Front page

Proposal full title: **Energy from Solid and Liquid Renewables**
Proposal acronym: **ESOLIRE**
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Type of instrument: Integrated Project

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Contents

Proposal summary page

Proposal full title: **Energy from Solid and Liquid Renewables**

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Research areas/ topics addressed:
SUSTDEV-1.2.5 New and advanced concepts in renewable energy technologies – Biomass
NMP-2002-3.4.3.2-1 Radical changes in the "basic materials" industry (excluding steel) for cleaner, safer and more eco-efficient production.
NMP-2002-3.4.3.2-2 Sustainable waste management and hazard reduction in production, storage and manufacturing.

Research areas and topics for 2003 (Call 2003.ML):
a) **Overcoming barriers to the development of bioenergy production systems.** *The main objective is the creation of an integrated structure, which will explore the synergies and allow the sharing of research infrastructures and research personnel in one or more of the most relevant areas of bioenergy (e.g. biofuels for transport, Combined Heat and Power). Research should cover the technological as well as the economic, social and environmental sustainability aspects of the entire bioenergy production chain.*
b) **Energy from bio-residues and energy crops** (innovative, low emission waste-to-energy and crop-to-energy concepts and technology development).

Proposal abstract:

We propose that by radical changes and innovations in the management of renewables, where combined aerobic and anaerobic operating systems are high-rate, simple to operate and have reliable performance, the new knowledge necessary for creating the appropriate technology for **biotechnology-based processes for efficient use of energy** bound in renewables will be developed.

The technology to be developed and tested refers to a system of *liquid and solid renewables*, directed both to small and large users, for the production of energy rich methane in biogas and energy rich biofertilisers. The biogas will be used locally as fuel or for heating, cooling and/or production of electric power in urban and rural areas, by using mobile line to be tested and that need little improvement to become marketable. Importance of energy in biofertilisers/soil amendments on cultivated soils, that is these days under valuated, have to be measured together with plant nutrients and beneficial microorganisms.

In this IP novel **sustainable solutions** that reduce present environmental and social problems concerning soil degradation, pollution of water and air, waste management, and the use of fossil energy sources and synthetic chemicals will be uncovered.

Facilities using technology and methods adjusted to microorganisms are needed to make bioconversion of the renewable organic material (from municipal and industrial waste, residues from agriculture, horticulture, forestry, green areas, and from fuel crops) **a mainstream renewables-to-energy-and-fertilisers conversion technology**.

B.1 Scientific and technological objectives of the project and state of the art

The ESOLIRE Integrated Project (IP) will operate in the field of science, research and innovation, and will explore new and emerging scientific and technological areas on the border biology and technology. The challenges of this IP are to create and implement a "breakthrough" model for bioconversion of renewables to biogas and biofertilisers and integrate social, economic and environmental dimensions. This model will be a new applicable knowledge to support transformation of industry.

The technology to be developed and tested refers to a system of *liquid and solid renewables*, directed both to small and large users, for the production of energy rich methane in biogas and energy rich biofertilisers. The biogas will be used locally for heating, cooling and electric power in urban and rural areas, by using mobile line to be tested and that need little improvement to become marketable.

Renewable organic materials = renewables are a vitally important biological resource, and can be considered to be the most important "basic material" for humans, being used for food, feed, fibre and fuel. The main objective of this IP is to make the **efficient biological transformation** of renewables - from municipal and industrial waste, residues from agriculture, horticulture, forestry, green areas, and from fuel crops - **a mainstream "renewables-to-energy-and-fertilisers" conversion technology**.

We propose that by radical changes and innovations in the management of renewables in waste and wastewater, where combined aerobic and anaerobic operating systems are high-rate, simple to operate and have reliable performance, the new knowledge, necessary for creating the appropriate technology for **biotechnology-based processes for efficient use of energy** bound in renewables, will be developed.

Furthermore, novel **sustainable solutions** that reduce present environmental and social problems concerning soil degradation, pollution of water and air, waste management, and the use of fossil energy sources and synthetic chemicals will be uncovered.

