European Cooperation in the field of Scientific and Technical Research - COST -

Brussels, 21 November 2012

CM1206

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action CM1206: EXIL - Exchange on Ionic Liquids

Delegations will find attached the Memorandum of Understanding for COST Action as approved by the COST Committee of Senior Officials (CSO) at its 186th meeting on 20-21 November 2012.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as

COST Action CM1206
EXIL - EXCHANGE ON IONIC LIQUIDS

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4154/11 "Rules and Procedures for Implementing COST Actions", or in any new document amending or replacing it, the contents of which the Parties are fully aware of.

2. The main objective of the Action is to provide a platform for knowledge exchange, cooperation and coordination in European Ionic Liquid science directed towards the development of innovative materials and processes.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 92 million in 2012 prices.

4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.

5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of Chapter V of the document referred to in Point 1 above.

A. ABSTRACT

The objective of this Action is to coordinate European research activities and knowledge exchange on ionic liquids (ILs, low melting salts, many of them liquid at room temperature and below) and to explore their full potential in the context of fundamental and applied chemistry, materials science and engineering. The COST Action will provide a coordinated forum for an efficient intra- and interdisciplinary knowledge and expertise exchange, networking and dissemination of information and results, training and initiating collaborations, harmonizing research activities, establishing an open public database and supplying the scientific community with systematic high quality information on ILs and their applications. The Action aims to combat misinformation as well as contradicting data and reports. EXIL will facilitate technology transfer from university to industry, enhance the supply routes of trained researchers from universities to industry, and structure the European science base. Transferring ILs from the laboratory workbench to true beneficial applications is the long-term goal of EXIL - the European exchange network on Ionic Liquids. An IL-COST Action will lead to an improvement of everyday life through new and improved technologies and materials, not to mention cleaner and safer production techniques and will thus contribute to strengthening European research and economy.
Keywords: Synthetic Inorganic and Organic Chemistry, Physical and Computational Chemistry, Materials Science, Engineering

B. BACKGROUND

B.1 General background

In recent years, interest in ionic liquids (ILs) has exploded. ILs are, quite simply, salts with a melting point below 100 °C, many of which are even liquid at, or below, room temperature. In contrast to classical salts they usually contain bulky asymmetric organic cations of low charge and weakly coordinating anions, which do not allow the ions to pack neatly in the solid state and prevent solidification. After first efforts in applying ILs as battery electrolytes in the late 1940s, it soon became apparent that ILs also possess other unique properties, e.g. a negligible vapour pressure which renders them attractive for many applications, most significantly as replacements for conventional volatile organic compounds (VOCs). VOCs are conventionally used for the industrial production of organic chemicals (bulk and fine chemicals, pharmaceuticals). However, the environmental impact of these solvents is significant and there is an increasing demand (political, economic, social and environmental) for the introduction of new clean technologies. A step towards greener industrial chemical processes is to replace the commonly used, traditional volatile organic compounds with safer alternatives such as ILs. Although ionic liquids are not intrinsically green, they can be designed to be green and the implementation of ILs in industrial processes may lead to a cleaner environment, enhanced work safety and a more efficient use of materials. However, the true benefit of ILs in the context of Green Chemistry, e.g. as environmentally benign replacements for VOCs, has to be critically evaluated. For today and the future, probably the most important and desirable feature of ILs is that they can be intelligently engineered for a specific application due to their modular tuneability. Consequently, ILs are currently evolving from electrochemical and general solvents to novel materials with diverse applications such as lubricants or thermal, magnetic and optical fluids. Technological advances made possible by this COST Action will lead to an improvement of everyday life through new and improved technologies and materials, not to mention cleaner and safer production techniques and as a result will contribute to strengthening European research and economy.

