groups in charge of defining the best practices and priorities for research investment. These expert groups will be supervised by the Executive Group of the Co-ordination Action. The Workpackage leaders will be assisted by experts from the Steering Committee, partners of the network or other agencies, industry, institutes or research bodies, depending on the required qualifications. They will become operational as soon as a structured outcome is defined as a result of the updated framework, i.e. during the mid-term review (see Fig. 3, schematic project network of activity).

Four groups of experts will perform an evaluation of the best practices and innovative concepts to be adopted during the Workpackages *Expertise on investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems (WP6), Expertise on drilling, stimulation and reservoir assessment (WP7) and Expertise on exploitation, economic, environmental and social impacts (WP8).* This synthesis will involve identifying the main gaps and barriers holding back the development of

innovative concepts that justify investment in the field of research and constitute the background for defining new integrated projects. The Workpackage on *Risk evaluation for the development of geothermal energy* (WP9) is aimed at synthesising the main scientific and technical aspects, as well as economic and environmental constraints, resulting from the different expert groups (WP6 to 8). This work will be done in particular through the use of Decision Support Systems that will integrate the critical parameters defined during this Co-ordination Action. From this modelling, a definition of the most favourable contexts for the development of Unconventional Geothermal Energy in Europe is expected. Thus, besides an updated toolbox for the investigation and exploitation of *Unconventional Geothermal Resources*, a high-level medium- to longer-term research programme is expected to be outlined. Deliverables will include a Best Practice Handbook and the definition of innovative concepts for geothermal investigation, reservoir stimulation and assessment and exploitation. This Handbook will include the results of this risk evaluation.

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.

Beyond this synthesis work, the links established between research and development teams, national energy-development programmes, industrial partners and advisory and financial agencies will help promote innovative, high-level medium- to longer-term research projects. Support from other agencies like the World Bank, EUREKA, International Energy Agency, and other instruments from the European Community (INCO projects, Intelligent Energy for Europe, etc.) has already been partly completed. The broadening of the international impact of the Co-ordination Action is thus considered as a new key issue for the achievement of the goals of the project. Contacts are now regular between the ENGINE Executive Group and representatives of international consortium, like International Energy Agency – Geothermal Implementing Agreement, Directors of the US Department of Energy, Co-ordinator of the US Geothermal Program and private firms involved in the development of the EGS concept in Australia (Geodynamics, Petrathem). For all these institutions and firms, the European experience in HDR at Soultz-sous-Forêts is a worldwide reference and they follow with great interest all activities in progress, especially activities supported by the 6th FP. In this framework, the extension of the network with new partners from Philippines, Mexico and El Salvador considered as a decisive step.

3. Participants list

Partic. Role*	Parti c. No.	Participant name	Participant short name	Country	Date enter project**	Date exit project**
CO	1	Bureau de Recherches Géologiques et Minières	BRGM	France	t1	t30
CR	3	GeoForschungsZentrum Potsdam	GFZ	Germany	t1	t30
CR	4	ISlenskar ORkurannsoknir	ISOR	Iceland	t1	t30
CR	5	Shell International Exploration and Production B.V.	SIEP B.V.	Netherlands	t1	t30
CR	6	Netherlands Organisation For Applied Scientific Research	TNO	Netherlands	t1	t30
CR	7	Institute for Geothermal Research	IGR DSC RAS	Russian Federation	t1	t30
CR	8	Instituto di Geoscienze e Georisorse	IGG	Italy	t1	t30
CR	9	CFG Services	CFG Services	France	t1	t30
CR	10	Institute for Energy and Environment Leipzig	IE	Germany	t1	t30
CR	11	Eotvos University	ELTE	Hungary	t1	t30
CR	12	Centre National de la	CNRS	France	t1	t30

		Recherche Scientifique				
CR	13	Leibniz Institute for Applied Geosciences	GGA	Germany	t1	t30
CR	14	Groupement Européen d'Intérêt Economique "Exploitation Minière de la Chaleur"	GEIE "EMC"	International consortium	t1	t30
CR	15	Geologijos Ir Geografijos Institutas	IGGL	Lithuania	t1	t30
CR	16	MeSy GeoMessSysteme GmbH	MeSy	Germany	t1	t30
CR	17	Vrije University Amsterdam	VUA	Netherlands	t1	t30
CR	18	Centre for Renewable Energy Sources	CRES	Greece	t1	t30
CR	19	National Centre for Scientific Research "Demokritos"	NSCRD	Greece	t1	t30
CR	20	Geoproduction Consultants	GPC	France	t1	t30
CR	21	Institutt for Energiteknikk	IFE	Norway	t1	t30
CR	22	Panstwowy Instytut Geologiczny	PGI	Poland	t1	t30
CR	23	Geological Survey of Denmark and Greenland	GEUS	Denmark	t1	t30
CR	24	University of Oradea	UOR	Romania	t1	t30
CR	25	Tsentr geoelektromagnitnykh issledovaniy Instituta fiziki zemli Rossiskoi akademii nauk	GEMRC IPE RAS	Russian Federation	t1	t30
CR	26	Institut vysokikh temperatur Rossyiskoi akademii nauk	IVTRAN	Russian Federation	t1	t30
CR	27	Joint Stock Company "Intergeotherm"	JSC "Intergeotherm"	Russian Federation	t1	t30
CR	28	Deep Heat Mining Association	DHMA	Switzerland	t1	t30
CR	29	GEOWATT AG	GEOWATT AG	Switzerland	t1	t30
CR	30	ORME JEOTERMAL A.S.	ORME	Turkey	t1	t30
CR	31	Instituto Geológico y Minero de España	IGME	Spain	t1	t30
CR	32	Centre for Research and Technology - Hellas	CERTH	Greece	t1	t30
CR	33	Filtech Energy Drilling Corporation	FEDCO	Philippines	t13	t30
CR	34	Instituto de Investigaciones Eléctricas	IIE	Mexico	t13	t30
CR	35	Centro de Investigación Científica y Educación Superior de Ensenada	CICESE	Mexico	t13	t30
CR	36	LaGeo S.A. de C.V.	LaGeo	El Salvador	t13	t30

Table 1. Participants list

4. Relevance to the objectives of the specific programme and/or thematic priority

The proposed Co-ordination Action addresses the priority thematic area 1.6 "Sustainable energy systems". It fits well within the framework of 6.1.3.2.3 "New and advanced concepts in renewable energy technology" (Research activities having an impact in the medium and longer term) concerning *Unconventional Geothermal Resources* and in particular Enhanced Geothermal Systems.

The development of renewable and sustainable energy will have a major impact on World economics and its sustainable development. The challenge defined in the 6th framework is to reverse the present pattern of development in order to achieve a truly sustainable energy system, one that preserves the equilibrium of ecosystems and encourages economic development (Work programme, 6.1. Sustainable energy systems). In line with the Kyoto protocol implementation, an EU directive has been established that aims, by year 2010, to double the contribution of renewable energy to total energy consumption from 6 to 12%, and to reduce greenhouse gases and pollutant emission by 15% (up cited). Finally, the Green Paper –Towards a European strategy for the security of energy supply– published in 2001, underlines that the EU will become increasingly dependent on external energy sources (70% in 2030), and that at present it is not in a position to respond to the challenge of climate change and meet its commitments, notably under the Kyoto Protocol. It is also noted that the development of certain renewable energy sources calls for major efforts in terms of research and technological development. In this context, the Green Paper adds that gas, oil and nuclear energy, all of which received substantial initial development aid, are now highly profitable.

How does geothermal energy fit into this global context? The contribution of geothermal energy will be significant in achieving the objectives of the European Commission mentioned above. The “heat engine” of the earth, i.e. geothermal energy, constitutes a sustainable and renewable source of energy if appropriate exploitation schemes are appropriately implemented. The energy available within the uppermost 9 km of the Earth’s crust is estimated at 50,000 times the energy provided by oil and gas resources throughout the World, 3.3×10^{15} tons of oil equivalent (Fire without smoke, document of the World Bank, October 2002). According to the IEA World Energy Outlook 2002, (“Reference Scenario”), geothermal energy is predicted to grow at an annual rate of 4% (OECD) until 2010. The White Paper for a Community Strategy and Action Plan (1997) expects electricity production to double from 500 to 1000 MW and an increase in heat production of geothermal origin from 750 to 2.5 MWth.

The access to Unconventional Geothermal Resources is a key factor for achieving these objectives. The European Hot Dry Rock (HDR) project in Soultz proved that the extraction of geothermal energy from HDR is technically feasible. This implies that **for the first time in human history**, the vast amounts of the heat content of the upper crust have been made available, although still with elevated costs. A rough calculation of the extractable amount of geothermal energy (technical geothermal potential) made for Greece, indicates that the technical geothermal potential for electricity generation has been estimated as around 21.000 MWe of installed power (for Greece only), corresponding to twice the needs for power production of the country for 1000 years of plant life. Furthermore, recent work of the “office of technology assessment at the German parliament (TAB)” and in particular on the report No 84 “Possibilities for geothermal electricity generation in Germany”, shows that with present technology geothermal energy can supply 50% of electricity needs of Germany for a period of 1000 years. Therefore, when the economic barriers are overcome, geothermal energy can play a dominant role towards the energy supply of EU and humanity. Initial estimates indicate that 70% of world energy needs can be covered by geothermal energy using present technology.

The potential of geothermal energy for Europe is strongly modified from a socio-economic point of view with the arrival of the new members, some of them presenting high resource potential (Fire without smoke, document of the World Bank, October 2002) and all of them having urgent needs in terms of heat-production systems and, to a lesser extent, electricity production. Geothermal energy could easily be integrated with other renewable energies into a perspective of sustainable development for Europe, and applied to emergent countries with crucial needs in energy.

The society and policy objectives mentioned above are highly ambitious. In order to meet with these, major research investment is needed as many gaps have to be filled and barriers overcome to render geothermal energy competitive and thus attractive for the industry. However, it is clear that this investment will only come about if the scientific community is able to (1) present credible research projects that integrate the know-how and best practices, and (2) demonstrate its ability to be federated and complementary in a common conceptual approach.

The community working in the geothermal field is dispersed, hence a lack of exchange, and very few international integrated projects are presently susceptible to mobilise the European community. This lack of integration and apparent scattering of efforts is probably the main cause for a lack of political support. Thus, it is concluded that a pooling of resources is called for in this domain.

The proposed Co-ordination Action is aimed at providing an integration of activities related to geothermal energy in Europe, and compiling recommendations from expert groups into a European

Reference Manual for the development of Unconventional Geothermal Resources and in particular Enhanced Geothermal Systems. The Co-ordination Action will thus contribute to these society and policy objectives by:

- identifying the gaps and barriers holding back geothermal-energy development (environmental impacts, policy/law/regulatory barriers, etc.) and proposing actions to overcome the bottlenecks (research projects, expert studies, information campaigns, promotion, etc.);
- demonstrating that Unconventional Geothermal Resources and in particular Enhanced Geothermal Systems cover a very large range of reservoir types and heat sources, and that geothermal energy can be considered as a source of energy potentially available throughout Europe;
- defining economic conditions for a reassessment of the profitability of geothermal energy in the framework of “ Unconventional Geothermal Resources ”; and in particular how geothermal energy can contribute, in the new candidate countries, to their heat and electricity production
- illustrating how a healthy geothermal energy industry can assist the energy self-sufficiency of Europe and promote the development of local industrial capability;
- proposing a complete economic approach towards geothermal energy, taking into account the sustainability and the environmental benefits.

The work programme defines a priority on innovative concepts for cost-effective investigation, assessment development and management of potentially exploitable Unconventional Geothermal Resources. The definition of innovative research and development programmes is linked to our ability to find, image and characterise natural or potential geothermal reservoirs. This scientific and technological challenge can only be successfully met if the best practices are promoted and shared, and if new innovative research projects emerge. Considering that such know-how and practices are presently highly dispersed throughout Europe, we identify a strong need for a pooling of resources in this scientific and technical thematic area.

The proposed Co-ordination Action will contribute to the scientific and technical objectives of this priority thematic area by:

- providing an updated framework of activities concerning geothermal energy in Europe and examining, for each scientific concept and technological process, the state-of-the-art, and the gaps and barriers holding back further development,
- promoting the dissemination of know-how and best practices for investigation, reservoir assessment, drilling and exploitation of Unconventional Geothermal Resources and in particular Enhanced Geothermal Systems through a Best Practice Handbook;
- providing a risk evaluation for the development of geothermal energy in Europe;
- promoting innovative concepts and projects to define the potential of Unconventional Geothermal Resources for the whole Europe and in Third Targeted Countries.

Costs must be significantly reduced in order to envisage the development of geothermal energy, and reach the target of 0.05 €/kWh indicated in the work programme. The proposed Co-ordination Action will contribute to the cost-effectiveness objectives of this priority thematic area by gathering together information from its industrial partners concerning recent developments in equipment and methodology, performed in fields such as oil, gas and mineral exploration, that could significantly reduce the costs and risks involved in the drilling for and monitoring of geothermal investigation and assessment.

5. Potential Impact, contribution to policy developments

The work programme of the priority thematic area 1.6 "Sustainable energy systems" defines a priority on innovative concepts for cost-effective investigation, assessment development and management of potentially exploitable Unconventional Geothermal Resources. 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. This reestablishment requires a mobilisation throughout the entire geothermal-energy community.

It is first of all necessary to structure the geothermal-energy community towards the definition of innovative research projects. The expected impact is the mobilisation of a large scientific and industrial community that will concentrate on the problem of “Heat exchange with the Earth’s thermal Engine”, taking into account the European policy for renewable energies and the targets defined by the circulars.

- Earth-science professionals must pay attention to applications of the knowledge recently acquired on the structure of the Earth's crust, particularly in Europe, for societal needs. How is heat partitioned at depth, what are the driving forces and what are the links between present-day stress fields and fluid circulation at the scale of a basin or that of a basement-cover interface? Answers to such questions would constrain the localisation at depth of potential heat-exchange reservoirs and thus have a high scientific impact.
- Geophysical methods and exploration techniques (3D and 4D seismic, drilling and microdrilling methods...) used by the oil and gas industry have been improved and adapted to allow investigation and production in new basins, for example deep water, sub-salt, etc. Successful application of this technology will reduce the geological uncertainty and hence lower the risk of drilling unsuccessful wells. It will also have a profound impact on the geothermal investigation methodologies used to identify and prove up geothermal reserves.
- The geothermal reservoir engineers must define the range of heat source parameters (nature, depth, physical) for which exploitation tools are either available or need to be developed at the short, medium or long term. They will then be in a position to define generic reservoir systems that geologists, geophysicists and geochemists will be able to translate into favourable geological settings. This type of coupled technological and scientific approach will enable the development of integrated projects and have a high impact on the European Energy Policy.
- Geothermal field operators and industrial enterprises involved in geothermal energy conversion and use must seek ways to drastically reduce both capital and operating costs and improve overall conversion efficiency. As existing equipment is tailor made for hydrothermal systems, they need to be adapted for use with enhanced unconventional geothermal systems such as hot dry rock.
- A permanent link will be established with other projects concerning geothermal energy. This will be the case with the Hot Dry Rocks Soultz experiment, the new I-GET STREP project that concerns the use of geophysical methods of investigation for assessment of geothermal reservoirs, the projects concerning the development of Larderello, Bouillante and Iceland geothermal field and in particular with the Deep Drilling project from Iceland. The extension of the project to new partners from Mexico, El Salvador and Philippines will provide additional knowledge and experience from third party countries that have a long experience in the development of active geothermal fields.

The first condition for the emergence of such integrated projects is 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. These are the objectives of the Co-ordination Action. 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 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.

This knowledge 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.

The exploitation of heat of geothermal origin is either ongoing or possible in all European countries and that all of them have research and development projects, of course very variable in size and targets. The meetings and conferences, advertised through the Web site of the Co-ordination Action, the electronic monthly newsletter and the Web sites of international association, will therefore attract numerous non-partner institutions and companies. Moreover, the link will be maintained with all institutes and national geothermal associations that have expressed interest to be associated to this Co-ordination Action (more than 20) that should quite quickly become an exchange work platform for

teams wishing to share experience and practices. This exchange dimension will be integrated into the concept of the Information and Dissemination Systems.

The Executive Group will be in charge of developing and strengthening links and business relationships with international and national agencies and policy makers. It will also be very important to develop contacts with international experts involved in research programmes sharing the same scientific, technological and socio-economic challenges. Contacts will be formalised with representatives of international consortium, like International Energy Agency – Geothermal Implementing Agreement, Directors of the US Department of Energy, Co-ordinator of the US Geothermal Program and private firms involved in the development of the EGS concept in Australia (Geodynamics, Petratherm). The extension of the project to new partners from Mexico, El Salvador and Philippines will also provide an extended audience for the ENGINE project and will concur to the promotion of the EC initiatives. In this context, the Executive Group will have to anticipate following up the Co-ordination Action by promoting new integrated projects based on the updated framework and on the results of the different expertises. The mobilisation of the community, the definition of innovative approaches for the development of Unconventional Geothermal Resources and the support of industrial partners will give credit to this representation. The expected impact is that the Co-ordination Action will create a raised level of promotion providing updated information and helping negotiations for new integrated projects.

Finally, a mobilised community and the use of a promotional circuit for geothermal energy could enhance the identification of new concepts for increasing the contribution of renewable energies, far beyond what is already expected and limiting significantly the energy dependence of Europe. For example, the medium- to long-term impact is the development of economically viable unconventional geothermal resources and in particular Enhanced Geothermal Systems. This could lead to large-scale production of geothermal energy within mainland Europe, provided that the technical and socio-economic bottlenecks are overcome. Furthermore, Iceland and Italy have an enormous potential for geothermal-energy production for electricity, much more than is forecast for use by the country itself in the case of Iceland. This potential lies in not only the conventional geothermal resources, but also, on a larger scale, in the probable existence of unconventional one.

6. Project management and exploitation/dissemination plans

6.1 Project management

The Co-ordinator, BRGM Orléans, will be responsible for the administration and organisation of the network, providing the organisational platform and professional support for the participants and committees. The project management of the Co-ordination Action will be performed by one Co-ordinator, P. Ledru, and one secretary.