Water, soil, minerals and biomass are scarce and precious resources that must be carefully managed. Improved knowledge of basic biological processes will going to play an increasingly important role in numerous key areas of scientific and technological progress associated with the effective utilisation of physical and biological resources. To meet these challenges the IP ESOLIRE will bring together researchers from various countries and with a range of expertise and ambition to develop modern research in a global environment. The objectives of activity in this IP are to improve integration and co-ordination of research on bioconversion processes in Europe which currently is underestimated and fragmented.

This IP will contribute to international efforts to mitigate against adverse trends in global change. The research expertise of the partners includes biological and biochemical process, energy, plant nutrients, cultivation, sanitation, logistics, transportation, process control, environmental and health aspects, waste and wastewater treatment as well as microbiology, design, engineering and construction.

One key objective is to contribute to the creation of a stronger scientific base orientated towards knowledge-based, more environment-friendly approaches essential for research and development in other topics in FP6. Results from ESOLIRE are of direct relevance and importance for most of the seven thematic priorities in the first block of FP6 activities.

Central to this IP will be the development and testing of mobile research facilities dealing with bioconversion/microbial transformation of renewables to biogas and biofertilisers. The proposed range of local experiments will make results easily available for researchers, students, planners, designers, architects, politicians, manufacturers, decision makers and for the public, and thus will enhance their implementation. Results from IP ESOLIRE will give the essential input for manufacturing novel equipment, for creating new infrastructure adjusted for the "production of tomorrow" and building novel, economic viable systems.

IP ESOLIRE will illustrate the potential for the elaboration of a clear roadmap for planners and manufacturers working on future bioconversion systems and methods in waste and wastewater management. This is important for increased efficiency in recovery of renewable energy (bioenergy), in recycling of elements (plant nutrients) bound in renewables and the support of "safer cultivation systems by using well designed biofertilisers that will have positive effects on "food safety", on life-cycle safety, on minimisation of man made chemicals, on carbon sequestration and on minimising of pollution.

In this Integrated Project enthusiastic researchers will develop and test the knowledge based concept ESOLIRE and break the barriers that exist between self-evident essential knowledge and implementation of it (Fig.1).

Our efforts are based on the most elementary processes. There is known that oxidative processes in organisms are necessary for life and that oxidative processes in fire are dangerous for living creatures. In both cases transformation of energy from one form to several forms occurs. Figure 1 symbolise these processes and shows what kind of impact on cultivated soils have sustainable or unsustainable management of renewables.