B.2 Current state of knowledge

What are ionic liquids? Ionic liquids are low temperature melting salts.. Many ILs are liquid at room temperature and even well below. The term ILs, as only defined by melting point, encompasses thus a very wide range of anion-cation combinations. This provides us with a large toolbox, and offers a convenient way to study the effects of simple modifications in the structures or ion combinations on the resulting physical and chemical properties. In spite of this, many researchers have wanted to study a 'typical' IL and apply it to a specialized problem, rather than find a specialized IL to solve a specific problem. Unfortunately, this has led to broad overgeneralizations of ILs as everything from non-toxic, non-flammable, and non-volatile to toxic, flammable, and volatile; each of these statements clearly can be true for a single IL salt, but cannot be true for the entire range of possible compounds which meet the definition of an IL.
Ionic Liquids as Technology Enablers and Novel Materials. A growing number of scientists and engineers are now realizing that ILs are actually customizable materials for a variety of specialized applications. ILs are evolving from electrochemical and general solvents, to novel materials in diverse applications such as specialized solvents, lubricants, thermal fluids, magnetic fluids, optical fluids, propellants, etc. Interdisciplinary exploration of both properties and potential uses of ILs have led to industrial application of ILs and chemical companies have developed hundreds of specialty IL products. Several companies have been founded to synthesize ILs in small to bulk

quantities and find novel applications. IL research is well past infancy and has evolved into a well-established, internationally recognized field. Over the past years entire IL symposia have been held at meetings of learned societies. The Conference on Molten Salts once established as a molten salt conference evolved to a Conference on Molten Salts and Ionic Liquids a world-wide conference series focusing on ILs was established.

B.3 Reasons for the Action

Despite strong research and development activities in the field of ILs there is currently no coordinated exchange mechanism for nationally funded IL chemists and engineers to initiate collaborations, training, knowledge transfer, networking and dissemination with each other. Thus, the existing research groups as well as European small and large enterprises operate in an individual, uncoordinated way. Research groups are funded at the national level and special activities of national funding agencies have led to a strong geographical imbalance of IL activities in the academic and private sector. In addition, plenty of misinformation exists on ILs. The literature is full of contradicting chemical and physical property data. Besides this, many simplifications and overgeneralizations such as "Ionic liquids are non-flammable, have no vapour pressure and are green" can be found. This makes it extremely difficult for newcomers and even sometimes for experts in the field, to critically evaluate and judge data and statements. This COST Action aims at battling these problems by providing and fostering the exchange of knowledge and people across disciplines and sectors (private and public). It will provide a platform to critically discuss and counter-check contradictory data in a wider forum and will fight overgeneralizations. It will become a valuable information source for the newcomer and will foster the involvement of young talented scientists. The area will benefit from cross-fertilization of ideas giving a higher platform of knowledge from new inter- and multi-disciplinary research which would be unattainable in a fragmented approach. Research will be harmonized and duplication of activities omitted by coordinated activities, and the research outcome of the coordinated activities will be larger than the sum of its parts. This will strengthen research and technological advancement in Europe. Thus the COST Action provides a benefit for academia, industry, science and professions, and in the wider, context society.

B.4 Complementarity with other research programmes

Several national programs have aimed at fostering the research activity in the field of ILs. National research centres have been founded that focus on IL research. Although this underlines the importance of IL research, all these initiatives take place only at a national level (most of them are located outside Europe) and concentrated on single sites rather than fostering exchange. A few multi-national EU projects have been funded in the FP 6&7 such as IOLISURF (ionic liquids for high performance coatings) or IONMET (new ionic liquid solvent technology to transform metal finishing). However, they all concentrate on very specific topics and represent only a small part of IL research. IL research is extremely broad and covers a wide range of disciplines. In the past (2002-2009) there has been a related CMST COST Action “Sustainable/Green Chemistry and Chemical Technology” (D29) where ILs as green reaction media were one of the topics with focus on electroreductive synthetic processes. However, since then ILs have shown more versatile and have many applications beyond environmentally benign solvent replacements. A new and wider, more general approach to unify the scientists in the field and establish a platform for efficient knowledge, people and data exchange has to be established. Thus, it is timely to start a new COST Action focusing solely on ILs and exploring their full potential. EXIL will enable an active exchange between scientists of various disciplines and school-of-thought in this rapidly evolving multi-disciplinary field of research and seed new collaborative research projects. There has never been a COST Action in this area and there are no current initiatives in ESF, EUREKA, ESA, or EU research programmes which duplicate this COST Action. The IL research shall be carried out in the EXIL participating groups and will be financed independently, while this new COST Action provides the networking platform.