Project management must ensure (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.

1. Ensuring the preparation, start up and closure of the project administration and organisation

A project Manual, defining the organisation of the Co-ordination Action, will be prepared by the Co-ordinator and submitted for approval to the Executive Group at the kick-off meeting. This document will be drawn up during the negotiation phase with the EU Authorities and will update the present proposal. It will include the structure, work plan, and resources of the Co-ordination, resized according to the technical reviews and the budget.

The following committees will be set up for the duration of the Co-ordination Action (Figure 1).

- An Executive Group, composed of members of the institutes at the initiative of this Co-ordination Action, will be in charge of the Direction of the Co-ordination Action and of all decisions regarding significant changes to the work plan. C. Fouillac has been elected president of the Executive Group. Three meetings are planned in connection with meetings of the Steering Committee. The opportunity to extend it with one or two representatives of the new partners will be proposed for the next meeting planned in January 2007. This extension is likely as the Executive Group is following up connections with international agencies, national programmes, industrial partners, etc
- A Steering Committee composed of leaders of the Workpackages and Expert Groups. A president will be elected. Six meetings are already planned in connection with conferences and workshops and others will be decided if necessary.

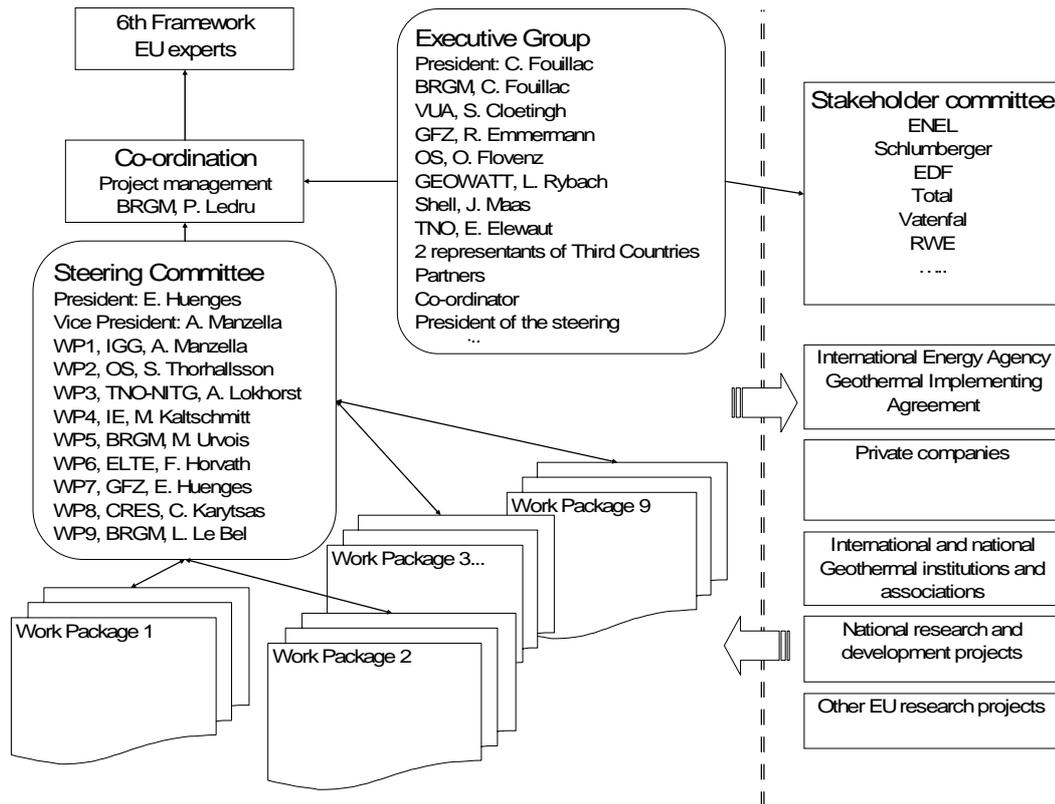


Figure 1. The ENGINE management structure

2. Ensuring the reporting with the Authorities of the 6th Framework

The Co-ordinator will provide comprehensive yearly reports on progress including a listing of work completed to date, details of any significant problems encountered, any anticipated problems, and provisional results. These reports will be presented to the appropriate programme manager in Brussels. The project co-ordinator will also provide an annual budgetary statement to the programme manager in Brussels based on cost statements from each project partner. The president of the Executive Group will approve all these documents.

3. Ensuring the smooth and streamlined information flow within the consortium

The Co-ordinator will be in charge of providing all facilities for the diffusion of information and the organisation of meetings and conferences. The project's internal communication strategy is intended to provide a clear picture of project status, facilitate meaningful interaction between project partners and support in-house dissemination of work progress and research findings. Project conferences will be used to provide a forum for oral progress reports by consortium partners. Additional bilateral and multilateral meetings of partners within Workpackages will also take place during specialised workshops or exchange of personnel. Copies of presentations made at these meetings will be made available to other partners in order to support the cross-disciplinary aspects of the research.

A straight link between the Co-ordinator and the Leader of the Information and dissemination System WP2 is a key to success of the network. Project management will be facilitated by the establishment of a project Internet Web site at the co-ordinating institution. It will be used for communication between partners, as a source for common documents such as the technical annex of the contract, draft and completed reports etc., to home abstracts of published material from the project, and as a dissemination tool that interested academic and industrial / commercial organisations can use to access project output. The site will be managed on a 'rolling access' basis with parts of the site being restricted to project partners and acknowledged EU programme managers only.

4. Ensuring the controlling duties of the project

A project Manual, defining the guidelines of the controlling duties, will be prepared by the Co-ordinator and submitted for approval to the Executive Group at the kick-off meeting. The follow-up of the project

will respect certain rules: (i) quality control of the deliverables, (ii) planning and time schedule, (iii) control of the budget and optimisation of the resources allocated.

4.1 Quality control

Quality assurance mechanisms for the project will involve both internally and externally sourced checks on the credibility, integrity and value of the work. The quality of both project management (work-plan execution, output delivery, etc.) and scientific method will be monitored. The main instruments for quality assurance will be comparison of project deliverables against stated objectives and peer review (both internal and external). Internal peer review will be conducted formally by the Executive Group. The assessment criteria to be used will be:

- The fit between project planning (respecting the milestones), carrying out the Workpackages and accomplishing the deliverables.
- The degree to which the completed work and deliverables conform to that defined in the work programme.
- Production of scientific and other deliverables.
- Quality of oral reports delivered during the project meetings.

External peer review will be achieved through the publication of conference and journal papers, the interaction with potential user groups and also the project's Web site. A 'comments' page will be included on the Web site where interested parties will have the opportunity to make observations on the project's objectives, methods and results. These comments will be integrated into the project reports.

4.2 Timing and time schedule

The planning for meetings, reports and milestones will be followed using Microsoft Project software.

4.3 Control of the budget and optimisation of the resources allocated.

The control of the budget and optimisation of the resources allocated to the Co-ordination Action will be done using the accounting procedure of the BRGM.

6.2 Plan for using and disseminating knowledge

The management and dissemination of knowledge will be addressed in the framework of the Workpackage 2 "Information and dissemination Systems". The information system of the Co-ordination Action will play a major role in the exchange and dissemination of data, good practices and standards. The associate collaborative Web site will be improved by the members of the project (with different level of permissions) to make a reference knowledge base on the Internet. As publications will be the main deliverable, the publication system is indicated as a main item of the Co-ordination Action. A special attention will be given to dissemination in order to strengthen the position of the geothermal energy among the other renewable energies.

The infrastructure of this information system, the definition of the publication policy and the management of knowledge and intellectual property will be proposed by the leader and associate partners of this workpackage, under the supervision of the Co-ordinator. The resulting document will be submitted for agreement to the Steering Committee and Executive Group.

The leader and associate partners of this workpackage 2 will then ensure maintenance and support of the Web site and electronic monthly newsletter and the smooth and streamlined information flow within the Co-ordination Action. They will be attentive to all requests from the other workpackages concerning matters of communication, information transfer and publication policy. During the whole duration of the project, assistance and support will be provided to the participants of the Co-ordination Action for the publication of their results in varied information channels. A mid-term review (t_{0+14}) will be common to all Workpackages and will be a milestone for the evaluation of the Web site and information and dissemination system.

6.3 Raising public participation and awareness

Environmental and social aspects of the development of geothermal energy are of great importance as the image of this renewable and sustainable energy must be improved not only in terms of awareness of decision makers, but also acceptance of the general public. This matter will be addressed in the framework of the Workpackage 5 and 8 that concerns Exploitation, economic, environmental and social impacts (integration and synthesis phases). A specialised Workshop "Increasing policy makers awareness and the public acceptance" will be organized by CRES and Greek partners and will take place in Milos Island (Greece).

In order to increase policy maker awareness and public acceptance, 3 main items will be addressed:

- Building a network for political support. 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. This reestablishment requires a mobilisation throughout the entire geothermal-energy community. Integration and synthesis of all information about know how, practices, innovations and barriers will be particularly helpful to the Executive Group that will be in charge of developing and strengthening links and business relationships with international and national agencies and policy makers.
- Societal needs and public requirement. The access to renewable energies and reduction of CO₂ and green house gas emission are societal needs that are progressively integrated by policy makers. It is necessary to evaluate in this framework the exploitation perspectives of the geothermal industry, identify and analyse the environmental and socio-economic barriers that hamper its development. The state-of-the-art, and in particular a review of case histories, 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.
- Communication policy for the promotion of the geothermal energy. The knowledge will be disseminated and made available through the information and publication systems, and should arise the interest of other potential scientific and industrial partners. Scientific and technical know-how and practices will be disseminated through scientific publications and on-line through the Web site. A special attention will be given to general scientific documents as multimedia programmes, articles and information brochures. These less specialised publications (hard copies and on-line access) aimed at a wider audience will contribute to the promotion of geothermal energy in terms of policy makers and public opinion. This communication policy 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.

7. Workplan– for whole duration of the project

7.1 Introduction - general description and milestones

Two main strategies will be applied in the framework of the Co-ordination Action

- a bottom-up and federative strategy to motivate the scientific community to face up to the scientific and technical challenges (WP3, WP4, WP5). Workshops and conferences will be regularly organised to ensure a smooth and streamlined flow of exchanges and co-ordination. Publications available on journals and on the Web site are the expected deliverables of these Workpackages.
- 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 (WP6, WP7, WP8). A Best Practice Handbook and the definition of innovative concepts for the investigation, reservoir assessment and exploitation of geothermal energy will constitute the deliverables of this work. It will include a technical and socio-economic risk evaluation for the development of the geothermal energy in Europe (WP9).
- A scientific and technical European Reference Manual for the development of Enhanced Geothermal Systems will result as the deliverable of this Co-ordination Action.

The project management activities are gathered in the Workpackage 1. A special attention will be paid to the information and dissemination system (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.

The scheduling of the main milestones and related deliverables are listed below. The nature of the deliverable is presented in table 4.

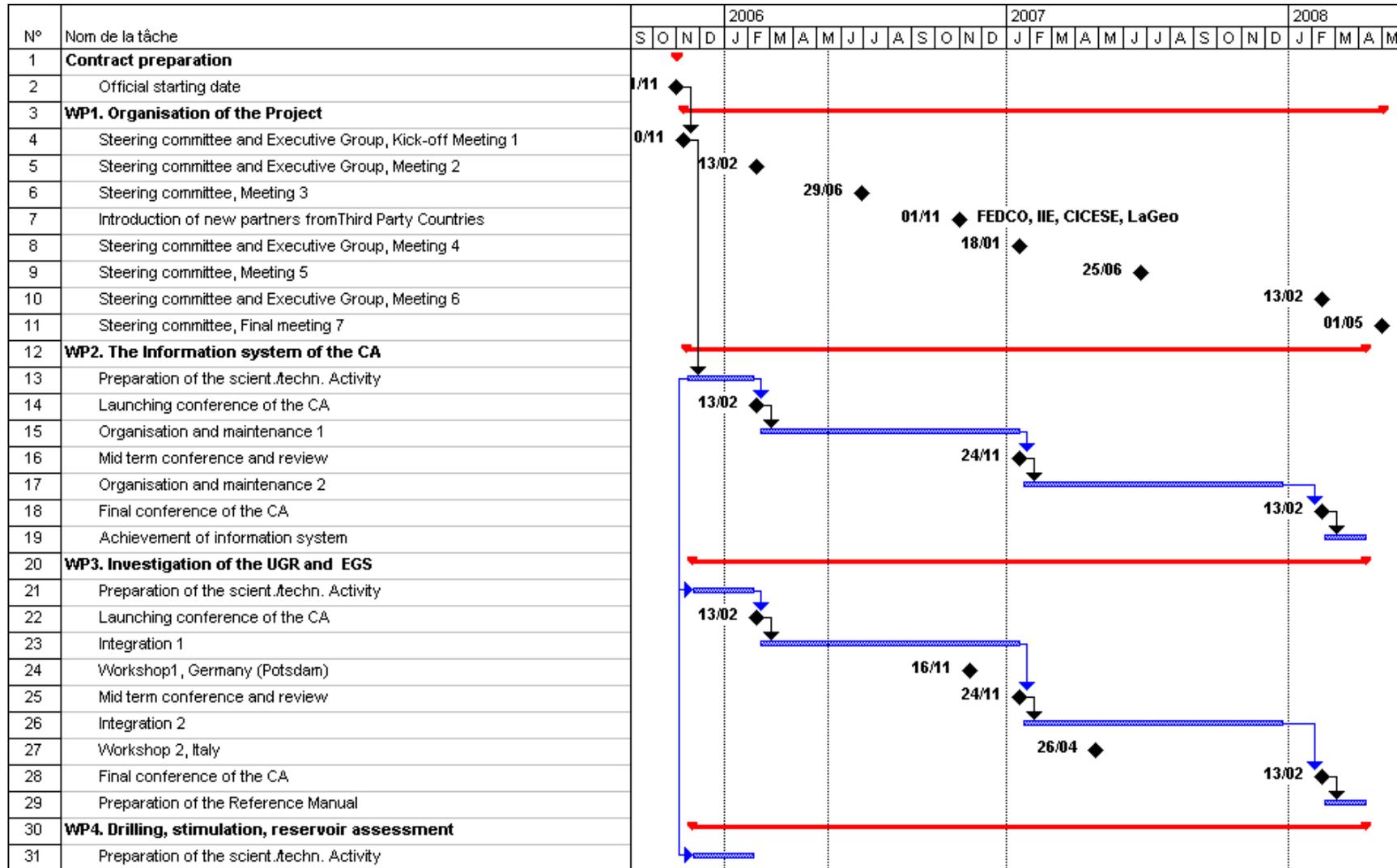
Milestones	Control date	Deliverable n°
Kick off meeting	t1	1
Six-months reports to the EU Commission	t6, 12, 18, 24, 30	2
Launching conference	t3	3, 4, 9, 21, 30
Workshop 1	t6	12
Workshop 3	t17	24
Workshop 5	t21	33
Mid Term conference	t14	5, 7, 8, 10, 22, 31
Workshop 2	t8	13
Workshop 4	t19	25
Workshop 6	t10	34
Final conference	t25	6, 11, 14, 15, 16, 17, 18, 19, 20, 23, 26, 27, 28, 29, 32, 35, 36, 37, 38, 39, 40, 41
Workshop 7	t27	50
Achievement of the Best Practices Handbook	t30	42, 43, 45, 47, 48
Achievement of the European Reference Manual	t30	44, 46, 49, 51, 52
Final meeting	t30	8

Table 2. Scheduling of the main milestones and related deliverables

7.2 Work planning and timetable

A work plan is defined for each Workpackage. A total duration of 2.5 years ($t_0 - t_{0+30}$) is planned for this Co-ordination Action. The GANTT diagram is presented (Figure 2). The content and objectives of the work packages have not been modified in connection with the extension of the network to TTC partners. Their special implication on each work package is detailed in the work package description forms.

ENGINE, Proposal/contract n° 019760, 17/10/06



WP1. Project management Workpackage 1.

The Co-ordinator (BRGM) will be responsible for the administration and organisation of the network, providing the organisational platform and professional support for the participants and committees. The project management of the Co-ordination Action will be performed by one Co-ordinator, P. Ledru, and one secretary.

The project management has four main objectives:

- 1.1. Ensuring the preparation, start up and closure of the project administration and organisation
- 1.2. Ensuring the reporting with the Authorities of the 6th Framework.
- 1.3. Ensuring the smooth and streamlined information flow within the consortium. The Co-ordinator will be in charge of providing all facilities for the diffusion of information and the organisation of meetings and conferences. A straight link between the Co-ordinator and the Leader of the Information System Workpackage is thus a key to success of the network.
- 1.4. Ensuring the controlling duties of the project. A project Manual, defining the guidelines, will be prepared by the Co-ordinator and submitted for approval to the Executive Group at the kick-off meeting. The follow-up of the project will respect certain rules (i) quality control of the deliverables, involving internal and external peer review of reports and articles by independent experts, (ii) planning of the time schedule for meetings, reports and milestones, using Microsoft Project software (Fig. 8), (iii) control of the budget and optimisation of the resources allocated to the Co-ordination Action using BRGM's accounting procedure.

The following committees will be set up for the duration of the Co-ordination Action (Fig. 5)

- An Executive Group, composed of members of the institutes at the initiative of this Co-ordination Action, will be in charge of the Direction of the Co-ordination Action and of all decisions regarding significant changes to the work plan. One president will be elected. The Executive Group will follow up connections with international agencies, national programmes, industrial partners, etc. .. The opportunity to extend it with one or two representatives of the new partners will be proposed for the next meeting planned in January 2007.
- A Steering Committee composed of the leaders of each Workpackages and Expert Groups. Seven meetings are planned for the whole duration of the project, coinciding for three of them with the meeting of the members of the Executive Group. E. Huenges has been elected as president and A. Manzella as Vice President.

WP2. The Information and dissemination Systems Workpackage 2.