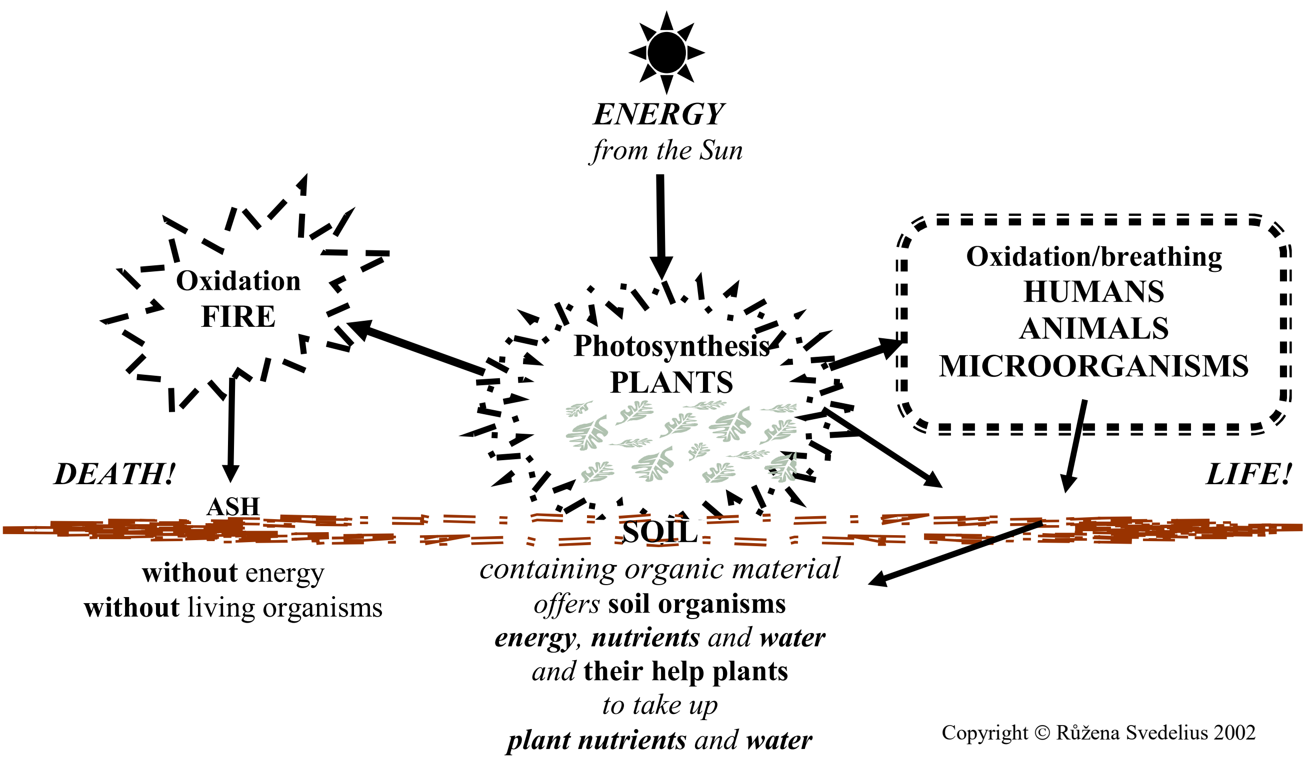

Figure 1. Comparison between oxidation in burning and oxidation in living organisms

To realise the importance of the main objective of our IP, figures 2 and 3 briefly compare present and possible future systems for handling waste and wastewater from housing areas. By using outdated methods for waste management in present systems (Fig. 2) the bioenergy is lost and nutrient elements, do seldom return to cultivation systems. Losses of elements pollute the environment and negatively affect human health. This is the international state-of-the-art. In most countries are used these polluting and costly methods to get rid of the renewables instead of utilising them as raw material for processing.

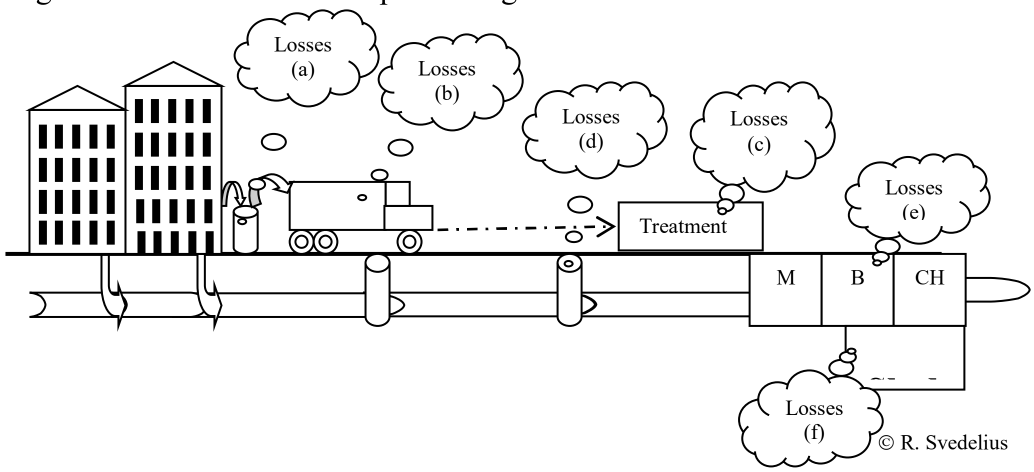

Figure 2: Present waste and wastewater "by end of pipe" management in open and centralised systems.

Losses of energy and plant nutrients appear:

When renewables in solid waste are collected in dust bins (a), transported (b), and treated (c) in incineration plants, on landfills, in central composting plants and in biogas plants using old rotting methods;

When liquid renewables (in human excreta) are diluted, transported in sewage system (d) and treated by expensive methods mechanically, biologically(e) and chemically in wastewater treatment plants, and when sewage sludge (f) of doubtful quality can not be used on cultivated soils.