C. OBJECTIVES AND BENEFITS

C.1 Aim

The aim of the Action is to focus research activities on ionic liquids (ILs) across Europe, and to explore their full potential in the context of chemistry, materials science and engineering with emphasis on the critical evaluation in the field of green chemistry and exploration of their potential as novel, advanced, smart materials. This COST Action will bring together scientists and engineers from various European nations, different scientific disciplines and numerous industry partners. EXIL will allow for a harmonization of research actions, enable the establishment of common standards, enhance data availability and exchange, and allow for new insights and research impulses through different views, knowledge and expertise and cross-fertilization between the different fields.

C.2 Objectives

The main objective is to attain a concerted, organised collaborative research activity that effectively focuses on areas of strategic importance to ionic liquid chemistry in Europe and to foster an environment where, via a multi-group approach (including industry), remarkably novel, ionic liquid research is delivered which forms the basis for new technology-driven processes. The COST Action will focus on the following *secondary objectives:* (1) Development of new ILs, evaluation of IL properties and IL applications, (2) Development of common standards (standardized synthesis protocols and IL purity tests), (3) Establishing a data base to compile and critically evaluate the vast amount of IL data, (4) Initiation of ground-breaking frontiers of research, (5) Knowledge transfer from the lab-bench to true application, (6) Networking for established scientists, industry-academia partnerships, newcomers to the field and ESRs (7) Training the future generations of researchers (ESRs) in skills. *Further objectives* will be (1) Promotion, development of IL-based technology and retention of IL experts in Europe, (2) Dissemination/exchange of best working practices and training, (3) Identification of current and future industrial requirements/opportunities, (4) Advancing public understanding in science.

C.3 How networking within the Action will yield the objectives?

In this COST Action the above listed objectives will be achieved by joining forces of experts working in different complementing disciplines with their main research interest in ILs through (1) Regular Working Group (WG) meetings, (2) Workshops to teach the fundamental science to postgraduate and postdoctoral researchers, (3) Short-Term Scientific Missions (STSMs) to enable postgraduate and postdoctoral mobility and to promote collaborations and scientific progress, (4) Large international conferences to facilitate dissemination of research outcomes and best working practices, (5) Establishing an industrial advisory board, (6) An open access database platform for the exchange and discussion of results.

C.4 Potential impact of the Action

Benefits to the scientific community. This COST Action will promote and deliver a better understanding of IL chemistry and reactivity, the application of ILs in organic and bio-catalysis, the application of ILs in material synthesis as well as the use of ILs as advanced smart materials themselves.. The development of ionic liquid materials featuring an added benefit in an specific application (e.g. as electrolytes, or in the preparation of nano(structured) materials) is one of the main goals. The Action will allow for a comprehensive distribution of information about ionic liquids.

*Benefits to the economy and for employment***.** European companies are the leaders in IL production and IL based technologies. With the current economic situation, it is extremely important that the major companies can hold their top-level positions but also that SME (small and medium enterprises) find a stimulating environment. By supporting early-stage researchers (ESRs) the Action will ensure a sustainable human resource management. This will secure the top-level position of Europe in the area. It is expected that the foundation of several new companies will result, marketing innovative materials throughout Europe. Strong connections on the national level between industry and academic research institutions in the field of ionic liquids exist, as indicated by the number of industrial participants at national and international conferences and joint authorship in scientific publications. This COST Action with is aimed at exploiting such potential, effecting the generation of jobs within Europe and strengthening its position.