Based on existing Internet tools developed during former EU research projects and the experience available from the associate members, the information system of the Co-ordination Action will play a major role in the exchange and dissemination of data, good practices and standards. The associate collaborative Web site will be improved by the members of the project (with different level of permissions) to make a reference knowledge base on the Internet. As publications will be the main deliverable, the publication system is indicated as a main item of the Co-ordination Action. A special attention will be given to dissemination in order to strengthen the position of the geothermal energy among the other renewable energies.

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

1. Preparation of the scientific and technical activity (t0 - t0+3)

The leader of this Workpackage, P. Calcagno (BRGM), and the associated partners will be in charge of the following tasks:

- Defining the structure of the Internet site
- Defining the address database and planning for its access as part of the Co-ordination Action
- Preparing a questionnaire about available databases and open-source software
- Providing the information about the exchange of personnel for the period t_{0+3} - t_{0+30} (identifying welcoming centres, defining the motivation for exchange)
- Defining and following up the publication policy with the WP3, WP4 and WP5 leaders

The WP2 leader and associated partners will meet as soon as the Co-ordination Action will start. Additional meetings will be held at regular intervals in order to follow the scientific and technical programme.

2. Launching conference of the Co-ordination Action (t0+3)

The launching conference, that will be held in BRGM Orléans and organised with the help of the French partners, will be common to all Workpackages and will involve all the partners. The WP2 leader and the associate partners will present the provisional Web site and the perspective of the information system (Session 2). They will be attentive to all requests from the other Workpackages concerning matters of communication and information transfer.

3. Organisation and maintenance of the Web site (t0+3 - t0+30)

The leader and associate partners will be in charge of the maintenance and support of the Web site and electronic monthly newsletter and will ensure the smooth and streamlined information flow within the Co-ordination Action. A mid-term review (t_{0+14}) will be common to all Workpackages and will be a milestone for the evaluation of the Web site and information and dissemination system.

4. Follow-up of the publications (t0+3 - t0+30)

The WP2 leader and associated partners will be attentive to all requests from the other Workpackages concerning their publication policy. During the whole duration of the project, assistance and support will be provided to the participants of the Co-ordination Action for the publication of their results in varied information channels.

A BOTTOM-UP AND FEDERATIVE STRATEGY FOR AN UPDATED FRAMEWORK OF ACTIVITIES CONCERNING GEOTHERMAL ENERGY IN EUROPE (WP 3 TO 5)

WP3. Investigation of Unconventional Geothermal Resources and in particular Enhanced Geothermal Systems

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.

The exchange of personnel constitutes one of the actions that the Co-ordination Action will favour as this is a very efficient way of sharing experience, disseminating best practices and integrating information from different sources.

In addition to the three conferences planned on Enhanced Geothermal Systems, common to all Workpackages, two specialised workshops will also be held, focused on:

- **Workshop 1 “Defining, exploring, imaging and assessing reservoirs for potential heat exchange”** to be held in Germany organised by GFZ Potsdam with the help of other German partners,
- **Workshop 2 “Exploring Supercritical fluid reservoir: a new challenge for geothermal energy”** to be held in Italy organised by IGG.

Deliverables of this Workpackage are mainly publications and dissemination of information and best practices that will be organised with the support of the Information and dissemination Systems WP 2.

The work plan is presented below.

1. Preparation of the scientific and technical activity ($t_0 - t_{0+3}$)

A first meeting of the Executive Group and Steering Committee will be held as soon as the Co-ordination Action will start. The leader of this Workpackage, A. Manzella (IGG), and the associated partners will then be in charge of the preparation of the scientific and technical activity:

- Preparing the scientific and technical programme of the launching conference planned to be held at t_{0+3} ; this programme will follow the themes detailed in the work programme; convenors and speakers will be invited.
- Defining the main actions to be undertaken for integration of the scientific and technical know-how and practices
- Proposing to the Steering Committee exchange of personnel for the period $t_{0+3} - t_{0+25}$ (identification of welcoming centres, definition of the motivation for the exchange)
- Defining a publication policy aimed at increasing the scientific quotation of associate members (publication of review articles, special issue of peer-review journals, books, etc.) and promoting geothermal energy (to increase the awareness of policy makers and improve public acceptance).
- Detailed planning of specialised workshop(s) to be held ($t_{0+3} - t_{0+25}$).

Meetings of the leader of the WP3 and the associated partners will be held at regular intervals in order to follow the scientific and technical programme.

2. Launching conference of the Co-ordination Action (t_{0+3})

The launching conference will be common to all Workpackages. Following this conference, synthesis and integration actions will be launched on the basis of the state-of-the-art presented.

3. Integration of scientific and technical know-how and practices concerning the investigation ($t_{0+3} - t_{0+25}$)

This integration will be carried out according to the actions defined. It will include the exchange of personnel and practical knowledge, analysis and studies.

The specialised workshops **Workshop 1 “Defining, exploring, imaging and assessing reservoirs for potential heat exchange”** and **Workshop 2 “Exploring Supercritical fluid reservoir: a new challenge for geothermal energy”** will form part of this integration process. Links will be established between the leader of the WP and the associated partners, the organisers of this workshop and agencies concerned directly or indirectly by geothermal energy.

A mid-term review (t_{0+14}) will be common to all Workpackages during the mid-term conference. The Expert Group working on WP6 will start its work during this mid-term review, and will use the results obtained from integration and studies already achieved. The leader and some members of the WP3 partners will participate in this Expert Group, along with other experts from amongst the network's partners or other agencies, industry, institutes and research agencies.

4. Final conference of the Co-ordination Action (t_{0+25})

This final conference will be common to all Workpackages. Following this conference, the main studies and integrated models will be synthesised and provide the basis for achieving the publication policy.

5. Achievement of the publication policy (t_{0+25} - t_{0+30})

The leader and associated partners will be in charge of supervising publication of the results.

WP4. 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

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.

The exchange of personnel constitutes one of the actions that the Co-ordination Action will favour as this is a very efficient way of sharing experience, disseminating best practices and integrating information from different sources.

Two specialised workshops are already planned concerning:

- **Workshop 3 “Stimulation of reservoir and induced microseismicity”** to be held in Switzerland, organised by GEOWATT,
- **Workshop 4 “Drilling cost effectiveness and feasibility of high-temperature drilling”** to be held in Iceland, organised by ISOR.

Deliverables of this Workpackage are mainly publications and dissemination of information and best practices that will be organised with the support of the Information and dissemination Systems WP 2.

The work plan is presented below.

1. Preparation of the scientific and technical activity (t_0 - t_{0+3})

A first meeting of the Executive Group and Steering Committee will be held as soon as the Co-ordination Action will start. The leader of this Workpackage, S. Thorhallsson (ISOR), and the associated partners will then be in charge of the preparation of the scientific and technical activity:

- Preparing the scientific and technical programme of the launching conference planned to be held at t_{0+3} ; this programme will follow the themes detailed in the work programme; convenors and speakers will be invited.
- Defining the main actions to be undertaken for integration of the scientific and technical know-how and practices
- Proposing to the Steering Committee exchange of personnel for the period t_{0+3} - t_{0+25} (identification of welcoming centres, definition of the motivation for the exchange)
- Defining a publication policy aimed at increasing the scientific quotation of associate members (publication of review articles, special issue of peer-review journals, books, etc.) and promoting geothermal energy (to increase the awareness of policy makers and improve public acceptance).
- Detailed planning of specialised workshop(s) to be held (t_{0+3} - t_{0+25}).

Meetings of the leader of the WP4 and the associated partners will be held at regular intervals in order to follow the scientific and technical programme.

2. Launching conference of the Co-ordination Action (t_{0+3})

The launching conference will be common to all Workpackages. Following this conference, synthesis and integration actions will be launched on the basis of the state-of-the-art presented.

3. Integration of the scientific and technical know-how and practices concerning the drilling and reservoir assessment (t_{0+3} - t_{0+25})

This integration will be carried out according to the defined actions. It will include the exchange of personnel and practical knowledge, analysis and studies. The **specialised Workshop 3 “Stimulation of reservoir and induced microseismicity”** and **Workshop 4 “Drilling cost effectiveness and feasibility of high-temperature drilling”** will form part of this integration process. A mid-term review (t_{0+14}) will be common to all Workpackages during the mid-term conference. The Expert Group working on WP7 will start its work during this mid-term review, and will use the results obtained from integration and studies already achieved. The leader and some members of the WP4 partners will participate in this Expert Group, along with other experts from amongst the network’s partners or other agencies, industry, institutes and research agencies.

4. Final conference of the Co-ordination Action (t_{0+25})

This final conference will be common to all Workpackages. Following this conference, the main studies and integrated models will be synthesised and provide the basis for achieving the publication policy.

5. Achievement of the publication policy (t_{0+30} - t_{0+30})

The leader and associated partners will be in charge of supervising publication of the results.

WP5. Exploitation, economic, environmental and social impacts

The objective of Workpackage 5 is to integrate scientific and technical know-how and practices related to the exploitation, economic, environmental and social impacts. It will pay special attention to the identification and analysis of the environmental and socio-economic barriers that hamper the development of the geothermal industry. It will be carried out in close contact with the Workpackages 3 and 4 in order to collect information concerning the economic factor and cost effectiveness of each scientific and technological approach.

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

5.3 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.

The exchange of personnel constitutes one of the actions that the Co-ordination Action will favour as this is a very efficient way of sharing experience, disseminating best practices and integrating information from different sources.

The specialised workshops already planned concern:

- **Workshop 5 “Electricity generation, combined heat and power”** to be held in France (Guadelupe or Soultz) organised by BRGM with the help of the French partners,

- **Workshop 6 "Increasing policy makers awareness and the public acceptance"**. This workshop will be organized by CRES with the help of the Greek partners and will take place in Milos island (Greece)

Deliverables of this Workpackage are mainly publications and dissemination of information and best practices that will be organised with the support of the Information and dissemination Systems WP2.

The work plan is presented below.

1. Preparation of the scientific and technical activity ($t_0 - t_{0+3}$)

A first meeting of the Executive Group and Steering Committee will be held as soon as the Co-ordination Action will start. The leader of this Workpackage, M. Kaltschmitt (IE), and the associated partners will then be in charge of the preparation of the scientific and technical activity:

- Preparing the scientific and technical programme of the launching conference planned to be held at t_{0+3} ; this programme will follow the themes detailed in the work programme; convenors and speakers will be invited.
- Defining the main actions to be undertaken for integration of the scientific and technical know-how and practices
- Proposing to the Steering Committee exchange of personnel for the period $t_{0+3} - t_{0+25}$ (identification of welcoming centres, definition of the motivation for the exchange)
- Defining a publication policy aimed at increasing the scientific quotation of associate members (publication of review articles, special issue of peer-review journals, books, etc.) and promoting geothermal energy (to increase the awareness of policy makers and improve public acceptance).
- Detailed planning of specialised workshop(s) to be held ($t_{0+3} - t_{0+25}$).

Meetings of the leader of the WP5 and the associated partners will be held at regular intervals in order to follow the scientific and technical programme.

2. Launching conference of the Co-ordination Action (t_{0+3})

The launching conference will be common to all Workpackages. Following this conference, synthesis and integration actions will be launched on the basis of the state-of-the-art presented.

3. Integration of the scientific and technical know-how and practices concerning the development and management of exploitation ($t_{0+3} - t_{0+25}$)

Meetings of the leader of the WP and the associated partners will be held at regular intervals in order to follow the scientific and technical programme. This integration will be carried out according to the defined actions. It will include the exchange of personnel and practical knowledge, analysis and studies. The specialised **Workshop 5 "Electricity generation, combined heat and power"** and **Workshop 6 "Increasing policy makers awareness and the public acceptance"** will form part of this integration process. A mid-term review (t_{0+14}) will be common to all Workpackages during the mid-term conference. The Expert Group working on WP8 will start its work during this mid-term review, and will use the results obtained from integration and studies already achieved. The leader and some members of the WP4 partners will participate in this Expert Group, along with other experts from amongst the network's partners or other agencies, industry, institutes and research agencies.

4. Final conference of the Co-ordination Action (t_{0+25})

This final conference will be common to all Workpackages. Following this conference, the main studies and integrated models will be synthesised and provide the basis for achieving the publication policy.

5. Achievement of the publication policy ($t_{0+30} - t_{0+30}$)

The leader and associated partners will be in charge of supervising publication of the results.

AN EXPERTISE FOR THE "EUROPEAN REFERENCE MANUAL FOR THE DEVELOPMENT OF ENHANCED GEOTHERMAL SYSTEMS": INNOVATIVE CONCEPTS FOR THE INVESTIGATION, RESOURCE ASSESSMENT AND EXPLOITATION OF GEOTHERMAL ENERGY (WP6 TO WP9)

The second strategy of the Co-ordination Action is based on Expert Groups.

WP6. Expertise on investigation of Unconventional Geothermal Systems and Enhanced Geothermal Systems

An Expert Group dedicated to investigation will start to work during the mid-term review (t_{0+14}). Limited to less than 10 participants in order to be efficient, this group, chaired by T. Kohl (GEOWATT AG), will be composed of the leader and some members of the WP3 and will include distinguished experts among the European geothermal community. Contacts will be taken with other experts from the network's partners and other agencies, industry, institutes or research agencies. The exact composition of the expert group will be approved during the second meeting of the Executive Group (t_{0+14}).

The main task of this Expert Group will be to evaluate the most pertinent methods for resource investigation and assessment. Special attention will be paid to topics for which research is still lacking. Besides an updated toolbox, high-level, medium- to longer-term research programmes will be outlined and discussed within the network through the information system. Studies and analysis work, as well as the organisation of meetings, will help the Expert Group to cover all the investigation aspects of Unconventional Geothermal Systems and Enhanced Geothermal Systems. Chapters 1a and 1b of the Best Practice Handbook concerning the "innovative concepts for investigating geothermal energy" and "generic studies for Unconventional Geothermal Resources and Enhanced Geothermal Systems in contrasting geo-environments in Europe" will be the deliverables of this work.

This Expert Group will present the first conclusions of this work during the final conference and finalise its study by integrating all the scientific and technical aspects, as well as the economic and ecological constraints, in close co-operation with the WP7 and WP8 Expert Groups during the last 6 months of the project (t_{0+30} - t_{0+30}). It will thus contribute to part of the European Reference Manual for the development of Enhanced Geothermal Systems, which will make available all information, data and models collected and developed during the Co-ordination Action.

In addition to this synthesis, the links established between the Expert Groups, research and development teams, national development programmes for Energy, industrial partners and industrial advisory and financial agencies, will be used to promote innovative, high-level, medium- to longer-term research projects.

WP7. Expertise on drilling, stimulation and reservoir assessment

An Expert Group dedicated to drilling and reservoir assessment will start work during the mid-term review (t_{0+14}). Limited to less than 10 participants in order to be efficient, this group, chaired by E. Huenges (GFZ Potsdam, Germany), will be composed of the leader and some members of the WP4 and will include distinguished experts among the European geothermal community. Contacts will be taken with other experts from the network's partners and other agencies, industry, institutes or research agencies. The exact composition of the expert group will be approved during the second meeting of the Executive Group (t_{0+14}).

The main task of this Expert Group will be to evaluate how to combine current best practices in the oil and gas industry (with proven track records of sustained cost reduction) and recent experience in geothermal drilling to raise the game by resulting in cheaper wells, eventually leading to improved economics of unconventional geothermal projects. The execution of studies and analysis work and the organisation of meetings will enable the Expert Group to cover all aspects of this question. A chapter 2 of the Best Practice Handbook and the definition of innovative concepts for drilling, stimulation and reservoir assessment will be the deliverables of this work.

This Expert Group will present the first conclusions of this work during the final conference and finalise its study by integrating all scientific and technical aspects, as well as economic and ecological constraints, in close co-operation with the WP6 and WP8 Expert Groups during the last 6 months of the project (t_{0+25} - t_{0+30}). It will thus contribute to part of the European Reference Manual for the development of Unconventional Geothermal Systems and Enhanced Geothermal Systems, which will make available all information collected and conclusions of studies and analyses carried out during the Co-ordination Action.

In addition to this synthesis, the links established between research and development teams, national development programmes for Energy, industrial partners and industrial advisory and financial agencies, will be used to promote innovative, high-level medium- to longer-term research projects.

WP8. Expertise on exploitation, economic, environmental and social impacts

An Expert Group dedicated to exploitation, economic, environmental and social impacts will start work during the mid-term review (t_0+14). Limited to less than 10 participants to be efficient, this group, chaired by C. Karytsas (CRES), will be composed of the leader and some members of the WP5 and of distinguished experts among the European geothermal community, with speciality on matters such as geothermal energy use, geothermal production technology, geothermal economics, geothermal field management, geothermal operations monitoring, geothermal reservoir monitoring, geothermal environmental impact and others. Contacts will be taken with other experts from the network's partners and other agencies, industry, institutes or research agencies. The exact composition of the expert group will be approved during the second meeting of the Executive Group (t_0+14).

The main task of this Expert Group will be to evaluate the exploitation perspectives of the geothermal industry, identify and analyse the environmental and socio-economic barriers that hamper its development. Studies and analysis work, as well as the organisation of meetings, will help the Expert Group cover all the aspects of this question. A chapter 3 of the Best Practice Handbook and the definition of actions to be carried out in order to promote the use of geothermal energy and the investigation of Geothermal Enhanced Systems will be the deliverables of this work.

This Expert Group will present the first conclusions of this work during the final conference and finalise its study by integrating all the scientific and technical aspects, as well as economic and environmental constraints, in close co-operation with the WP6 and WP7 Expert Groups during the last 6 months of the project (t_0+25 - t_0+30). It will thus contribute to part of the European Reference Manual for the development of Unconventional Geothermal Systems and Enhanced Geothermal Systems, which will make available all information collected and conclusions of studies and analyses carried out during the Co-ordination Action.

In addition to this synthesis, the links established between research and development teams, national development programs for Energy, industrial partners and industrial advisory and financial agencies, will be used to promote innovative, high-level, medium- to longer-term research projects.