Some of the losses are pollutants transported across international boundaries.

Costs for construction and operating are huge. Most of the above-described management is principally based on old-fashioned systems, which cause environmental damage and are a health hazard.

Sustainable waste and wastewater systems are possible only by radical changes of facilities, methods and management. More knowledge and clear examples of novel concepts (Fig. 2) are required to change old fashion thinking and step by step phase out the polluting systems.

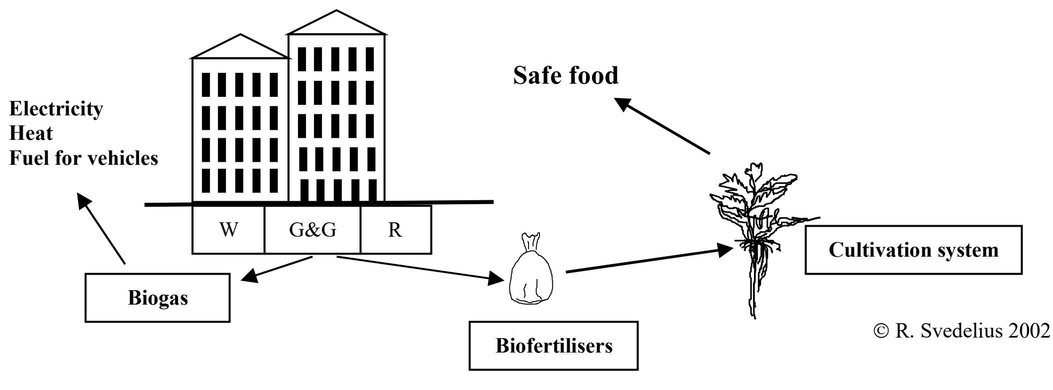

Figure 3: Future integrated waste and wastewater "at source" management in closed localised systems.

Losses of energy and plant nutrients are minimised when concept "ESOLIRE" is used.

(W) Grey water is treated in "Bio H2O".

(G&G) Renewables from solid and liquid waste is by microorganisms transformed to biogas and biofertilisers in "G&G-System" (Gas & Gögsel/fertiliser-System).

(R) Mixed waste of inorganic and non-renewable materials such as glass, plastics, metal and toxic waste are sorted in "Refuse House" and then handled by specialists for reuse, recovery, destruction or burying on landfills.

B.2 Relevance to the objectives of this Priority Thematic Area

The proposal is consistent with the Thematic Priority 6.1 *(*Sustainable Energy Systems*)* of part B – New and advanced concepts in renewable energy technologies 6.1.3.2.3 (Energy from bio-residues and energy crops) (innovative, low emission waste-to-energy and crop-to-energy concepts and technology development). – Biomass – In particular, the proposal aims at increasing the share of energy produced from renewables to meet the demand of reducing fossil sources, and negative impact on environment and climate.

The project work plan includes the development of all activities directed to optimise the efficiency of the innovative system "Energy from Solid and Liquid Renewables" and to reduce the cost of biogas production from renewable materials in waste/residues and from biomass.

Demand of better knowledge concerning processes of microbial transformation (bioconversion) is growing very fast all over the world, due to the growing renewable energy use expectations and, according to the major scientists, to the global climatic modifications. A new energy efficient technology has certainly a large potential specially where geographic and local conditions are appropriated. Technologies to transform biomass efficiently and safe by microbial processes, that do not pollute the environment, can be widely implemented in mega cities as in the rural areas.

These technologies will not only reduce CO_2 emissions and other pollutants but in most every case, such technologies will save enough money, now spent on fuel, to pay for their capital cost.
By supplying, 80 to 90 percent[1] of the useful energy in fuel can be put to beneficial use. The Intergovernmental Panel on Global Climate Change (IPCC) found that within the energy supply sector «an increase in efficiency of 1% would result in a 2.5% reduction in CO_2 emissions».[2] To put the possible benefit in perspective, the ESOLIRE project will reach at least 15 % efficiency increase compared to which of the standard systems. When biogas is used to supply heating in existing and new thermal distribution networks efficiencies can increase. ESOLIRE consortium will refine the operation of such energy balanced systems.