Benefits to society. Ultimately, the COST Action will lead to an improvement of everyday life through new and improved technologies and materials, not to mention cleaner and safer production techniques and as a result will contribute to strengthening European research and economy.

C.5 Target groups/end users

This COST Action will benefit the following end users: European science, academia, the private sector; in particular the chemical, pharmaceutical, electronics and petrochemical industries; and ultimately society as a whole. Furthermore, other non-scientific, business professions, requiring academics with excellent inter-personal, problem-solving capabilities and organizational skills, will benefit. People from all these target groups have already been involved in the preparation of this COST Action.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

The main focus of this COST Action is the investigation of chemical and physical properties of ILs. Four *main scientific tasks* will be achieved by this Action:

• Establishment of best-practice examples for IL synthesis and development of standard synthesis procedures

• Standardized IL purity tests

• Identification and implementation of innovative IL-based technologies

• Website for data and knowledge dissemination, finding collaboration partners and informing the public.

In order to efficiently tackle these tasks four Working Groups (WGs) will be established. The human and technical means required are: (1) doctoral student researchers, (2) postdoctoral researchers, (3) principal investigators skilled in ionic liquid chemistry, (4) good laboratory space, (5) specialist synthetic, spectroscopic and computational equipment and, finally, (6) strong links with industry. Although this is routinely provided within national research grants, a COST Action will tie all aspects together, providing an environment more enriching than the sum of its parts, and promoting European science and economy, and ultimately societal welfare.

D.2 Scientific work plan – methods and means

The scientific objectives and the above-mentioned work packages of the Action will be implemented by means of four interactive Working Groups.

WG 1: Design and synthesis of ionic liquids with specific functions.

ILs are a class of compounds featuring an exceptionally large possibility for structural change: e.g. the cation, the anion and the ion’s substituent(s). More complex structures of ILs shift into focus as they are designed for a given application, so-called “task-specific ionic liquids”. However, one of the obstacles of such materials is their manufacture, which often requires complex synthesis protocols. Even for well-known ILs, small-to-large-scale synthesis methods have to be explored. Life-cycle assessment investigations of alternative synthesis routes, and the set-up of production demonstration apparatus etc. must be undertaken. Furthermore, best-practice synthesis protocols for ILs will be disseminated via the Action´s website. An important topic is the assessment of IL purity. Even small impurities may dramatically change IL properties such as viscosities or catalytic activity. Thus, adequate standard IL purity tests and best practice for assessing IL purity have to be set up and disseminated. In this group synthetic chemists and engineers will work together.

Central tasks of WG 1

• Development of standard synthesis protocols,

• Standards for IL purity (standardization of purity tests)

• Design and synthesis of ILs with specific functions

WG 2: Fundamental chemical and physical properties of ionic liquids.

Each change in the IL cation and anion and their combination brings about a change in the physico-chemical properties and the magnitude of these changes cannot yet be predicted. Although in recent years, knowledge on the behaviour of individual ionic liquids has increased, general predictions of the effect of structure changes remain largely imprecise. This fact makes it difficult to exploit the potential that this large structural variety brings to applications. Achieving an understanding of how ionic liquids behave remains an art that is largely a long-term process. It is now time to solidify the existing basis in terms of manifesting general rules, specifying accepted methods and procedures to become textbook knowledge. In this topic, groups capable of determining the various physico-chemical properties will work together. The development of predicting tools such as group-contribution methods, and the application of theoretical chemistry methods will play a role. The ultimate goal is to perform computer-aided design of new ILs displaying a given set of physico-chemical properties of interest in view of industrial applications. Although knowledge and prediction of properties of neat ILs are important, even more important is to study ILs in environments in which they are to be applied. In such instances, solutes (reactants, auxiliaries, additives, catalysts, …) will be present and these solutes will interact with the ionic liquid moieties to affect their properties. Furthermore, questions arise as to whether specific structural ordering occurs at interfaces (e.g. vacuum, metal vessels, liquid-liquid-biphasic systems), how such structures can be enforced and what influence this has for a given application. Groups measuring physico-chemical properties, spectroscopists, chemical engineers, and synthetic chemists will work together in this workgroup.