WP9. Risk evaluation for the development of geothermal energy

An Expert Group chaired by Ad Lockhorst (TNO) will be composed of the leaders of all Workpackages. It will start after the final conference and the presentation of the first conclusion of the Expert Groups (t_0+25 - t_0+30).

Decision support systems enable an evaluation of the technical and socio-economic risk for the development of the geothermal energy. The data that will become available from the updated framework of activities and from the expertise of WP6, WP7, WP8 will be discussed and integrated in such modelling. The final synthesis will be performed by integrating the results of this evaluation as well as the results of the expert groups under the supervision of the Executive Group. A special **Workshop 7 on "Risk analysis for development of geothermal energy"** will also be held in The Netherlands, organised by TNO, in order to elaborate a procedure for selecting discrete and significant parameters for the risk analysis. The scientific and technical European Reference Manual for the development of Unconventional Geothermal Systems and Enhanced Geothermal Systems energy will be the deliverable of this Workpackage. This Manual will make available a synthesis of the Best Practices Handbook and will refer to all information, metadata base, database and models collected and compiled during the Co-ordination Action.

7.3 Graphical presentation of work packages

The breakdown structure, the schematic project network of activity (PERT) and the resources are presented (Figures 3, 4, 5).

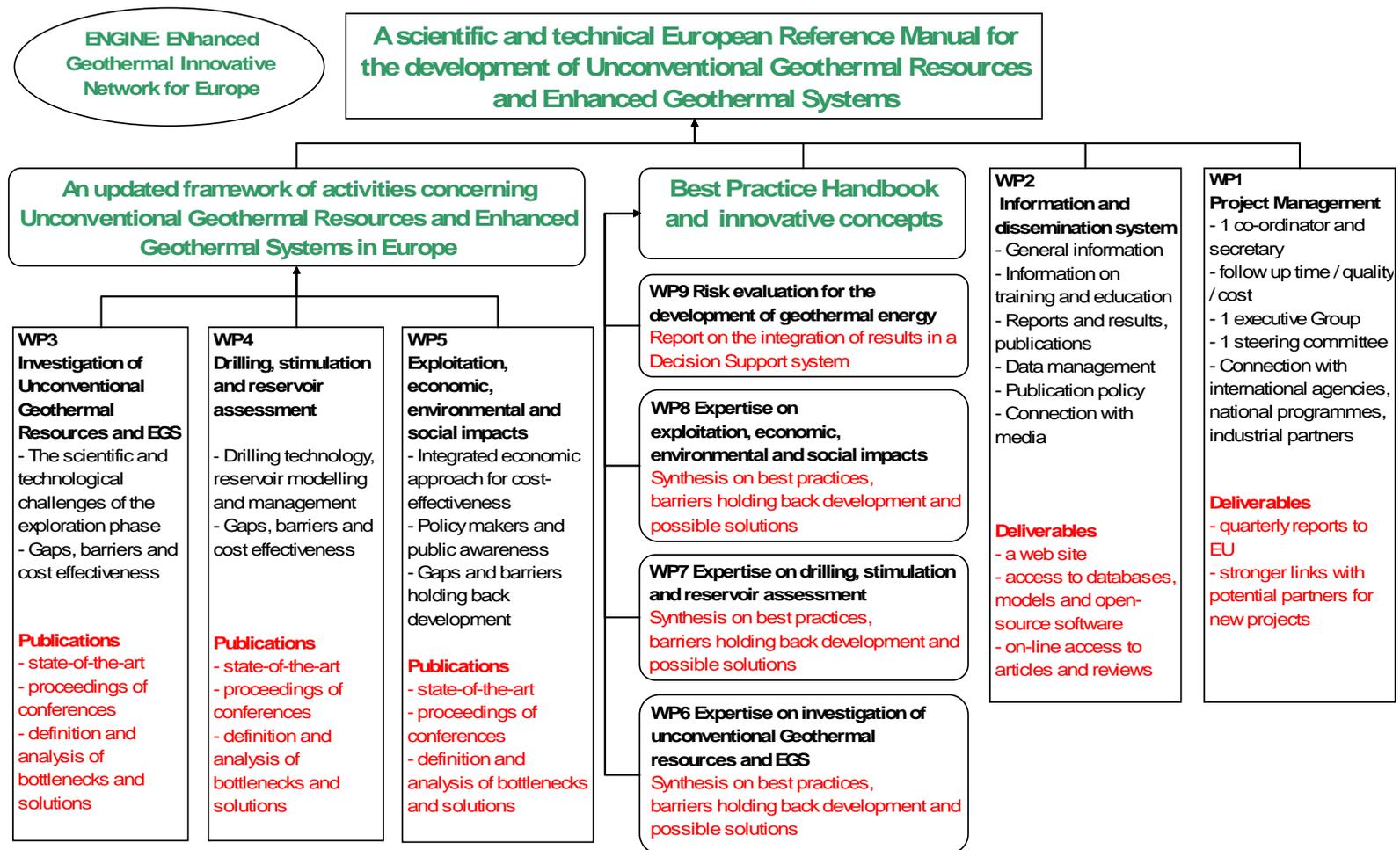


Figure 3. Breakdown of the ENGINE structure, brief description of Workpackages

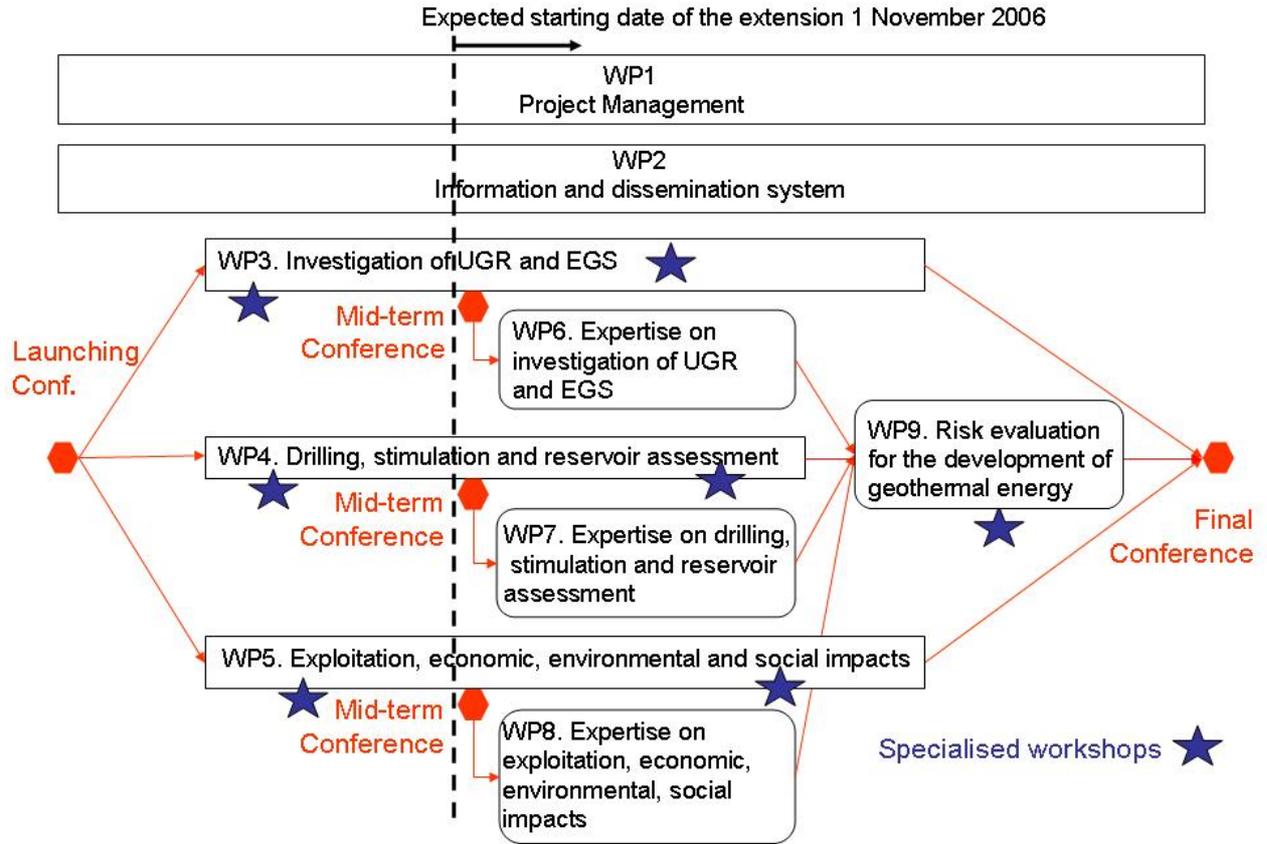


Figure 4. Project network of activity

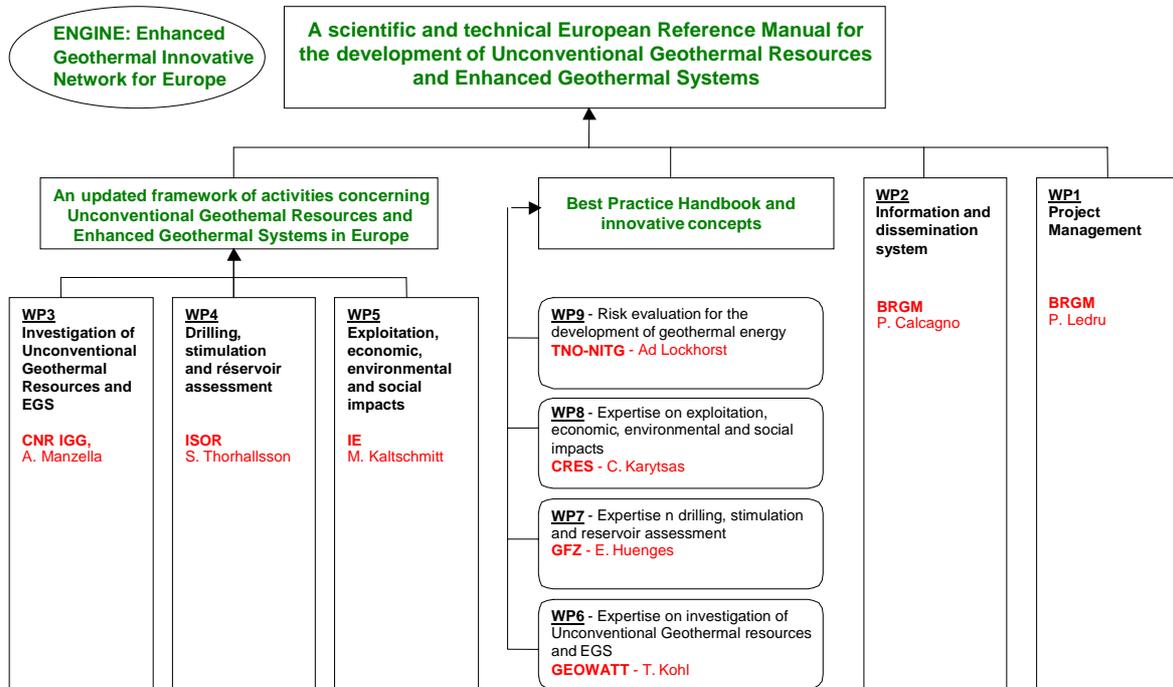


Figure 5. Breakdown of the ENGINE resources and Workpackage leaders

7.4 Work package list

The Coordination Action's effort is divided into 9 work packages. The extension of the ENGINE partnership has no impact on their content.

Work-package N ¹	Workpackage title	Lead contract or No ²	Person-months ³	Start month ⁴	End month ⁵	Deliverable No ⁶
WP 1	Project management	1	7	t1	t30	1-2
WP 2	Information and dissemination system	1	26	t1	t30	3-8
WP 3	Investigation of Unconventional Geothermal Resources and EGS	8	43	t1	t30	9-20
WP 4	Drilling, stimulation and reservoir assessment	4	43	t1	t30	21-29
WP 5	Exploitation, economic, environmental and social impacts	10	39	t1	t30	30-41
WP6	Expertise on investigation of unconventional Geothermal resources and EGS	29	21	t14	t30	42-44
WP7	Expertise on drilling, stimulation and reservoir assessment	3	24	t14	t30	45-46
WP8	Expertise on exploitation, economic, environmental and social impacts	18	15	t14	t30	47-49
WP9	Risk evaluation for the development of geothermal energy	6	20	t25	t30	50-52
	TOTAL		238			

Table 3: Workpackage list (full duration of the project)

¹ Workpackage number: WP 1 – WP n.

² Number of the contractor leading the work in this workpackage.

³ The total number of person-months allocated to each workpackage.

⁴ Relative start date for the work in the specific workpackages, month 0 marking the start of the project, and all other start dates being relative to this start date.

⁵ Relative end date, month 0 marking the start of the project, and all ends dates being relative to this start date.

⁶ Deliverable number: Number for the deliverable(s)/result(s) mentioned in the workpackage: D1 - Dn.

7.5 Deliverables list

The extension of the ENGINE partnership has no impact on the deliverables in terms of nature, dissemination level or delivery date. Each new partner will contribute directly to the preparation of the deliverables corresponding to the work packages they are involved in.

Del n°	Deliverable name	WP n°	Lead participant	Estimated person month	Nature	Dissemination level	Delivery date
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	1		R	PP	t3
2	Six-months reports to the EU Commission	1	1		R	PP	t3
3	A provisional Web site and an electronic monthly newsletter	2	1		O	PP	t3
4	Presentation and documentation of the provisional Web site and of the perspective of the information system at the Launching conference, Session 2	2	1		O	PU	t3
5	Proceedings of the Mid term conference, Session 2. Information and Dissemination System	2	1		R	PU	t14
6	Proceedings of the Final conference, Session 2. Information and Dissemination System	2	1		R	PU	t25
7	A finalised Web site and an Information System (including an electronic monthly newsletter)	2	1		O	PU	t14
8	The bibliography of the Co-ordination Action	2	1		O	PU	t14
9	Proceedings of the Launching conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.	3	8		R	PU	t3
10	Proceedings of the Mid term conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.	3	8		R	PU	t14
11	Proceedings of the Final conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.	3	8		R	PU	t25
12	Guide to the Workshop 1 "Defining, exploring, imaging and assessing reservoirs for potential heat exchange"	3	8		R	PU	t13
13	Guide to the Workshop 2 "Exploring Supercritical fluid reservoir: a new challenge for geothermal energy"	3	8		R	PU	t17
14	A Review article about recent progress in knowledge concerning the European lithosphere and the exploration of EGS	3	8		R	PU	t25
15	A review article about Mechanical behaviour of the upper crust and its response to stress, fluid circulation and heat-flow gradients	3	8		R	PU	t25
16	A review article about Exploring different types of geothermal reservoir	3	8		R	PU	t25
17	A review article about Technological challenge of the investigation phase	3	8		R	PU	t25
18	An inventory of database, maps and models concerning the distribution of heat with the upper crust	3	8		O	RE	t25
19	Reports of study and analysis	3	8		R	PP	t25

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	8		R	PU	t25
21	Proceedings of the Launching conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems	4	4		R	PU	t3
22	Proceedings of the Mid term conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems	4	4		R	PU	t14
23	Proceedings of the Final conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems	4	4		R	PU	t25
24	Guide to the Workshop 3 "Stimulation of reservoir and induced microseismicity"	4	4		R	PU	T8
25	Guide to the Workshop 4 "Drilling cost effectiveness and feasibility of high-temperature drilling "	4	4		R	PU	t19
26	A review article about recent progress in knowledge concerning the Dynamics of the geothermal field	4	4		R	PU	t25
27	A review article about Drilling	4	4		R	PU	t25
28	Reports of study and analysis	4	4		R	PP	t25
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	4		R	PU	t25
30	Proceedings of the Launching conference, Session 5. Exploitation, economic, environmental and social impacts	5	10		R	PU	t3
31	Proceedings of the Mid term conference, Session 5. Exploitation, economic, environmental and social impacts	5	10		R	PU	t14
32	Proceedings of the Final conference, Session 5. Exploitation, economic, environmental and social impacts	5	10		R	PU	t25
33	Guide to the Workshop 5 "Electricity generation, combined heat and power"	5	10		R	PU	t10
34	Guide to the Workshop 6 "Increasing policy makers awareness and the public acceptance"	5	10		R	PU	t21
35	An article about Economic approach of geothermal energy	5	10		R	PU	t25
36	An article about Socio-economic benefits of geothermal exploitations	5	10		R	PU	t25
37	An article about Environmental impacts	5	10		R	PU	t25
38	An article about Increasing policy makers awareness and public acceptance	5	10		R	PU	t25
39	Reports of study and analysis	5	10		R	PP	t25
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	10		R	PU	t25
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	10		R	PU	t25

42	A chapter 1a of the Best Practice Handbook on the definition of innovative concepts for investigating geothermal energy	6	29		R	PU	t30
43	A chapter 1b of the Best Practice Handbook on generic studies for Unconventional Geothermal Resources and Enhanced Geothermal Systems in contrasting geo-environments in Europe	6	29		R	PU	t30
44	A chapter 1 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems	6	29		R	PU	t30
45	A chapter 2 of the Best Practice Handbook and the definition of innovative concepts for drilling, stimulation and reservoir assessment	7	3		R	PU	t30
46	A chapter 2 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems	7	3		R	PU	t30
47	A chapter 3 of the Best Practice Handbook and the definition of innovative concepts for exploitation	8	18		R	PU	t30
48	A chapter 4 of the Best Practice Handbook analyzing the economic, environmental and social impacts	8	18		R	PU	t30
49	A chapter 3 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems	8	18		R	PU	t30
50	Guide to the Workshop 7 "Risk analysis for development of geothermal energy"	9	6		R	PU	t27
51	An article presenting the risk evaluation for the development of geothermal energy	9	6		R	PU	t30
52	European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems	9	6		R	PU	t31
TOTAL							

Table 4. Deliverables list (full duration of the project)

7.6. Work package description (full duration of the project)

Workpackage number	1	Start date or starting event:	t1
Activity type	Management activity		
Participant ID	1		
Person-months per participant:	11		

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.