The research to be developed includes the utilisation of novel equipment, methods and modern logistics, which are energy efficient, costs effective, and environmentally safe. The proposal is also finalised at the emphasise of those components that integrate and perform the best efficiency/cost relationship in the Mediterranean environment and select the best combination of technologic parameters which allows for the highest adaptability of the system to different applications (commercial users, offices, housing areas, farms, etc.).

[1] Intergovernmental Panel on Climate Change (1996)
[2] Intergovernmental Panel on Climate Change (1996)

B.3 Potential impact

The project ESOLIRE contributes to the EU social objectives at two main levels:
- health benefits in terms of EMF reduction
- creation of direct and indirect new job opportunities

The implications of biomass stem not just from its inherent efficiency, but also from its decentralised character. Because it is costly to transport energy and raw material over any distance, equipment for bioconversion of renewables must be located physically close to its user. A number of positive consequences flow from this fact: power tends to be generated close to the power consumer, reducing transmission losses, stray current, and the need for distribution equipment significantly. Plants for bioconversion tend to be built smaller, and owned and operated by smaller and more localised companies.

Energy from bioconversion is suitable for a wide range of applications, and effectively displaces the combustion of carbon-based fuels, with all their environmental implications.

The research to be developed is indeed based on the utilisation of Mobile experimental line, which are energy efficient, cost effective, and environmentally safe. The proposed technology offers an important health benefits i.e. an improved working environment and due to the completely closed system that minimise emissions (= polluting losses).

Because of the receptivity of the market, the realisation of the project may also stimulate an evolution of both the demand and the offer of innovative and environmental safe systems, and therefore the creation of direct and indirect new job opportunities. Indeed, a number of studies show that the development of decentralised systems dealing with bioconversion creates jobs.

Impact on Europe

There is a widely acknowledged need throughout Europe to enhance the manufacture and use of more sustainable systems based on knowledge of biological processes.

There were at the 1st January 2002, exactly 376 461 772 inhabitants in EU.
These inhabitants are responsible for the total production of about 753 000 tonnes per day of renewables in Municipal Solid Waste (MSW) together with renewables in wastewater (human excreta). This annual production of renewables contains at least 825 TWh of bioenergy and plant nutrients NPK (nitrogen, phosphorus and potash) to the value of approximately 3.8 billion euros.

To these figures can be added the greater amount of bioenergy and NPK in renewables from industrial waste and in residues from agriculture, horticulture, forestry and green areas, and from fuel crops that can be, by modernised processes of bioconversion, used as raw material in more sustainable systems. Using the present knowledge the bioenergy in renewables can be transformed biologically with following results:
1. About ⅓ **recovered as biogas;**
2. About ½ bound **in biofertilisers** a) in the remaining structures from renewables and b) in microorganisms while both include element important as plant nutrients.

In concept ESOLIRE will increase utilisation of raw material by using technical improvements and newly created knowledge on efficient bioconversion. Unfortunately, a great amount of water, chemicals and energy from fossil sources are used today for getting rid of renewables from all above mentioned sources.

Economic benefits of the SUMAWA concept are:
* Profit from biogas;
* Profit from biofertilisers.
* Lower total costs for waste and wastewater treatment;
* Lower costs for collection and transportation of waste and wastewater;

By expanding the agricultural possibilities of biofertilisers, produced from renewables in solid and liquid urban waste in localised bioconversion plants, several million € could be saved annually in Europe. These savings would come from:
* Reduced use of fossil-based fertiliser, pesticides, and herbicides;
* Energy savings;
* Reduced collection and transportation costs;
* Increased yields of cultivated crops;
* Water savings.