Central tasks of WG 2

• Determination of properties of IL-co-solvent mixtures

• Modelling of ILs and mixtures

• Interactions between ionic liquids and solutes and structures at interfaces

WG 3: Application of ILs in Synthesis.

ILs can be applied as solvents in organic synthesis and catalysis as well as biocatalysis in ionic liquids. As it is possible to change the cation, the anion, or both, producing millions of different combinations, ILs can be truly called designer solvents. By selecting the correct combination, it becomes possible to optimise IL phenomena such as biodegradability, ecotoxicity, cost, physical properties, reaction kinetics, *etc.* It is now possible to deliberately design a solvent to optimise a reaction (with control over yield and selectivity), rather than to have the solvent dictate the course of the reaction. As enzymes are soluble in ionic liquids keeping their activity, they are also of interest for biocatalysis and biofuel-cells and for biofuels which might be accessible from cellulose or lignin. Another important aspect of using ionic liquids in material's technologies is to make use of their molecular defined nature and their extremely low vapour pressure to modify the chemical and physicochemical properties of solid surfaces by ionic liquid coatings. Such SILP (Supported Ionic Liquid Phase) materials have attracted steeply growing interest for catalytic application and in gas cleaning technologies. ILs can also act as templates and precursors to functional materials and nanostructures, not only as solvents. New synthetic methods use ionic liquids as smart solvents in the preparation of nanoparticles with a controlled size and shape, mesoporous support materials with tailored pore sizes and interfaces, and functional carbon materials with nanoscale architectures. In recent years the interest in ionic liquids for future energy issues has risen considerably. Due to their usually negligible vapour pressures, their high thermal stability and their wide electrochemical windows they are of great interest in fundamental battery research as non-volatile and non-combustible electrolytes.

Central tasks of WG 3:

• Organic synthesis and catalysis as well as biocatalysis in ionic liquids
• Synthesis of inorganic and nano-materials in ionic liquids
• Advanced electrolytes based on ionic liquids (biofuels, batteries, energy)

WG 4: Long term prospects and scale-up challenges.

ILs have shown great promise to improve the sustainability of chemical processes and other applications. Several processes were optimized on pilot plant scale. While a few large-scale processes are known to run now on the basis of ionic liquids, there are also a great number which have not yet been commercialized. In all these applications, remaining questions to be answered are centred around five main aspects: 1) recyclability, 2) cost, 3) lack of established regeneration methods, 4) disposal strategies, and 5) registration requirements. It is therefore necessary to provide a forum in which industrialists, potential founders of spin-off companies and academics get together to approach such problems, including the optimization of IL-production strategies, work-up, recycling and regeneration procedures. Furthermore, questions relating to the final disposal, and, connected to this, the collection of data on toxicity and persistence in the environment should be discussed and approached as a group to achieve industrial realization of more processes.