Description of work

The Co-ordinator (BRGM) will be responsible for the administration and organisation of the network, providing the organisational platform and professional support for the participants and committees. The project management of the Co-ordination Action will be performed by one Co-ordinator, P. Ledru, and one secretary.

The breakdown of the project management will be done according 4 main items:

- 1.1 Ensuring the preparation, start up and closure of the project administration and organisation
- 1.2 Ensuring the reporting with the Authorities of the 6th Framework.
- 1.3 Ensuring the smooth and streamlined information flow within the consortium. The Co-ordinator will be in charge of providing all facilities for the diffusion of information and the organisation of meetings and conferences. A straight link between the Co-ordinator and the President of the Information System Workpackage is thus a key to success of the network.
- 1.4 Ensuring the controlling duties of the project. A project Manual, defining the guidelines, will be prepared by the Co-ordinator and submitted for approval to the Executive Group at the kick-off meeting. The follow-up of the project will respect certain rules (i) quality control of the deliverables, involving internal and external peer review of reports and articles by independent experts, (ii) planning of the time schedule for meetings, reports and milestones, using Microsoft Project software (Fig. 8), (iii) control of the budget and optimisation of the resources allocated to the Co-ordination Action using BRGM's accounting procedure.

The following committees will be set up for the duration of the Co-ordination Action (Fig. 5)

- An Executive Group, composed of members of the institutes at the initiative of this Co-ordination Action, will be in charge of the Direction of the Co-ordination Action and of all decisions regarding significant changes to the work plan. One president will be elected. The Executive Group will follow up connections with international agencies, national programmes, industrial partners, etc. and will be extended with one or two representatives of the TTC partners.
- A Steering Committee composed of the leaders of the Workpackages and Expert Groups. A meeting is planned every six months. E. Huenges has been elected president and A. Manzella Vice-President.

Deliverables

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.
2. Six-months reports to the EU Commission

Milestones and expected results

Meetings of the Steering Committee and Expert Group, expected result is the smooth and streamlined information flow within the consortium and a success of the Co-ordination Action

Workpackage number	2		Start date or starting event:				t1	
Activity type	Co-ordination activity							
Participant ID	1	3	8	15	23	24	29	35
Person-months per participant:	6	4	1	2	2	6	2	1

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

The new partners will be contacted by the workpackage leader, P. Calcagno (BRGM), in order to implement the information system by providing general information about training and education, on-line reports and results, publications, data and metadata base, models, open-source software... They will also contribute to the publication system through scientific publications (peer-review journals, proceedings of conferences and meetings on-line on the Web site) and reports (open file or with access restricted to Co-ordination Action members). They will be involved in the dissemination system by contributing to the Web site and electronic newsletter of the Co-ordination Action and participating to general scientific dissemination (multimedia programmes, articles and information brochures, press releases and media contacts). A special contribution is expected from CICESE as their action in organising training courses and seminars complements the action of IGG and University of Oradea.

Description of work

1. Preparation of the scientific and technical activity (t0 - t0+3)

The leader of this Workpackage, P. Calcagno (BRGM), and the associated partners will be in charge of the following tasks:

- Defining the structure of the Internet site
- Defining the address database and planning for its access as part of the Co-ordination Action
- Preparing a questionnaire about available databases and open-source software
- Providing the information about the exchange of personnel for the period t_{0+3} - t_{0+25} (identifying welcoming centres, defining the motivation for exchange)
- Defining and following up the publication policy with the WP3, WP4 and WP5 leaders

The leader and associated partners will meet as soon as the Co-ordination Action will start. Additional meetings will be held at regular intervals in order to follow the scientific and technical programme.

2. Launching conference of the Co-ordination Action (t0+3)

The launching conference, that will be held in BRGM Orléans and organised with the help of French partners, will be common to all work packages and will involve all the partners. The WP2 leader and the associate partners will present the provisional Web site and the perspective of the information system (Session 2). They will be attentive to all requests from the other work packages concerning matters of communication and information transfer.

3. Organisation and maintenance of the Web site (t0+3 - t0+30)

A mid-term review (t_{0+14}) will be common to all work packages and will involve all the partners. It will be held in Germany and organised by the German partners of the Consortium. The WP2 leader and the associate partners will be attentive to all requests from the other work packages concerning matters of communication and information transfer.

4. Final conference of the Co-ordination Action (t0+25)

This final conference will be common to all work packages and will involve all the partners. The location will be organized Lithuania, one of the new member countries. Following this conference, the main studies and integrated models provided by the different work packages will be put on the Web site. The WP2 leader and the associate partners will be attentive to all requests from the other work packages concerning matters of communication and information transfer.

5. Achievement of the information and publication systems (t0+3 - t0+30)

The WP2 leader and the associate partners will be attentive to all requests from the other work packages concerning their publication policy.

Deliverables

3. A provisional Web site and an electronic monthly newsletter
4. Presentation and documentation of the provisional Web site and of the perspective of the information system at the Launching conference, Session 2
5. Proceedings of the Mid term conference, Session 2. Information and Dissemination System
6. Proceedings of the Final conference, Session 2. Information and Dissemination System
7. A finalised Web site and an Information System including electronic monthly newsletter
8. The bibliography of the Co-ordination Action

Milestones and expected results

Launching, Mid term and final conferences. Expected results are accesses to metadata and data base, models, open-source software

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	34	35	
Person-months per participant:	4	4	1	6	3	3	1	1	4	2	3	3	3	6	2	3	

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.

Description of work

The procedure concerning the integration of scientific and technical know-how and practices is common to all work packages of the integration phase (State-of-the-art, Exchange of personnel, conferences, workshops, studies and analysis, informal meetings...). All the participants share a part of knowledge and practices on these matters. Except for some organisation tasks, like setting up workshops, the Co-ordination will privilege exchanges and knowledge transfer. BRGM, ELTE, GFZ, IGG, IGME, VUA, PGI, GEMRC IPE RAS... have performed studies at the scale of the European lithosphere, associated to large acquisition programmes like EUROPROBE. Numerous datasets, maps and models are available and can be revisited for understanding the thermal budget of the main basins and ranges. Without investment in research, compilation of data can provide new insights on the structure of the upper crust and precious information on favourable zones for developing EGS.

1. Preparation of the scientific and technical activity ($t_0 - t_{0+3}$)

The leader of this Workpackage 3, A. Manzella (IGG), and the associated partners will be in charge of the following tasks:

- Preparing the scientific and technical programme of the launching conference planned to be held at t_{0+3} ; this programme will follow the themes detailed in the work programme; convenors and speakers will be invited.
- Defining the main actions to be undertaken for integration of the scientific and technical know-how and practices
- Proposing to the Steering Committee exchange of personnel for the period $t_{0+3} - t_{0+25}$ (identification of welcoming centres, definition of the motivation for the exchange)
- Defining a publication policy aimed at increasing the scientific quotation of associate members (publication of review articles, special issue of peer-review journals, books, etc.) and promoting geothermal energy (to increase the awareness of policy makers and improve public acceptance).
- Detailed planning of specialised workshop(s) to be held ($t_{0+3} - t_{0+25}$).

These tasks will be launched as soon as the Co-ordination Action will start. Additional meetings of the leader of the WP3 and the associated partners will then be held at regular intervals in order to follow the scientific and technical programme.

2. Launching conference of the Co-ordination Action (t_{0+3})

The launching conference, that will be held in BRGM Orléans and organised with the help of the French partners, will be common to all work packages and will involve all the partners. The results of the preparatory work of the WP3 partners will be presented in a Session (1). Following this conference, synthesis and integration actions will be launched on the basis of the state-of-the-art presented.

3. Integration of scientific and technical know-how and practices concerning the investigation ($t_{0+3} - t_{0+25}$)

This integration will be carried out according to the actions defined by the leader and associated partners. It will include the exchange of personnel and practical knowledge, analysis and studies.

The specialised **Workshop 1 "Defining, exploring, imaging and assessing reservoirs for potential heat "** will be organised by GFZ with the help of the German partners. The specialised **Workshop 2 "Exploring Supercritical fluid reservoir: a new challenge for geothermal energy"** will be organised by IGG in Italy. The dates are arbitrary defined in the Gantt chart (Fig. 7) and will be confirmed by the leader and associated partners. Links will be established between them, the organisers of this workshop and agencies concerned directly or indirectly by geothermal energy. Contacts with the media and dissemination of information will be organised with the leader and associated partners of WP2.

A mid-term review (t_{0+14}) will be common to all work packages and will involve all the partners. It will be held in Germany and organised by the German partners of the Consortium.

IIE and CICESE will participate to the mid-term and final conferences common to all Workpackages and to the specialised workshops. For each of the above, they will contribute to the state-of-the-art 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. Thus, the new partners will prepare these workshop and conference by performing the following tasks:

- a review of previous works that were either published or presented in conferences and technical meetings in their country that would be relevant to this project,
- a coordination with other experts from their country for additional information, if any, that will be presented in the ENGINE's workshops
- a coordination with European experts on topics or expertise that may require complementary information from their countries

The Expert Group working on WP6 will start its work during this mid-term review, and will use the results obtained from the different studies and the integrated models already achieved. It is likely that the leader of WP3 and some partners will participate in this expertise, along with other experts from amongst the network's partners or other agencies, industry, institutes and research agencies.

4. Final conference of the Co-ordination Action (t_{0+24})

This final conference will be common to all work packages and will involve all the partners. The location will be organized Lithuania, one of the new member countries.. Following this conference, the main studies and integrated models will be synthesised and provide the basis for achieving the publication policy.

5. Achievement of the publication policy (t_{0+25} - t_{0+30})

The leader and associated partners will be in charge of supervising publication of the results.

Deliverables

9. Proceedings of the Launching conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.
10. Proceedings of the Mid term conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.
11. Proceedings of the Final conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.
12. Guide to the **Workshop 1 "Defining, exploring, imaging and assessing reservoirs for potential heat exchange"**
13. Guide to the **Workshop 2 "Exploring Supercritical fluid reservoir: a new challenge for geothermal energy"**
14. A review article about recent progress in knowledge concerning the European lithosphere and the exploration of EGS
15. A review article about Mechanical behaviour of the upper crust and its response to stress, fluid circulation and heat-flow gradients
16. A review article about Exploring different types of geothermal reservoir
17. A review article about Technological challenge of the investigation phase
18. An inventory of database, maps and models concerning the distribution of heat with the upper crust
19. Reports of study and analysis
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

Milestones and expected results

1. Launching, Mid term and final conferences. Expected results are publications
2. Workshops. Expected results are publications and exchange of information and best practices

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	33	34	36							
Person-months	3	3	6	1	2	1	2	3	1	4	2	2	2	2	3	3	3	2	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.

Description of work

The procedure concerning the integration of scientific and technical know-how and practices is common to all work packages of the integration phase (State-of-the-art, Exchange of personnel, conferences, workshops, studies and analysis, informal meetings...). All the participants share a part of knowledge and practices on these matters. Except for some organisation tasks, like setting up workshops, the Co-ordination will privilege exchanges and knowledge transfer. The very large panel of participants involved in this Workpackage shows the importance of this topic for the future development of geothermal energy. The range of competencies that demonstrates interest on drilling and reservoir assessment is already a very positive aspect of this Co-ordination Action.

1. Preparation of the scientific and technical activity ($t_0 - t_{0+3}$)

The leader of this Workpackage 4, S. Thorhallsson (ISOR), and the associated partners will be in charge of the following tasks:

- Preparing the scientific and technical programme of the launching conference planned to be held at t_{0+3} ; this programme will follow the themes detailed in the work programme; convenors and speakers will be invited.
- Defining the main actions to be undertaken for integration of the scientific and technical know-how and practices
- Preparing a call for tender for the exchange of personnel for the period $t_{0+3} - t_{0+25}$ (identification of welcoming centres, definition of the motivation for the exchange)
- Defining a publication policy aimed at increasing the scientific quotation of associate members (publication of review articles, special issue of peer-review journals, books, etc.) and promoting geothermal energy (to increase the awareness of policy makers and improve public acceptance).
- Detailed planning of specialised workshop(s) to be held ($t_{0+3} - t_{0+25}$).

These tasks will be launched as soon as the Co-ordination Action will start. Additional meetings of the leader of the WP4 and the associated partners will then be held at regular intervals in order to follow the scientific and technical programme.

2. Launching conference of the Co-ordination Action (t_{0+3})

The launching conference, that will be held in BRGM Orléans and organised with the help of the French partners, will be common to all work packages and will involve all the partners. The results of the preparatory work of the WP4 partners will be presented in a Session (2). Following this conference, synthesis and integration actions will be launched on the basis of the state-of-the-art presented.

3. Integration of the scientific and technical know-how and practices concerning the drilling, stimulation and reservoir assessment ($t_{0+3} - t_{0+30}$)

This integration will be carried out according to the actions defined by the leader and associated partners. It will include the exchange of personnel and practical knowledge, analysis and studies.

The specialised **Workshop 3 "Stimulation of reservoir and induced microseismicity"** organised by GEOWATT in

Switzerland and **Workshop 4 "Drilling cost effectiveness and feasibility of high-temperature drilling"** organised by ISOR in Iceland will form part of this integration process. The dates are arbitrary defined in the Gantt chart (Fig. 8) and will be confirmed by the leader and associated partners.

A mid-term review (**t₀+14**) will be common to all work packages and will involve all the partners. It will be held in Germany and organised by the German partners of the Consortium.

FEDCO, IEE and LaGeo will participate to the mid-term and final conferences common to all Workpackages and to the specialised workshop focused on "Drilling cost effectiveness and feasibility of high-temperature drilling". For each of the above, they will contribute to the state-of-the-art 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. Thus, the new partners will prepare these workshop and conference by performing the following tasks:

- a review of previous works that were either published or presented in conferences and technical meetings in their country that would be relevant to this project,
- a coordination with other experts from their country for additional information, if any, that will be presented in the ENGINE's workshops
- a coordination with European experts on topics or expertise that may require complementary information from their countries

The Expert Group working on WP7 will start its work during this mid-term review, and will use the results obtained from the different studies and the integrated models already achieved. It is likely that the leader of WP4 and some partners will participate in this group, along with other experts from amongst the network's partners or other agencies, industry, institutes and research agencies.

4. Final conference of the Co-ordination Action (t₀+25)

This final conference will be common to all work packages and will involve all the partners. The location will be organized Lithuania, one of the new member countries. Following this conference, the main studies and integrated models will be synthesised and provide the basis for achieving the publication policy.

5. Achievement of the publication policy (t₀+25 - t₀+30)

The leader and associated partners will be in charge of supervising publication of the results.

Deliverables

21. Proceedings of the Launching conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems
22. Proceedings of the Mid term conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems
23. Proceedings of the Final conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems
24. Guide to the **Workshop 3 "Stimulation of reservoir and induced microseismicity"**
25. Guide to the **Workshop 4 "Drilling cost effectiveness and feasibility of high-temperature drilling"**
26. A review article about recent progress in knowledge concerning the Dynamics of the geothermal field
27. A review article about Drilling
28. Reports of study and analysis
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

Milestones and expected results

1. Launching, Mid term and final conferences. Expected results are publications
2. Workshops. Expected results are publications and exchange of information and best practices

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	33	36	
Person-months per participant:	2	3	1	3	1	5	6	4	3	2	3	3	5	1	3	2	

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.

Description of work

The procedure concerning the integration of scientific and technical know-how and practices is common to all Workpackages of the integration phase (State-of-the-art, Exchange of personnel, conferences, workshops, studies and analysis, informal meetings...). All the participants share a part of knowledge and practices on these matters. Except for some organisation tasks, like setting up workshops, the Co-ordination will privilege exchanges and knowledge transfer.

1. Preparation of the scientific and technical activity ($t_0 - t_{0+3}$)

The leader of this Workpackage 5, M. Kaltschmitt (IE), and the associated partners will be in charge of the following tasks:

- Preparing the scientific and technical programme of the launching conference planned to be held at t_{0+3} ; this programme will follow the themes detailed in the work programme; convenors and speakers will be invited.
- Defining the main actions to be undertaken for integration of the scientific and technical know-how and practices
- Preparing a call for tender for the exchange of personnel for the period $t_{0+3} - t_{0+25}$ (identification of welcoming centres, definition of the motivation for the exchange)
- Defining a publication policy aimed at increasing the scientific quotation of associate members (publication of review articles, special issue of peer-review journals, books, etc.) and promoting geothermal energy (to increase the awareness of policy makers and improve public acceptance).
- Detailed planning of specialised workshop(s) to be held ($t_{0+3} - t_{0+25}$).

These tasks will be launched as soon as the Co-ordination Action will start. Additional meetings of the leader of the WP5 and the associated partners will then be held at regular intervals in order to follow the scientific and technical programme. Contacts will be established with scientists, economists, environmentalists and sociologists with previous experience in such evaluations.

2. Launching conference of the Co-ordination Action (t_{0+3})

The launching conference, that will be held in BRGM Orléans and organised with the help of the French partners, will be common to all Workpackages and will involve all the partners. The results of the preparatory work of the WP5

partners will be presented in a Session 3. Following this conference, synthesis and integration actions will be launched on the basis of the state-of-the-art presented.

3. Integration of the scientific and technical know-how and practices concerning the exploitation, economic, environmental and social impacts (t0+3 - t0+25)

This integration will be carried out according to the actions defined by the leader and associated partners. It will include the exchange of personnel and practical knowledge, analysis and studies.

The specialised **Workshop 5 "Electricity generation, combined heat and power"** is planned to be organised in Guadalupe or in Sultz by BRGM with the help of the French partners. The specialised **Workshop 6 "Increasing policy makers awareness and the public acceptance"** is planned to be organised by CRES on Milos island in Greece. The dates are arbitrary defined in the Gantt chart (Fig. 8) and will be confirmed by the leader and associated partners.

A mid-term review (t₀₊₁₄) will be common to all Workpackages and will involve all the partners. It will be held in Germany and organised by the German partners of the Consortium.