Beyond the energetic and financial savings made by use of biofertilisers instead of synthetic agrochemicals, there lies a multitude of environmental benefits such as:
- The decrease of emissions that in turn decreases peoples' exposure to unhealthy conditions during collection, through transportation and treatment of renewables in waste with outdated methods of composting and rotting, on landfills, at incineration plants, and/or wastewater treatment plants.
- Improving the physical, chemical and biological properties of cultivated soils in the long-term, thereby resulting in reduced soil erosion, increasing crop yields and improving their quality. In addition to a higher resistance of cultivated crops to weeds, parasites and disease, the more effective use of biofertilisers will reduce harmful agricultural run-off by cutting the use of fossil-based pesticides, herbicides and fertilisers. There will be further conservation of water by increasing the water holding capacity of the soil, and therefore decreasing percolation, evaporation and runoff of plant nutrients and increased sequestration of carbon.

Social impacts of the concept ESOLIRE include:
* Novel technology, with the possibility creating new employment.
* User friendly, good working milieu and thus high acceptance of the system;
* Inhabitants satisfaction through being part of an ecologically sustainable system suitable for all societies;
* Holistic approach with a significant impact on the global environment;

Ecological impacts of the concept ESOLIRE
Environmental aspects which have, or can have a significant direct and *indirect* effect on the environment include:
* Reduction in air pollution;
* Reduction in the negative impact on water and cultivated soil, its fertility and productivity;
* Better quality food, which affects human health.
The European Environment Agency presented an overview in 'Official Publications of the European Communities (1998)' of the state of the environment in Europe and the main areas requiring action at national or international level. Only "waste" and "soil degradation" showed little or no change in the state of the environment, and little development of policies or unfavourable development for the state of the environment.

The requirement of new strategies for sustainable recovery of energy from renewables in waste and wastewater, and for the sustainable production of food, feed, fibre and fuel, is obvious. Therefore, in the concept ESOLIRE we want to use renewables efficiently as a raw material in novel closed systems for

* The recovery of renewable energy as methane in biogas;
* The production of soil amendments/biofertilisers that contain energy, plant nutrients, and beneficial microorganisms;
* The protection of the environment as each yearly addition of energy rich structures in biofertilisers will increase the carbon sequestering abilities of soils.

Our Holistic Philosophy/Vision

There is lack of a holistic view of bioenergy and plant nutrients flows through different spheres of human activity. Some examples:

- In conventional approaches to waste management and waste water treatment uses substantial amounts of fossil energy to get rid of energy and nutrients from renewables. These renewables contain energy from the sun and plant nutrients bound in biochemical compounds that could give energy rich methane in biogas and positive effects on cultivated soils.

- In conventional cultivation systems, with a goal to maintain/increase crop yields for the production of food, feed, fibre and fuel, unfortunately, to make up for the deficiency of plant nutrients, the cultivation factors are optimised by using agrochemicals made from fossil sources.

- Here a third sector pursued their goal through an effective marketing strategy. The production of agrochemicals uses plenty of energy, mostly from fossil sources and pollutes the environment. In addition the transportation methods used are a polluting factor.

Many partners in IP ESOLIRE feel responsibility for more efficient use of renewables and for soil fertility and productivity. The soils content of organic material strongly affects food quality and human health. In the above examples, people have to pay for the disposal of organic compounds in renewables, which are then replaced by artificially produced inputs of newly paid energy. There is also the environmental damage caused as a result, in addition to the healthcare cost.

B.3.1 Contributions to standards

The activities under IP ESOLIRE will highlight the importance of new Community policies. The outcome from this IP will be valuable knowledge for the support of European policies in waste and wastewater management, which is particularly relevant to the Common Agricultural Policy (CAP), energy, transport, environment, health, development aid, consumer protection and enterprise policy. The strength of the consortium is that it is composed of excellent scientists who are highly enthusiastic and open minded partners. Their specialities show good complementarily and provide an excellent base for cross-frontier cooperation.

In the WP 12: **Study on sustainable energy and material recovery intensive system** we will find one of objectives:
Stage 1: To form sustainable, up-to date most effective bioconversion system, for microbial transformation of renewables to energy rich biogas and biofertilisers, a pattern for EU countries. Calculate and quantify the benefits from such system as a future standard in the Europe.
2. Stage: Results (best practices) use as a valuable base to form synthesis - the **S**ustainable, up-to date most effective **B**ioconversion **S**ystem (SBS). We will make calculation on energy balance and try to quantify material savings by using the new system.
3. Stage: We will analyse the present potential for implementation of the SBS in EU countries - define legislative, technological and economical tools, steps and standards necessary for successful implementation and enforcement of SBS. There will be defined the principles as a long-time basis for the improvement towards SBS as well as the measurable indicators to control and evaluate the improvement, within the European Union.