Central tasks of WG 4:

• Transfer of knowledge from the lab bench to industrial applications
• Long term prospects and scale-up challenges
• Commercial exploitation
• Identification and exploitation of emerging technologies

Scientific work plan. All this work will be undertaken via integrated synthetic, reactivity, property, structural, spectroscopic and theoretical studies by specialists in the respective areas. The Action members are each renowned experts in a specific area. Their methods, knowledge and instrumentation are beyond state-of-art and routine, and the network will benefit from the diverse amount of specialized methods available. A high level of cooperation is required to bring the specialists together and to set up a platform for structured interaction. It is the overarching COST Action that will provide the framework for this greater cooperative effort which would otherwise not be possible and will guarantee that the joint research efforts will lead to results and innovation that independent, non-coordinated activities cannot produce. To get started, two of the most commonly used ionic liquids such as 1-butyl-3-methylimidazolium tetrafluoroborate, $(C_4mim)[BF_4]$, and 1-butyl-3-methylimidzolium bis(trifluoromethane)sulfonylamide, $(C_4mim)[NTf_2]$, for which plenty of contradictory results are reported in the literature with respect to physical properties and use (and influence) in applications like catalysis are selected. A critical evaluation of synthetic methods with emphasis on purity will be carried out by members of WG 1. Members of WG 2 will critically assess the structural and physical properties of these ILs and evaluate the influence of impurities on the IL properties. Light will be shed on contradictory reports on the properties of these IL and how in general impurities affect IL properties. Computational methods will be evaluated against the experiments. Members of WG 3 will critically assess reports on the use of these ILs in syntheses, e.g. are enhanced catalytic activities observed when using $(C_4mim)[BF_4]$ as the solvent really due to the solvent or rather to impurities and hydrolysis products such as HF. Members of WG 3 also will assess the toxicity of these ILs at various levels. WG 4 will look at these ILs from an industrial point of view and critically evaluate relevant aspects such as large scale production, recyclability, regeneration, cost, disposal strategies and registration requirements. The researchers will exchange information on a regular basis, define common standards and best practice. In a second round, EXIL will focus on the innovative aspects in IL research and identify novel aspects, recent advances, challenges and opportunities in IL research. EXIL then will focus on novel, promising ILs with high innovation potential and all WGs will assess these with their means. By the end of the Action, a quite comprehensive picture of ILs and their advantages and disadvantages for certain applications will result and new directions of research will be identified.

Action-specific website. A dedicated website will be constructed, published and maintained as an information and cyber-exchange platform. It will contain: (1) pages on the nature of the Action; (2) pages and links on individuals involved; (3) pages on past, current, and future activities; (4) pages on safety and good working practices; (5) pages of broad appeal such as a collection of material preparation procedures, and other literature of general use; (6) links to other Actions and areas of interest to this COST Action; (7) an open IL database; (8) regularly updated press releases/news letters (reports from the WG) and presentations of the main COST Action findings on a popular scientific level. It also will contain a link to a data and document exchange server for participating PIs.

Central tasks of the website:

- IL property database
- Information platform for researches and the public
- Researcher Database
- Dissemination of COST Action´s results

E. ORGANISATION

E.1 Coordination and organisation

The structure of this COST Action follows the recommendations contained by the "Rules and Procedures for implementing COST Actions" document. A Chair, a Vice-Chair, Working Group Leaders and a Grant Holder will be elected by the Management Committee (MC) at the first MC meeting. The MC supervises four Working Groups (WGs). Each WG is managed by a Working Group Leader and a Co-Leader. Together with the Chair and the Vice-Chair of the MC, WG Leaders and Co-Leaders form the Core Group (CG). Certified Quality Engineers responsible for the SOPs the different WGs should be recruited to ensure proper diffusion of SOPs, for the different members. *Management Committee (MC).* The MC will be appointed to supervise and manage the key issues of the Action. It will consist of up to two MC members per participating COST country. The MC will appoint the WG Leaders who will implement the Action and will continuously monitor the progress. The MC will ensure that each WG composition is optimal with respect to complementary skills, existing collaborations, career stages, gender balance, and industrial membership. The MC will also be responsible for the establishment of contacts with other European and international programmes and associations, as well as governmental bodies. Finally, the MC will prepare reports related to the Action. An *Industrial Advisory Board (IAB)* with representatives of the participating parties from the private sector which will help the Action work towards its longer term goals. *Working Groups (WGs).* Each WG will be chaired by a Working Group Leader and a Co-Leader who are elected by the MC during its first meeting. Leaders and Co-Leaders are responsible for the coordination, organization and supervision of their WGs. *Short-Term Scientific Missions (STSMs).* The STSM Manager will be appointed by the MC. *Dissemination Manager (DM).* The Dissemination Manager will be responsible for the organization of the Working Group independent COST tasks related to scientific communication, for maintenance of a COST Action specific website and its regular update.