FEDCO and LaGeo will participate to the mid-term and final conferences common to all Workpackages and to a specialised workshop focused on "Increasing policy makers awareness and the public acceptance". For each of the above, they will contribute to the state-of-the-art 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. Thus, the new partners will prepare these workshop and conference by performing the following tasks:

- a review of previous works that were either published or presented in conferences and technical meetings in their country that would be relevant to this project,
- a coordination with other experts from their country for additional information, if any, that will be presented in the ENGINE's workshops
- a coordination with European experts on topics or expertise that may require complementary information from their countries

The Expert Group working on WP8 will start its work during this mid-term review, and will use the results obtained from the different studies and the integrated models already achieved. It is likely that the leader and some partners of WP5 will participate in this group, along with other experts from amongst the network's partners or other agencies, industry, institutes and research agencies.

4. Final conference of the Co-ordination Action (t0+25)

This final conference will be common to all work packages and will involve all the partners. The location will be organized Lithuania, one of the new member countries. Following this conference, the main studies and integrated models will be synthesised and provide the basis for achieving the publication policy.

5. Achievement of the publication policy (t0+25 - t0+30)

The leader and associated partners will be in charge of supervising publication of the results.

Deliverables

30. Proceedings of the Launching conference, Session 5. Exploitation, economic, environmental and social impacts
31. Proceedings of the Mid term conference, Session 5. Exploitation, economic, environmental and social impacts
32. Proceedings of the Final conference, Session 5. Exploitation, economic, environmental and social impacts
33. Guide to the **Workshop 5 "Electricity generation, combined heat and power"**
34. Guide to the **Workshop 6 "Increasing policy makers awareness and the public acceptance"**
35. An article about Economic approach of geothermal energy
36. An article about Socio-economic benefits of geothermal exploitations
37. An article about Environmental impacts
38. An article about Increasing policy makers awareness and public acceptance
39. Reports of study and analysis
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
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

Milestones and expected results

1. Launching, Mid term and final conferences. Expected results are publications
2. Workshops. Expected results are publications and exchange of information and best practices

Workpackage number	6			Start date or starting event:				t14				
Activity type	Co-ordination activity											
Participant ID	1	3	4	6	8	11	14	17	22	25	29	35
Person-months per participant:	1	2	1	1	2	2	1	2	2	4	6	2

Objectives, Expertise on investigation of Unconventional Geothermal Resources and EGS

The objective of this expertise is, using information collected during the integration phase of the Co-ordination Action, an evaluation of the most pertinent methods for resource investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems. Generic studies for such resources will be realised in contrasting geo-environments in Europe. Two chapters 1a and 1b of the Best Practice Handbook concerning the definition of innovative concepts for investigating geothermal energy and Highlights of Generic studies for Unconventional Geothermal Resources and Enhanced Geothermal Systems in contrasting geo-environments in Europe will be the deliverables of this work.

Description of work

An Expert Group dedicated to investigation will start to work during the mid-term review (t_{0+14}). Limited to less than 10 participants in order to be efficient, this group, chaired by T. Kohl (GEOWATT, Switzerland), will be composed of the leader and some members of the WP3 and will include distinguished experts among the European geothermal community. Contacts will be taken with other experts from the network's partners and other agencies, industry, institutes or research agencies. The exact composition of the expert group will be approved during the second meeting of the Executive Group (t_{0+14}).

The main task of this Expert Group will be to evaluate the most pertinent methods for resource investigation and assessment. Special attention will be paid to topics for which research is still lacking. Besides an updated toolbox, high-level, medium- to longer-term research programmes will be outlined and discussed within the network through the information system. Studies and analysis work, as well as the organisation of meetings, will help the Expert Group cover all the exploration aspects of Unconventional Geothermal Resources and Enhanced Geothermal Systems. A chapter 1a of the Best Practice Handbook and the definition of innovative concepts for investigating geothermal energy will be the deliverables of this work.

This Expert Group will finalise its study by integrating all the scientific and technical aspects, as well as the economic and ecological constraints, in close co-operation with the WP7 and WP8 Expert Groups during the last 6 months of the project (t_{0+25} - t_{0+30}). It will thus contribute to part of the "European Reference Manual for the development of "Unconventional Geothermal Resources and Enhanced Geothermal Systems", which will make available all information, data and models collected and developed during the Co-ordination Action.

The participation of CICESE, representing a Third Party Country will strengthen the links established between the Expert Groups, research and development teams, national development programmes for Energy, industrial partners and industrial advisory and financial agencies. These links will be used to promote innovative, high-level, medium- to longer-term research projects.

Deliverables

42. A chapter 1a of the Best Practice Handbook on the definition of innovative concepts for investigating geothermal energy
43. A chapter 1b of the Best Practice Handbook on generic studies for Unconventional Geothermal Resources and Enhanced Geothermal Systems in contrasting geo-environments in Europe
44. A chapter 1 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems

Milestones and expected results

Final conference. The presentation of the main results of the integration and synthesis phases will be presented and should motivate a larger community to present new innovative integrated projects.

Workpackage number	7					Start date or starting event:					t14					
Activity type	Co-ordination activity															
Participant ID	1	3	4	6	13	14	16	19	20	21	28	31	32	33	34	36
Person-months per participant:	1	6	1	1	2	1	3	1	1	1	3	2	2	1	1	1

Objectives, Expertise on drilling, stimulation and reservoir assessment

The objective of this expertise is, using information collected during the integration phase of the Co-ordination Action, an evaluation of the most pertinent methods for drilling and reservoir assessment. A chapter 2 of the Best Practice Handbook and the definition of innovative concepts will be the deliverables of this work.

Description of work (indicating the role of each partner involved)

An Expert Group dedicated to drilling and reservoir assessment will start work during the mid-term review (t_{0+14}). Limited to less than 10 participants in order to be efficient, this group, chaired by E. Huenges (GFZ, Germany), will be composed of the leader and some members of the WP4 and will include distinguished experts among the European geothermal community. Contacts will be taken with other experts from the network's partners and other agencies, industry, institutes or research agencies. The exact composition of the expert group will be approved during the second meeting of the Executive Group (t_{0+14}).

The main task of this Expert Group will be to evaluate how to combine current best practices in the oil and gas industry (with proven track records of sustained cost reduction) and recent experience in geothermal drilling to raise the game by resulting in cheaper wells, eventually leading to improved economics of conventional geothermal and EGS projects. The execution of studies and analysis work and the organisation of meetings will enable the Expert Group to cover all aspects of drilling and reservoir technology. The participants to this expert group, like BRGM, GFZ, Shell, ISOR, DHMA... have a sound experience in drilling for scientific or applied purposes while the others are currently involved in the follow up of geothermal drilling. A chapter 2 of the Best Practice Handbook and the definition of innovative concepts for drilling and reservoir assessment will be the deliverables of this work.

This Expert Group will finalise its study by integrating all scientific and technical aspects, as well as economic and ecological constraints, in close co-operation with the WP6 and WP8 Expert Groups during the last 6 months of the project (t_{0+25} - t_{0+30}). It will thus contribute to part of the "European Reference Manual for the development of "Unconventional Geothermal Resources and Enhanced Geothermal Systems", which will make available all information collected and conclusions of studies and analyses carried out during the Co-ordination Action.

The participation of FEDCO, IIE and LaGeo, representing Third Party Countries, will strengthen the links established between the Expert Groups, research and development teams, national development programmes for Energy, industrial partners and industrial advisory and financial agencies. These links will be used to promote innovative, high-level, medium- to longer-term research projects.

Deliverables

45. A chapter 2 of the Best Practice Handbook and the definition of innovative concepts for drilling, stimulation and reservoir assessment
46. A chapter 2 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems

Milestones and expected results

Final conference. The presentation of the main results of the integration and synthesis phases will be presented and should motivate a larger community to present new innovative integrated projects.

Workpackage number	8			Start date or starting event:				t14				
Activity type	Co-ordination activity											
Participant ID	1	3	7	9	10	18	22	26	27	33	34	36
Person-months per participant:	1	1	2	2	2	5	2	3	2	1	1	1

Objectives, Expertise on exploitation, economic, environmental and social impacts

The objective of this expertise is, using information collected during the integration phase of the Co-ordination Action, an evaluation of the most pertinent methods for exploitation of the geothermal resource. The economic, environmental and social impacts will be illustrated and proposals for promotion of the positive impacts will be made. A chapter 3 of the Best Practice Handbook and the definition of innovative concepts will be the deliverables of this work.

Description of work

An Expert Group dedicated to exploitation, economic, environmental and social impacts will start work during the mid-term review (t_{0+14}). Limited to less than 10 participants to be efficient, this group, chaired by Dr. C. Karytsas (CRES), will be composed of the leader and some members of the WP5 and will include distinguished experts among the European geothermal community. Contacts will be taken with other experts from the network's partners and other agencies, industry, institutes or research agencies. The exact composition of the expert group will be approved during the second meeting of the Executive Group (t_{0+14}).

The main task of this Expert Group will be to evaluate the exploitation perspectives of the geothermal industry, identify and analyse the environmental and socio-economic barriers that hamper its development. Studies and analysis work, as well as the organisation of meetings, will help the Expert Group cover all the aspects of this question. The expert group will work on aspects such as geothermal energy use (electricity generation, direct heat applications, conversion efficiency), geothermal production technology (submersible pumps, piping and surface equipment, power plant, heat exchangers, district heating equipment, automation, materials selection, etc.), geothermal economics (capital and operation costs, return on investment, payback, etc.), geothermal field management (remote control, heat supply, geothermal energy extraction rate, land use, reinjection, maintenance, etc.), geothermal operations monitoring (pressure, temperature and chemistry transients, monitoring equipment), geothermal reservoir monitoring (3D physical and chemical properties, porosity and permeability changes, heat recovery, etc), geothermal environmental impact (non-condensable gases, heat pollution, noise, subsidence) and others.

The participants to this expert group are mainly exploitation-oriented firms and have a good knowledge of the geothermal market and economics, as well as the environmental and socio-economic barriers that hamper the development of geothermal energy. A chapter 3 of the Best Practice Handbook and the definition of actions to be carried out in order to promote the use of geothermal energy will be the deliverables of this work.

This Expert Group will finalise its study by integrating all the scientific and technical aspects regarding power generation, direct heat applications and especially cogeneration of heat and power which results in superior conversion efficiencies and significant lower geothermal energy costs, always targeting the exploitation of enhanced geothermal systems in both immediate and distant future, as well as economic and environmental constraints, in close co-operation with the WP6 and WP7 Expert Groups during the last 6 months of the project ($t_{0+25} - t_{0+30}$). It will thus contribute to part of the "European Reference Manual for the development of "Unconventional Geothermal Resources and Enhanced Geothermal Systems ", which will make available all information collected and conclusions of studies and analyses carried out during the Co-ordination Action. Special attention will be paid in ways and methodology of costs reduction aiming in coordinating research towards improving significantly the geothermal economics and making the exploitation of enhanced geothermal systems competitive to the today and future energy market.

The participation of FEDCO, IIE and LaGeo, representing Third Party Countries, will strengthen the links established between the Expert Groups, research and development teams, national development programmes for Energy, industrial partners and industrial advisory and financial agencies. These links will be used to promote innovative, high-level, medium- to longer-term research projects. The expert group will identify the technology needs of the geothermal production industry towards the exploitation of enhanced, and propose research actions aiming in improving geothermal technology, either by adapting existing technology to enhance geothermal systems parameters (short term) or by seeking new and more cost effective geothermal production technologies (long term).

Deliverables

- 47. A chapter 3 of the Best Practice Handbook and the definition of innovative concepts for exploitation
- 48. A chapter 4 of the Best Practice Handbook analysing the economic, environmental and social impacts
- 49. A chapter 3 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems

Milestones and expected results

Final conference. The presentation of the main results of the integration and synthesis phases will be presented and should motivate a larger community to present new innovative integrated projects.

Workpackage number	9				Start date or starting event:						t25				
Activity type	Co-ordination activity														
Participant ID	1	3	4	6	7	10	11	16	18	20	26	27	29	30	
Person-months per participant:	1	1	1	5	1	1	1	1	1	1	1	1	1	1	

Objectives, Risk evaluation for the development of geothermal energy

The objective of this expertise is a technical and socio-economic risk evaluation for the development of geothermal energy taking into account the information collected during the bottom up and expertise phases of the Co-ordination Action. It will also aggregate the main conclusions of each expertise. A European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems will result of this work.

Description of work

A risk evaluation for the development of geothermal energy will be performed by A. Lokhorst (TNO, The Netherlands), with the participation of the leaders of all Workpackages. This aggregation work will be performed under the supervision of the Executive Group. The risk analysis will include technical and the socio-economic aspects, whereas their impact will be made transparent to decision makers by using a decision support approach.

The work will start at (t_{0+25}) during the final conference, 1 year after the start of WP6-WP8, and will incorporate the results of these Expert Groups.

The following work breakdown is foreseen:

- Review of existing risk analysis approaches in geothermal energy with special attention to probabilistic risk propagation.
- A scientific and technical European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems, that will aggregate the main conclusions of each expertise, will be the main deliverable of this Workpackage. This Manual will make available a synthesis of the main chapters of the Best Practices Handbook and will refer to all information (metadata base, database and models) collected and compiled during the Co-ordination Action and the risk evaluation for the development of geothermal energy.

A special **Workshop 7** will be organised “**Risk analysis for the development of geothermal energy**” by TNO in the Netherlands. The participation of most of the key persons of the Co-ordination Action will be strongly encouraged.

Deliverables

50. Guide to the **Workshop 7 "Risk analysis for development of geothermal energy"**
51. An article presenting the risk evaluation for the development of geothermal energy
52. European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems

Milestones and expected results

Final meeting. The presentation of the main results of the integration and synthesis phases will be presented and should motivate policy makers to support new integrated projects.

8. Project resources and budget overview**8.1 Efforts for the project (Coordination Action Effort Form in Appendix 1)****CA Project Effort Form 1****Full duration of the project**

(insert the planned person-months for each activity in which a partner is involved)

Project acronym ENGINE

	1 BRGM	3 GFZ	4 ISOR	5 Shell	6 TNO	7 IGR	8 IGG	9 CFG	10 IE	11 ELTE	12 CNRS	13 GGA	14 GEIE	15 IGGL	16 MeSy	17 VUA	Total 1
Co-ordination activities																	
WP 2 Information and dissemination system	6	4					1							2			13
WP 3 Investigation of UGR and EGS	4	4	1				6			3	3	1	1	4	2	3	32
WP 4 Drilling, stimulation and reservoir assessment	4	3	6	1			2	1			2	3	1		4		27
WP 5 Exploitation, economic, environmental and social impacts	2	3			1	3	1	5	6								21
WP6. Expertise on investigation of UGR and EGS	1	2	1		1		2			2			1			2	12
WP7 Expertise on drilling, stimulation and reservoir assessment	1	6	1		1							2	1		3		15
WP8 Expertise on exploitation, economic, environmental and social impacts	1	1				2		2	2								8
WP9. Risk evaluation for the development of geothermal energy	1	1	1		5	1			1	1					1		12
Total co-ordination activities	20	24	10	1	8	6	12	8	9	6	5	6	4	6	10	5	140
Management activities																	
WP 1 Project management	11																11
Total management activity	11																11
TOTAL (ALL ACTIVITIES)	31	24	10	1	8	5	12	8	9	6	5	6	4	6	10	5	151

CA Project Effort Form 2
Full duration of the project

(insert the planned person-months for each activity in which a partner is involved)

Project acronym ENGINE

	18 CRES	19 NSCR D	20 GPC	21 IFE	22 PGI	23 GEUS	24 UOR	25 GEMR C	26 IVTRA N	27 JSC "Intergeot herm"	28 DHMA	29 Geowa tt AG	30 Orme	31 IGME	32 CERT H	Total 2	Total 1+2
Co-ordination activities																	
WP 2 Information and dissemination system						2	6					2				10	23
WP 3 Investigation of UGR and EGS	3				3			6								12	44
WP 4 Drilling, stimulation and reservoir assessment		2	2	2		2					3			3	3	17	44
WP 5 Exploitation, economic, environmental and social impacts	4				3	2			3	3			5	1		21	42
WP6. Expertise on investigation of UGR and EGS					2			4				6				12	24
WP7 Expertise on drilling, stimulation and reservoir assessment		1	1	1							3			2	2	10	25
WP8 Expertise on exploitation, economic, environmental and social impacts	5				2				2	2						11	19
WP9. Risk evaluation for the development of geothermal energy	1		1						1	1		1	1			6	18
Total co-ordination activities	13	3	4	3	10	6	6	10	6	6	6	9	6	6	5	99	239
Management activities																	
WP 1 Project management																	11
Total management activity																	11
TOTAL (ALL ACTIVITIES)	13	3	4	3	10	6	6	10	6	6	6	9	6	6	5	99	250

CA Project Effort Form 3
Full duration of the project

(insert the planned person-months for each activity in which a partner is involved)

ENGINE TTC	33 FEDCO	34 IEE	35 CICESE	36 LaGeo	Total 3	Total 1+2+3
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Co-ordination activities						
WP 2. Information and dissemination system			1		1	24
WP 3. Investigation of UGR and EGS		2	3		5	49
WP 4. Drilling, stimulation and reservoir assessment	2	3		3	8	52
WP 5. Exploitation, economic, environmental and social impacts	3			2	5	47
WP6. Expertise on investigation of UGR and EGS			2		2	28
WP7. Expertise on drilling, stimulation and reservoir assessment	1	1		1	3	28
WP8. Expertise on exploitation, economic, environmental and social impacts	1	1		1	3	22
WP9. Risk evaluation for the development of geothermal energy						18
Total co-ordination activities	7	7	6	7	27	266

Management activities						
WP 1. Project management						11
Total management activity						11
TOTAL (ALL ACTIVITIES)	7	7	6	7	27	277

8.2 Overall budget for the project (Forms A3.1 & A3.2 from CPFs)

The overall budget is fixed at 2 099 289 €, in conformity with the financial contribution of the Commission. One partner has renounced to join the CA (ENEL) and one has been declared ineligible (IGA). One new partner, the Institute for Geothermal Research from Russian Federation (Republic of Daghestan) has joined the CA, in close association with IVTRAN with which the budget has been partly shared. The exceeding budget has been provisionally affected to BRGM. This money will be used to cover expenses for the invitation of experts to some meeting and workshop, among which the President of IGA-EB, K. Popovski.