Decisions will be based on meritocratic principles and research quality, taking into account thematic complementarity, pertinence of the application, the participation of early-stage researchers as well as gender balance issues.

Milestones. Key milestones for this Action • Successful installation of the MC, CG, WGs, STSM Manager, Dissemination Manager • Distribution of additional invitations to join the Action • Creation of an Action-specific website • Publication of standard synthesis procedures • Publication of standardized tests for IL purity • Creation of the IL database • Annual workshops for each WG • Short-Term Scientific Missions • Staff exchange • International conferences in the first , middle and last year of the Action.

E.2 Working Groups

A Working Group structure will be implemented to efficiently share workload and thereby help the realization of the Action´s goals. The tasks and the scientific program of the Working Groups have been described in detail in section D. Each Working Group is constituted of different teams, but particular teams can be involved in different WGs. Each WG will meet once a year.

E.3 Liaison and interaction with other research programmes

There are no current initiatives in COST, ESF, FP, EUREKA, or EU research programmes which duplicate this COST Action. However, this COST Action will overlap extensively with nationally funded research projects across Europe and will strengthen them by adding the dimension of overarching cooperation which is lacking in individual national-level projects. Information will be exchanged by the following means. (1) Face-to-face exchange at meetings and seminars. Organization of COST sessions at international conferences to disseminate the results of the COST Action. (2**)** Cyber-Exchange. An Action-specific website with communication platform will be established which will contain information mentioned in E.1. It also will contain a link to a data and document exchange server for participating PIs. (3) Student and researcher exchange via Short-Term Scientific Missions (STSMs) between collaborating groups**.**

E.4 Gender balance and involvement of early-stage researchers

This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. The Action will also be committed to considerably involve early-stage researchers. This item will also be placed as a standard item on all MC agendas.
Training and mentoring of young scientists at all career stages is a key part of the sustainable mentoring package within EXIL. ESRs will be given preference to give talks at conferences and meetings and attend STSMs. This will highly beneficial for their career due to networking opportunities and strong exposure to the private sector. A main aim is to involve them at the highest possible levels in the Action, e.g. as WG Leaders.

F. TIMETABLE

The duration of this COST Action is four years. In Year 1, the Action will be started with the first MC/kick-off meeting. During this meeting the MC as well as the Leaders of the Working Groups will be elected. A website will be established for information and communication in which all essential information concerning this Action will be implemented and which will be updated on a regular basis. The MC will meet annually to review progress, receive feedback from the WGs, give feedback to WGs, and plan future events. In year 1 a scientific kick-off meeting will be held. At the end of year 2/beginning of year 3, a mid-term conference will be held which will focus on training, and will involve formal lectures on all aspects of ionic liquids chemistry by leading experts to train the future generation of scientists. The Action will be closed with a final conference. This conference will focus on research achieved under the COST Action and lead to a definition of future directions. Priority will be given to presentations by early career researchers. Throughout, as the budget allows, applications will be considered for STSMs at the meetings of the MC.

	Year 1				Year 2				Year 3				Year 4			
Reporting				x				x				x				x
Website set-up	x															
Website up-date		x		x		x		x		x		x		x		x
MC meeting	x				x				x				x			
CG meeting		x		x		x		x		x		x		x		x
Workshops				x								x				
WG1 meeting	x				x				x				x			

WG2 meeting		x				x				x				x		
WG3 meeting			x				x				x				x	
WG4 meeting				x				x				x				x
Start conference		x														
Mid-term conference								x								
Final conference																x

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: AT, BE, BG, CH, CZ, DE, DK, EE, EL, ES, FI, FR, HU, IE, IT, LV, NL, NO, PL, PT, SE, SI, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 92 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

H.1 Who?