Proposal Number		019760		Proposal Acronym		ENGINE			
Financial information - whole duration of the project									
Participant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)	Costs and EC contribution per type of activities			Total (4)=(1)+(2)+(3)	Total receipts	
				Coordination activities (1)	Training activities (2)	Consortium Management activities (3)			
1	BRGM	FC	Eligible costs	Direct Costs (a)	191 092,00	,00	126 129,00	317 221,00	,00
				of which subcontracting	,00	,00	52 000,00	52 000,00	
				Indirect costs (b)	38 218,00	,00	25 226,00	63 444,00	
				Total eligible costs (a)+(b)	229 310,00	,00	151 355,00	380 665,00	
			Requested EC contribution	229 310,00	,00	151 355,00	380 665,00		
3	GFZ	AC	Eligible costs	Direct Costs (a)	146 153,00	,00	,00	146 153,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	29 231,00	,00	,00	29 231,00	
				Total eligible costs (a)+(b)	175 384,00	,00	,00	175 384,00	
			Requested EC contribution	175 384,00	,00	,00	175 384,00		
4	ISOR	FC	Eligible costs	Direct Costs (a)	134 000,00	,00	,00	134 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	26 800,00	,00	,00	26 800,00	
				Total eligible costs (a)+(b)	160 800,00	,00	,00	160 800,00	
			Requested EC contribution	160 800,00	,00	,00	160 800,00		
5	SIEP B.V.	FC	Eligible costs	Direct Costs (a)	5 000,00	,00	,00	5 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	1 000,00	,00	,00	1 000,00	
				Total eligible costs (a)+(b)	6 000,00	,00	,00	6 000,00	
			Requested EC contribution	6 000,00	,00	,00	6 000,00		

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Action**

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Proposal Number	019760	Proposal Acronym	ENGINE
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Financial information - whole duration of the project

Participat n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+(3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
6	TNO	FC	Eligible costs	Direct Costs (a)	104 000,00	,00	,00	104 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	20 800,00	,00	,00	20 800,00	
				Total eligible costs (a)+(b)	124 800,00	,00	,00	124 800,00	
			Requested EC contribution	124 800,00	,00	,00	124 800,00		
7	IGR DSC RAS	FC	Eligible costs	Direct Costs (a)	14 000,00	,00	,00	14 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	2 800,00	,00	,00	2 800,00	
				Total eligible costs (a)+(b)	16 800,00	,00	,00	16 800,00	
			Requested EC contribution	16 800,00	,00	,00	16 800,00		
8	IGG	FC	Eligible costs	Direct Costs (a)	84 000,00	,00	,00	84 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	16 800,00	,00	,00	16 800,00	
				Total eligible costs (a)+(b)	100 800,00	,00	,00	100 800,00	
			Requested EC contribution	100 800,00	,00	,00	100 800,00		
9	CFG Services	FC	Eligible costs	Direct Costs (a)	71 000,00	,00	,00	71 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	14 200,00	,00	,00	14 200,00	
				Total eligible costs (a)+(b)	85 200,00	,00	,00	85 200,00	
			Requested EC contribution	85 200,00	,00	,00	85 200,00		

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Financial information - whole duration of the project

Participant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+(3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
10	IE	FC	Eligible costs	Direct Costs (a)	63 000,00	,00	,00	63 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	12 600,00	,00	,00	12 600,00	
				Total eligible costs (a)+(b)	75 600,00	,00	,00	75 600,00	
			Requested EC contribution	75 600,00	,00	,00	75 600,00		
11	ELTE	AC	Eligible costs	Direct Costs (a)	45 000,00	,00	,00	45 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	9 000,00	,00	,00	9 000,00	
				Total eligible costs (a)+(b)	54 000,00	,00	,00	54 000,00	
			Requested EC contribution	54 000,00	,00	,00	54 000,00		
12	CNRS	FCF	Eligible costs	Direct Costs (a)	37 000,00	,00	,00	37 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	7 400,00	,00	,00	7 400,00	
				Total eligible costs (a)+(b)	44 400,00	,00	,00	44 400,00	
			Requested EC contribution	44 400,00	,00	,00	44 400,00		
13	GGA-Institute	FC	Eligible costs	Direct Costs (a)	37 000,00	,00	,00	37 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	7 400,00	,00	,00	7 400,00	
				Total eligible costs (a)+(b)	44 400,00	,00	,00	44 400,00	
			Requested EC contribution	44 400,00	,00	,00	44 400,00		

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Financial information - whole duration of the project									
Partici pant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+ (3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
14	GEIE	FC	Eligible costs	Direct Costs (a)	7 000,00	,00	,00	7 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	1 400,00	,00	,00	1 400,00	
				Total eligible costs (a)+(b)	8 400,00	,00	,00	8 400,00	
			Requested EC contribution	8 400,00	,00	,00	8 400,00		
15	IGGL	AC	Eligible costs	Direct Costs (a)	16 000,00	,00	,00	16 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	3 200,00	,00	,00	3 200,00	
				Total eligible costs (a)+(b)	19 200,00	,00	,00	19 200,00	
			Requested EC contribution	19 200,00	,00	,00	19 200,00		
16	MeSy	FC	Eligible costs	Direct Costs (a)	67 000,00	,00	,00	67 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	13 400,00	,00	,00	13 400,00	
				Total eligible costs (a)+(b)	80 400,00	,00	,00	80 400,00	
			Requested EC contribution	80 400,00	,00	,00	80 400,00		
17	VUA	AC	Eligible costs	Direct Costs (a)	32 000,00	,00	,00	32 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	6 400,00	,00	,00	6 400,00	
				Total eligible costs (a)+(b)	38 400,00	,00	,00	38 400,00	
			Requested EC contribution	38 400,00	,00	,00	38 400,00		

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Financial information - whole duration of the project									
Partici pant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+ (3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
18	CRES	FC	Eligible costs	Direct Costs (a)	96 800,00	,00	,00	96 800,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	19 360,00	,00	,00	19 360,00	,00
				Total eligible costs (a)+(b)	116 160,00	,00	,00	116 160,00	,00
				Requested EC contribution	116 160,00	,00	,00	116 160,00	,00
19	NCSR D	FC	Eligible costs	Direct Costs (a)	32 000,00	,00	,00	32 000,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	6 400,00	,00	,00	6 400,00	,00
				Total eligible costs (a)+(b)	38 400,00	,00	,00	38 400,00	,00
				Requested EC contribution	38 400,00	,00	,00	38 400,00	,00
20	GPC	FC	Eligible costs	Direct Costs (a)	31 000,00	,00	,00	31 000,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	6 200,00	,00	,00	6 200,00	,00
				Total eligible costs (a)+(b)	37 200,00	,00	,00	37 200,00	,00
				Requested EC contribution	37 200,00	,00	,00	37 200,00	,00
21	IFE	FC	Eligible costs	Direct Costs (a)	38 000,00	,00	,00	38 000,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	7 600,00	,00	,00	7 600,00	,00
				Total eligible costs (a)+(b)	45 600,00	,00	,00	45 600,00	,00
				Requested EC contribution	45 600,00	,00	,00	45 600,00	,00

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Financial information - whole duration of the project									
Partici pant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+ (3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
22	PGI	FC	Eligible costs	Direct Costs (a)	19 000,00	,00	,00	19 000,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	3 800,00	,00	,00	3 800,00	,00
				Total eligible costs (a)+(b)	22 800,00	,00	,00	22 800,00	,00
			Requested EC contribution	22 800,00	,00	,00	22 800,00	,00	
23	GEUS	FC	Eligible costs	Direct Costs (a)	60 500,00	,00	,00	60 500,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	12 100,00	,00	,00	12 100,00	,00
				Total eligible costs (a)+(b)	72 600,00	,00	,00	72 600,00	,00
			Requested EC contribution	72 600,00	,00	,00	72 600,00	,00	
24	UOR	AC	Eligible costs	Direct Costs (a)	16 000,00	,00	,00	16 000,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	3 200,00	,00	,00	3 200,00	,00
				Total eligible costs (a)+(b)	19 200,00	,00	,00	19 200,00	,00
			Requested EC contribution	19 200,00	,00	,00	19 200,00	,00	
25	GEMRC IPE RAS	FC	Eligible costs	Direct Costs (a)	22 000,00	,00	,00	22 000,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	4 400,00	,00	,00	4 400,00	,00
				Total eligible costs (a)+(b)	26 400,00	,00	,00	26 400,00	,00
			Requested EC contribution	26 400,00	,00	,00	26 400,00	,00	

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Proposal Number 019760

Proposal Acronym ENGINE

Financial information - whole duration of the project

Participant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+(3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
26	IVT RAN	FC	Eligible costs	Direct Costs (a)	14 000,00	,00	,00	14 000,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	2 800,00	,00	,00	2 800,00	,00
				Total eligible costs (a)+(b)	16 800,00	,00	,00	16 800,00	,00
			Requested EC contribution	16 800,00	,00	,00	16 800,00	,00	
27	JSC "Intergeotherm"	FC	Eligible costs	Direct Costs (a)	17 000,00	,00	,00	17 000,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	3 400,00	,00	,00	3 400,00	,00
				Total eligible costs (a)+(b)	20 400,00	,00	,00	20 400,00	,00
			Requested EC contribution	20 400,00	,00	,00	20 400,00	,00	
28	DHMA	AC	Eligible costs	Direct Costs (a)	49 000,00	,00	,00	49 000,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	9 800,00	,00	,00	9 800,00	,00
				Total eligible costs (a)+(b)	58 800,00	,00	,00	58 800,00	,00
			Requested EC contribution	58 800,00	,00	,00	58 800,00	,00	
29	GEOWATT AG	FC	Eligible costs	Direct Costs (a)	96 000,00	,00	,00	96 000,00	,00
				of which subcontracting	,00	,00	,00	,00	,00
				Indirect costs (b)	19 200,00	,00	,00	19 200,00	,00
				Total eligible costs (a)+(b)	115 200,00	,00	,00	115 200,00	,00
			Requested EC contribution	115 200,00	,00	,00	115 200,00	,00	

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Proposal Number 019760

Proposal Acronym ENGINE

Financial information - whole duration of the project

Participant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+(3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
30	ORME	FC	Eligible costs	Direct Costs (a)	16 000,00	,00	,00	16 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	3 200,00	,00	,00	3 200,00	
				Total eligible costs (a)+(b)	19 200,00	,00	,00	19 200,00	
			Requested EC contribution	19 200,00	,00	,00	19 200,00		
31	IGME	FC	Eligible costs	Direct Costs (a)	41 000,00	,00	,00	41 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	8 200,00	,00	,00	8 200,00	
				Total eligible costs (a)+(b)	49 200,00	,00	,00	49 200,00	
			Requested EC contribution	49 200,00	,00	,00	49 200,00		
32	CERTH	FC	Eligible costs	Direct Costs (a)	33 000,00	,00	,00	33 000,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	6 600,00	,00	,00	6 600,00	
				Total eligible costs (a)+(b)	39 600,00	,00	,00	39 600,00	
			Requested EC contribution	39 600,00	,00	,00	39 600,00		
33	FEDCO	FCF	Eligible costs	Direct Costs (a)	58 300,00	,00	,00	58 300,00	,00
				of which subcontracting	,00	,00	,00	,00	
				Indirect costs (b)	11 660,00	,00	,00	11 660,00	
				Total eligible costs (a)+(b)	69 960,00	,00	,00	69 960,00	
			Requested EC contribution	69 960,00	,00	,00	69 960,00		

Proposal Number 019760

Proposal Acronym ENGINE

Financial information - whole duration of the project

Participant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+(3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
34	IIE	FC	Eligible costs	Direct Costs (a)	33 650,00			33 650,00	
				of which subcontracting				,00	
				Indirect costs (b)	6 730,00			6 730,00	
				Total eligible costs (a)+(b)	40 380,00	,00	,00	40 380,00	
				Requested EC contribution	40 380,00			40 380,00	
35	CICESE	FCF	Eligible costs	Direct Costs (a)	32 300,00			32 300,00	
				of which subcontracting				,00	
				Indirect costs (b)	6 460,00			6 460,00	
				Total eligible costs (a)+(b)	38 760,00	,00	,00	38 760,00	
				Requested EC contribution	38 760,00			38 760,00	
36	LaGeo	FC	Eligible costs	Direct Costs (a)	33 650,00			33 650,00	
				of which subcontracting				,00	
				Indirect costs (b)	6 730,00			6 730,00	
				Total eligible costs (a)+(b)	40 380,00	,00	,00	40 380,00	
				Requested EC contribution	40 380,00			40 380,00	
TOTAL			Eligible costs	2 150 934,00	,00	151 355,00	2 302 289,00	,00	
			Requested EC contribution	2 150 934,00	,00	151 355,00	2 302 289,00		

Please use as many copies of form A3.1 as necessary for the number of participants Form A3.1 page 9 of 9

A3.2

Proposal Number	019760		Proposal Acronym	ENGINE	
Estimated breakdown of the EC contribution per reporting period					
Reporting Periods	Start month	End month	Estimated Grant to the Budget		
			Total	In which first six months	
Reporting Period 1	1	12	840 000,00	,00	
Reporting Period 2	13	24	976 000,00	488 000,00	
Reporting Period 3	25	30	486 289,00	486 289,00	
Reporting Period 4			,00	,00	
Reporting Period 5			,00	,00	
Reporting Period 6			,00	,00	
Reporting Period 7			,00	,00	

8.3 Management level description of resources and budget.

The budget has been built with an amount of expenses for management level limited at 6,6%. It includes a provision of 52 000 € for audit certificates. Following article 6.2. of the Consortium Agreement, the coordinator will reimburse with its management budget the audit certificate of each of the contractors up to 1000 euros per audit maximum. This procedure has been proposed in order to avoid dispersion of this budget over all partners. Furthermore, several institutes, as the BRGM, will be able to provide an audit certificate free of charge. In case this amount is over evaluated, it should be used for other coordination tasks.

A table is presented showing the breakdown of activities and financial support for each partner (Figure 7).

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			Cost Model	Man/month coordination activities	Cost/month	Workshop	Travel	Total activity, transport, workshop	Total	Overheads	Total coordination activities	Total BRGM coordination activities (incl. TTC)	Man/month management	Cost/month	Audit Certificates (1000€)	Overheads	Total management activity	
1	BRGM	France	FC	20	6 739	35 000	16783	186564	186 564	37 313	223876	229310	BRGM	10	6 739	52 000	23878	143268
2								0	0	0	0		BRGM (TTC extension)	1	6 739		1348	8087
3	GFZ	Germany	FC	24	4 256	35 000	9001	146154	146 154	29 231	175384							
4	ISOR	Iceland	FC	10	11 000	15 000	9000	134000	134 000	26 800	160800							151355
5	SHELL	Netherlands	FC	1			5000	5000	5 000	1 000	6000							
6	TNO-NITG	Netherlands	FC	8	10 000	15 000	9000	104000	104 000	20 800	124800							
7	IGR	Russian Federation	FC	6	1 500		5000	14000	14 000	2 800	16800							
8	IGG	Italy	FC	12	5 000	15 000	9000	84000	84 000	16 800	100800							
9	CFG	France	FC	8	8 000		7000	71000	71 000	14 200	85200							
10	IE	Germany	FC	9	6 000		9000	63000	63 000	12 600	75600							
11	ELTE	Hungary	AC	6	3 000	20 000	7000	45000	45 000	9 000	54000							
12	CNRS	France	FCF	5	7 000		7000	37000	37 000	7 400	44400							
13	GGA Institut	Germany	FC	6	5 000		7000	37000	37 000	7 400	44400							
14	EEIG	International consortium	AC	4			7000	7000	7 000	1 400	8400							
15	IGGL	Lithuania	FC	6	1 500		7000	16000	16 000	3 200	19200							
16	MeSy	Germany	FC	10	6 000		7000	67000	67 000	13 400	80400							
17	VUA	Netherlands	AC	5	5 000		7000	32000	32 000	6 400	38400							
18	CRES	Greece	FC	13	5 600	15 000	9000	96800	96 800	19 360	116160							
19	NSCRD	Greece	FC	3	9 000		5000	32000	32 000	6 400	38400							
20	GPC	France	FC	4	6 000		7000	31000	31 000	6 200	37200							
21	IFE	Norway	FC	3	11 000		5000	38000	38 000	7 600	45600							
22	PGJ	Poland	FC	10	1 200		7000	19000	19 000	3 800	22800							
23	GEUS	Denmark	FC	6	9 250		5000	60500	60 500	12 100	72600							
24	UOP	Romania	AC	6	1 500		7000	16000	16 000	3 200	19200							
25	GEMRC IPE RAS	Russia	AC	10	1 500		7000	22000	22 000	4 400	26400							
26	IVTRAN	Russia	AC	6	1 500		5000	14000	14 000	2 800	16800							
27	Intergeotherm.m	Russia	FC	6	2 000		5000	17000	17 000	3 400	20400							
28	DHMA	Switzerland	AC	6	7 000		7000	49000	49 000	9 800	58800							
29	Geowatt AG	Switzerland	FC	9	8 000	15 000	9000	96000	96 000	19 200	115200							
30	ORME	Turkey	FC	6	1 500		7000	16000	16 000	3 200	19200							
31	IGME	Spain	FC	6	6 000		5000	41000	41 000	8 200	49200							
32	CERTH	Greece	FC	5	5 600		5000	33000	33 000	6 600	39600							
				239		165 000	222784	1630017	1 630 017	326 003	1956021							
TTC Extension																		
1	BRGM	France	FC				4528	4528	4528	905,6	5434							
33	FEDCO	Philippines	FCF	7	6 900		10000	58300	58300	11660	69960							
34	IIE	Mexico	FC	7	3 450		9500	33650	33650	6730	40380							
35	CICESE	Mexico	AC	6	3 800		9500	32300	32300	6460	38760							
36	LaGeo	El Salvador	FC	7	3 450		9500	33650	33650	6730	40380							
				27														
				Total months	266													
										Total coordination activities	2150934							
																		Total coordination/management activities
																		2302289,5

Figure 7. Breakdown of activities and financial support for each partner

9. Other issues (optional)

The ENGINE co-ordination action does not raise any sensitive ethical questions related to human beings, human biological samples, genetic information, or ethical concerns related to animals.

Appendix A - Consortium description

A.1 Participants and consortium

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 extension of the network will bring to this group the experience of

- **Filtech Energy Drilling Corporation** (FEDCO) a private consultancy firm recently organized by geothermal pioneers in the Philippines, now actively involved in providing consultancy and manpower services in the industry,
- **Centro de Investigación Científica y Educación Superior de Ensenada (CICESE, Mexico)**, an academic institution providing scientific consulting and involved in research projects related with geothermal exploration, in Mexican fields as Cerro Prieto, Los Humeros and Las Tres Vírgenes, and abroad, in Ahuachapán and Chipilapa fields in El Salvador, CA.,
- **LaGeo** (El Salvador), a company with large experience in the development and management of the geothermal resources in Latin America and is pioneer in several research projects (Hydro Fracturing, acid stimulation jobs, Tracer Flow testing, etc.).

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). The extension of the network will strengthen this group with the participation of the "Instituto de Investigaciones Eléctricas" (IIE, Mexico), a R&D national laboratory focused on all aspects of electric power production, transmission and distribution,

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, 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 Rossyiskoi 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).

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N°	Partner and internet site	Field of expertise	Main present geothermal projects and 6 th framework projects	Key person and Responsibilities	Conference and workshop organisation
1	BRGM http://www.brgm.fr A French Public Institution responsible for mobilising the Earth Sciences in the sustainable management of natural resources and the subsurface domain	Exploration, Reservoir assessment, Modelling of geothermal field, General expertise, Information system	HDR Soultz experiment Bouillante (Guadalupe)	Christian Fouillac, Executive group member Patrick Ledru, Co-ordinator, WP1 leader Albert Genter, Co-ordinator Assistant Laurent Le Bel, Co-ordinator Adviser Philippe Calcagno, WP2 leader	Launching conference Workshop 5
3	GFZ http://www.gfz-potsdam.de The National German Research Centre for Earth Sciences combining all solid earth science fields including geodesy, geology, geophysics, mineralogy and geochemistry, in a multidisciplinary research centre	Exploration, Drilling and reservoir assessment, Modelling of geothermal field, Exploitation, Impact, General expertise, Information system	In situ geothermal laboratory Gross Schoenebeck, Project leader of the DGRES I-GET (Integrated Geophysical Exploration Technologies for deep fractured geothermal systems) STREP	Rolf Emmermann, Executive group member Ernst Huenges, WP6 leader Angela Spalek, public relation	Kick off meeting Workshop 1 Mid-term conference
4	ISOR http://www.isor.is A service and research institute providing specialised services to the Icelandic power industry, the Icelandic government and foreign companies in the field of geothermal sciences and utilisation	Exploration, Drilling and reservoir assessment, Modelling of geothermal field, Exploitation, Impact, General expertise	Numerous geothermal projects for the geothermal industry incl. two new power plants and the Icelandic Deep drilling project	Olafur Flovenz, Executive group member Sverrir Thorhallsson, WP4 leader	Workshop 4
5	SIEP B.V. http://www.shell.com/eandp-en One of the Royal Dutch/Shell Group of Companies recognised as a leading technology innovator in the oil and gas industry and many of these innovations are applicable as well to enhanced geothermal activities	Drilling and reservoir assessment, Modelling of geothermal field, Exploitation, General expertise		Jos Maas, Executive group member	
6	TNO http://www.tno.nl The central geoscience institute in the Netherlands for information and research to promote the sustainable management and use of the subsurface and its natural resources	Reservoir assessment, Modelling of geothermal field, Exploitation, Impact	Risk assessment for the development of geothermal field in Indonesia	Emile Elewaut, Executive group member Ad Lokhorst, WP9 leader Dr. Jan-Diederik van Wees	Workshop 7
7	IGR DSC RAS the Institute for Geothermal Research of the Daghestan Scientific Centre of Russian Academy of Sciences	Modelling of geothermal field, Exploitation, Impact, General expertise	Development of geothermal heat supply of Makhachkala town	Dr. Alibek Alkhasov	
8	IGG http://www.igg.cnr.it Institute of the Italian National Research Council (CNR) for research in the field of Earth sciences and resources	Exploration, Reservoir assessment, Modelling of geothermal field, Information system	Larderello-Travale	Adele Manzella, WP3 leader	Workshop 2
9	CFG Services An engineering company, subsidiary of BRGM, conducting high and medium enthalpy geothermal projects from the exploration phase to the field development	Exploration, Drilling and reservoir assessment, Modelling of geothermal field, Exploitation, Impact	Bouillante (Guadalupe)	Dominique Tournaye	

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N°	Partner and internet site	Field of expertise	Main present geothermal projects and 6 th framework projects	Key person and Responsibilities	Conference and workshop organisation
10	IE http://www.ie-leipzig.de An interdisciplinary non-profit research company working on topics in the fields of energy, environment and water both theoretically and practically	Exploitation, Impact		Dr. Martin Kaltschmitt, WP5 leader	
11	ELTE http://teo.elte.hu/fs/envibase.html The Geophysical Department of the Eotvos University (ELTE), a unique know-how in building and processing data bases concerning the structure and thermal budget of the European crust	Exploration, Reservoir assessment, Modelling of geothermal field		Prof. Frank Horvath	
12	CNRS http://eost.u-strasbg.fr A cluster of 10 laboratories of the CNRS in the framework of the HDR Soutz experiment	Drilling and reservoir assessment, Modelling of geothermal field, Impact	HDR Soutz experiment	Bertrand Fritz	
13	GGA-Institute http://www.gga-hannover.de German, independent, non-university research institute for applied geosciences, conducting research in the field of physical geosciences	Stimulation technology, hydraulic testing, Modelling of geothermal field, Drilling and reservoir assessment	HDR Soutz experiment, GeneSys project	Dr. Jens Orzol	
14	GEIE "EMC" http://www.soutz.net A group involving 3 companies operating in the domains of power generation and/or distribution (Electricité de France, Electricité de Strasbourg, Pfalzwerke) and a servicing company (Bestec GmbH).	Exploration, Reservoir assessment, Modelling of geothermal field	HDR Soutz experiment	André Gérard	
15	IGGL http://www.geo.lt The National Lithuanian Research Institute for Earth Sciences, involved in the development of geothermal projects and regional assessment of the geothermal energy potential	Exploration, Regional and reservoir assessment	Preliminary assesment of geothermal potential of Zemaiciu Naumiestis HDR	Dr.habil.Saulius Slaupia	Final conference (to be confirmed)
16	MeSy http://www.mesy-online.de MeSy is a SME that is an active partner of the European HDR Soutz-sous-Forêts project and has contributed with rock physics, rock mechanics, reservoir hydraulics and innovated technical developments to the present status of this project	Drilling and reservoir assessment, Modelling of geothermal field, Exploitation	HDR Soutz experiment	Fritz Rummel	
17	VUA http://www.ises.nu The largest concentrated research unit in the field of integrated sedimentary basin studies, continental margins and environmental tectonics in Europe	Exploration, Reservoir assessment, Modelling of geothermal field		Prof. Sierd Cloetingh, Executive group member	
18	CRES http://www.cres.gr The national coordination centre of Greece on renewable energy technologies, including geothermal energy	Exploration, Reservoir assessment, Modelling of geothermal field, Exploitation, Impact, Information system	Project leader of the DGTREN LowBin (Efficient Low Temperature Geothermal Binary Power) STREP	Prof. Costas Karytsas, WP8 leader Dimitrios Mendrinos, responsible for work regarding other WP	Workshop 6

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N°	Partner and internet site	Field of expertise	Main present geothermal projects and 6 th framework projects	Key person and Responsibilities	Conference and workshop organisation
19	NSCRD http://www.demokritos.gr A research institute specializes among others in the field of sorption and transport phenomena in porous materials	Reservoir assessment, Exploitation	HDR Soultz experiment (sub-contractor)	Dr. Athanassios Stubos	
20	GPC http://www.gpc-france.com A consulting engineers bureau and service company created in 1989, from a nucleus of professionals experienced in exploration and production of underground fluids with a view to promote new drilling/completion/production technologies	Drilling and reservoir assessment, Modelling of geothermal field, Exploitation, Impact		Pierre Ungemach	
21	IFE http://www.ife.no It represents state-of-the-art in Europe (and world wide) integrated solutions for tracer technology activities within petroleum sector including following areas on both laboratory and field scales	Drilling and reservoir assessment, Exploitation	HDR Soultz experiment	Dr. Jiri Muller	
22	PGI http://www.pgi.gov.pl The main research centre for the Earth Sciences in Poland, on behalf of the Ministry of Environment	Reservoir assessment, Modelling of geothermal field		Marta Wróblewska	
23	GEUS http://www.geus.dk A research and advisory institute under the Danish Ministry for the Environment providing R&D and advisory services for government agencies, local authorities and private enterprises in Denmark as well as internationally	Exploration, Reservoir assessment, Modelling of geothermal field, Exploitation, Impact, Information system		Anders Mathiesen	
24	UOR http://www.uoradea.ro A state university established under this name in 1990, including the Geothermal Research Centre, the International Geothermal Training Centre	General expertise, Information system		Prof. Marcel Rosca	
25	GEMRC IPE RAS http://www.igemi.troitsk.ru One of the World's leading centres of electromagnetic studies of the Earth	Exploration, Reservoir assessment		Prof. Viacheslav Spichak	
26	IVTRAN A leading research institute of the Russian Academy of Sciences in field of physical and technical problems of energy, experienced in the development and investigation of advanced energy systems, including geothermal energy installations	Modelling of geothermal field, Exploitation		Prof. Evald Shpilrain	

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N°	Partner and internet site	Field of expertise	Main present geothermal projects and 6 th framework projects	Key person and Responsibilities	Conference and workshop organisation
27	Joint Stock Company "Intergeotherm" http://www.gesa.ru A private firm that has constructed a series of Geothermal Power Plants in Russian Federation, Latin America (Nicaragua, Salvador, Mexico, etc) and to participate in implementing geothermal projects in Latin America, Yugoslavia, Russian Federation (Kamchatka).	Drilling and reservoir assessment, Modelling of geothermal field, Exploitation	Construction of the forth 6.5. MW binary cycle power unit at Verkhne-Mutnovsky GeoPP (Kamchatka, Russian Federation) 2. Construction of a geothermal system of heat and electricity supply to Labinsk City (Krasnodar region, Russian Federation) 3. Heat and electricity supply of Petropavlovsk-Kamchatsky City from HDR of Avachinsky volcano (Kamchatka, Russian Federation)	Prof. Oleg Povarov	
28	DHMA http://www.dhm.ch http://www.geothermal-energy.ch A society engaged in advancing and promoting EGS technology via encouraging and managing a broad range of basic and applied research.	Drilling and reservoir assessment, Stimulation technology, Modelling of geothermal field, Exploitation	HDR Soultz experiment HDR Basel experiment	Dr. François-D. Vuataz Dr. Keith Evans Dr. Robert Hopkirk Dr. Markus Häring	
29	GEOWATT AG http://www.geowatt.ch A private company that offers integrated and customised engineering and numerical solutions of high quality to projects in the domains of Geothermal Energy and Hydrogeology	Drilling and reservoir assessment, Modelling of geothermal field, Exploitation	HDR Soultz experiment	Dr. Ladislaus Rybach, Executive group member Dr. Thomas Kohl, WP 6 leader Dr. Thomas Mège Simone Bassetti, organisation of a workshop	Workshop 3
30	ORME Jeothermal A.S. http://www.ormejeothermal.com.tr A private firm that is one of the top three companies in the world regarding geothermal district heating systems, including feasibility detailed engineering studies, construction and operation.	Geothermal District Heating, General expertise, drilling, production and reservoir assessment, Modelling of geothermal field, Exploitation	Turkey: Balçova, Geothermal District System , Kırşehir DHS, Gönen DHS, Edremit DHS, Salihli DHS, Kizilcahamam DHS, Kizildere Geothermal field	Orhan Mertoglu	
31	IGME http://www.igme.es An institution for the study of the Spanish territory geology, the drawing of a national geological map, the reconnaissance of mineral deposits and the study of subterranean waters	Exploitation, Impact		Celestino García de la Noceda.	
32	CERTH http://www.certh.gr An Institute for the development of new techniques and assistance in technology transfer for upgrading the utilisation of national energy resources and the optimisation of industrial processes	Drilling and reservoir assessment, Modelling of geothermal field, Exploitation, Impact		Prof. Anastasios Karabelas	
33	Filtech Energy Drilling Corp (FEDCO) http://www.fedcophil.com A Philippine Private Corporation providing consultancy and manpower	Exploration, Drilling, Reservoir assessment, modelling and management, Information System	Multifinger 3D and down hole video logging, hydraulic snubbing units, database management, geothermal	Zosimo F. Sarmiento	

	services in the development and optimum use of geothermal resources		assessment and evaluation		
34	Instituto de Investigaciones Electricas (IIE) http://www.iiie.org.mx/ A Mexican R&D national laboratory focused on all aspects of electric power production, transmission and distribution	Reservoir assessment and management, Tracer testing, Petrophysics, Geochemistry	Tracer testing (Los Azufres, Las Tres Virgenes), Assessment of Mexican geothermal reserves, Interpreting exploitation-induced evolution of geothermal reservoirs (Cerro Prieto, Los Azufres, Los Humeros, Las Tres Virgenes)	Eduardo Iglesias Rodríguez	
35	Centro de Investigación Científica y Educación Superior de Ensenada (CICESE) http://www.cicese.mx/ A Mexican academic institution and an Applied Geophysics Department involved in research projects related with geothermal exploration	Exploration, Reservoir assessment, R&D of geophysical methods, Modelling of geophysical data, training & education		Jose Manuel Romo Jones	
36	LaGeo http://www.lageo.com.sv/main.html The largest geothermal company in El Salvador with 153 MW of installed capacity	Exploration, reservoir assessment, numerical modelling, field management, hydro-fracturing permeability enhancement, acid stimulation.	Binary power plant, acid stimulation, hydro-fracturing	Manuel Monterosa	

Figure 8. The consortium, domains of interest, key persons

A.2 Sub-contracting

The sub-contracting activity for the ENGINE Co-ordination Action will be limited to the realisation of audit certificates.

A.3 Third parties

The partner n°28 is the Deep Heat Mining Association (DHMA). This association of experts was founded in 1996 and is an association engaged exclusively in advancing and promoting EGS technology via a broad range of basic and applied research. In the case of the ENGINE co-ordination action, several non-contractors will contribute and provide resources to DHMA for which they will be remunerated. These non-contractors will be considered as third parties.

Thus, Engineering Geology, ETH Zürich, will make available as resource the knowledge of Keith Evans, who has been studying rock mechanics, micro-seismic and hydraulic data from the Soultz EGS project for nearly 20 years. The Centre de Recherche en Géothermie (CREGE), Université de Neuchâtel will provide as a resource the experience of François Vuataz, who has almost 30 years of experience in various aspects of geothermal energy usage, concentrating mainly on the geochemical aspect. Häring Geoproject will provide as resource the experience of Markus Häring, geologist and Project Developer for the Basel EGS project. Finally, Polydynamics Engineering will provide as resource the knowledge of Robert Hopkirk, research and development engineer, who now has 30 years of experience in analysing EGS systems. Agreements have been established between the DHMA and these non-contractors prior to their contributions to the project. The following table summarizes the contribution of DHMA.

Third Parties	Experts	Man-hours	Cost
Häring GeoProject, 8126 Steinmaur (HGP)	M.O. Häring	160	14700
Polydynamics Engineering, 8708 Männedorf (PDE)	R.J. Hopkirk	160	14700
Centre de recherche en géothermie, Université de Neuchâtel, 2007 Neuchâtel (CREGE)	F.D. Vuataz	150	14700
Engineering Geology, ETH, Zürich, 8093 Zürich (ENGEOL)	K. Evans	150	14700
			58800

A.4 Funding of third country participants

The extension of the network to Targeted Third Countries has been favourably evaluated by the commission for an estimated contribution of the commission up to 203000€. The following institutes will be involved in the forthcoming actions:

- Filtech Energy Drilling Corporation (FEDCO). A resource of 7 person/months is expected from FEDCO and evaluated to 70000€. This amount will mainly cover expenses related to the coordination activities on WP4, 5, 7, 8 (cost person/month, including overheads) and travel and subsistence expenses while attending the conferences and workshops. No financing support for durable equipment or consumables is required.
- Instituto de Investigaciones Eléctricas of Mexico (IIE). A resource of 7 person/months is expected from IIE and evaluated to 40000€. This amount will mainly cover expenses related to the coordination activities on WP3, 4, 7, 8 (cost person/month, including overheads) and travel and subsistence expenses while attending the conferences and workshops. No financing support for durable equipment or consumables is required.
- Centro de Investigación Científica y Educación Superior de Ensenada (CICESE). A resource of 6 person/months is expected from CICESE and evaluated to 40000€. This amount will mainly cover expenses related to the coordination activities on WP2, 3, 6 (cost person/month, including overheads) and travel and subsistence expenses while attending the conferences and workshops. No financing support for durable equipment or consumables is required.
- LaGeo C.A. de C.V. (LaGeo). A resource of 7 person/months is expected from LaGeo and evaluated to 40000€. This amount will mainly cover expenses related to the coordination activities on WP4, 5, 7, 8 (cost person/month, including overheads) and travel and subsistence expenses while attending the conferences and workshops. No financing support for durable equipment or consumables is required.

BRGM charges related to the extension of the ENGINE Coordination Action are evaluated to 13000€, including overheads. This amount will mainly cover expenses related to the management of the extension, i.e. administrative work, information of the new partners, contacts with the Executive Group and Steering Committee...