There are four distinct categories of target audiences for this Action. These are the research specialists from the public and private sector, students of natural science, the wider scientific community and the general public. In order to promote the exploitation of the Action's results and networks, there are two main strategic approaches to be performed: (a) internal and external marketing activities tailored to the scientific and commercial needs of the four different target groups, and (b) communication of the Action results in the academic, industrial, and general (society/public) sector.

H.2 What?

Promotional material. WG members will prepare promotional materials to show the importance of ionic liquids in everyday life. It is important to understand that they are great tools and have significant relevance in the context of environmental awareness. *Print material.* A flyer and a poster will be designed at the beginning of the COST Action to outline the scientific background and the objectives of the training. *Website***.** A website will be launched at the start of the project to present regularly updated information both for the participating scientist (restricted area) as well as in an open-access portal to inform the public. *Electronic mailing lists.* Internal topic mailing lists will be established in order to provide efficient and fast information channels. It is envisaged to start with a list containing all members of the project's teams. For specific topics, it may be even advantageous to broaden the network and include selected specialists to stimulate the progress of these research projects. Thus, in a second stage, external mailing list will be created - either for sharing scientific expertise and knowledge or for providing other scientific communities or the general public with information about the Action. *Newsletter.* A quarterly newsletter will be distributed among all participants and persons expressing interest in the projects. *Data exchange server.* A data exchange server will be set up to allow for an efficient electronic communication network. This system will be tailored to the actual needs of the members of EXIL. It is important to have a functional, practice-oriented and flexible system that can grow and adapt during EXIL's life time, and beyond. *Database.* A dedicated database will be set up; this database shall be open-access. *Press releases.* The university press offices will responsible for Action-related press releases (in English). The press releases will be distributed regularly to the scientific community, news agencies, and other institutions. This allows for professional information about the Action's events. It will report on the content of research topics, periodically release updates and highlight major breakthroughs in a general, comprehensive, and target-group tailored fashion**.** *Video-Clip.* Video-clips related to the versatile topics and application fields of ionic liquids will be realized with the support of the network members. These video-clips will benefit from the didactic competence assembled within EXIL and tailored to the target groups. They will be available to the public and released on the Action website. *Open day to the public.* Visualizing fundamental scientific principles, as well as transporting the fascination for science in general and ionic liquids in particular, is one of the objectives of EXIL. One measure to do so and to give real "insights" as well as "hands-on experiences" to the public. Children, adults (students, teachers, scientists, individuals working in industry or other agencies, specialists, and non-specialists) will receive the opportunity to visit the research institutions and laboratories involved in the Action. *Public events for school children.* Under the leadership of one of the institution involved in the Action operates a laboratory for school children, where individual children/youths or entire school classes can carry out practical experiments in chemistry, physics, biology, engineering etc. An education course will be developed and the material developed in cooperation with the help of the above mentioned laboratory will be distributed in the network to help set up events for school pupils throughout Europe. *Organisation of training workshops and international conferences.*

H.3 How?

Dissemination and exploitation of results represents a central task in this COST Action and is essential to achieve the challenging and ambitious aims of the Action. An interactive project website will be created and updated on a regular basis, where the general information of the Action, the aims and planned activities will be posted. In order to increase the network, an open call encouraging interested investigators to join the Action will be posted. This Website will serve as the major dissemination tool to publish the results of the scientific efforts of participating investigators, reports about the course of the Action (open workshops), SOPs, as well as major results of the Action will be included. Original research articles are going to be published in peer-reviewed scientific journals. In addition, in order to reach the general public, press releases for newsletters and popular media will be published on the website.