B.4 Outline implementation plan

The overall structure of IP ESOLIRE is built on scientific and technical excellence and contains experts on biological processes in bioconversion, plants, animals, microorganisms, substrates and soils for cultivation of crops, biological processes in water systems, etc; chemical process; energy; plant nutrients supply; design; construction; process control; logistics; transportation; environmental and health aspects; waste treatment; wastewater treatment; sanitation; irrigation; social and economic impacts; engineers, manufacturers and householders.

This multidisciplinary proposal has been designed to create extensive synergy with other European, national or regional programmes in order to provide for the needs of candidate countries. An international dimension and holistic perspective is central to our philosophy, and has been included. Furthermore, IP ESOLIRE will co-ordinate activities that evidently respond to EU IPPC (Integrated Pollution Prevention and Control) directive and with the aim to enhance the quality of decision making IP ESOLIRE will provide policy and decision-makers in the public and private sectors with relevant knowledge and data extracted from research carried out by the IP consortium.

During the bioconversion process raw material in renewables is upgraded to valuable products. Renewables from municipal and industrial waste, residues from agriculture, horticulture, forestry, green areas, from human and animal excreta and from fuel crops should be used as a raw material. The only problem is that there is luck of modern equipment and efficient methods. Like in cooking we need both facilities and recipes. Therefore in this IP we want to use expertise, skilfulness and competence of all partners to built up new knowledge necessary for sustainable solutions.

One of the important objectives of this IP is to link the technological applications with hygienic, sociological and economic aspects.

There is a growing demand for integrated decentralised sanitation systems providing opportunities to save and reuse resources. To arrive at an optimal decentralised sanitation and reuse system multidisciplinary approach is required. With the quality of life of future generations in mind, initial steps have to be made to make society realise the necessity for more sustainable environmental protection methods.

As mentioned before the present high-tech centralised systems for treatment of solid waste and wastewater offer great public comfort but are expensive and do not offer either sustainable reuse of energy and elements or efficient protection of the environment.

Municipal solid waste is composed mainly of organic matter i.e. renewables from plants and animals. This renewable source of energy ends up mostly in incineration plants and on landfills. A small amount of renewables is processed by outdated composting and rotting methods. Plant nutrients should be returned back to cultivation systems.

Wastewater produced in households and industries that contains renewables is collected and transported to central treatment plants. Centralised urban sanitation systems are characterised by high investment costs and by high energy requirements during processing as well as by addition of several chemicals and huge amount of emissions. Conventional sludge treatment results in a large amount of poorly stabilised and significantly polluted sludge, which is not acceptable for cultivation of crops for food. This approach is far from sustainable as it results in the loss of useful resources and by the wastage of water.

In this IP we want to meet the needs of both present and future generations.
Our concept "ESOLIRE"

- is a revolutionary achievement never before realised by conventional waste and wastewater technologies, producing biogas and to cultivation adjusted biofertilisers
- can improve agricultural productivity by improving soil fertility and reducing the impact of erosion,
- do not degrade the environment - is technically appropriate, economically viable and socially acceptable,
- creates employment and generates income through manufacturing, processing, distribution sectors and farming and contributes to overall national development,
- provides professional engineering solutions, automation and control systems for organic solid and liquid waste handling and treatment operations,
- gives example of possibilities for practical helps to developing countries and promotes development that provides long-term solutions to the fundamental problems of poverty and hunger.

Knowledge is a vital tool for development. Scientific and technological advances have brought unprecedented changes to every field of human activity - including waste and wastewater management, agriculture and food production. Radical changes of present methods must begin.

It is hoped that presented proposal will stimulate further research and constructive efforts to develop and implement concept "ESOLIRE".

Building up the knowledge and technology for design and testing of the integrated system for future waste and wastewater "at source" management (Fig. 4), and the required facilities and methods, is one of the common objectives of this IP. The concept ESOLIRE can be used as model.

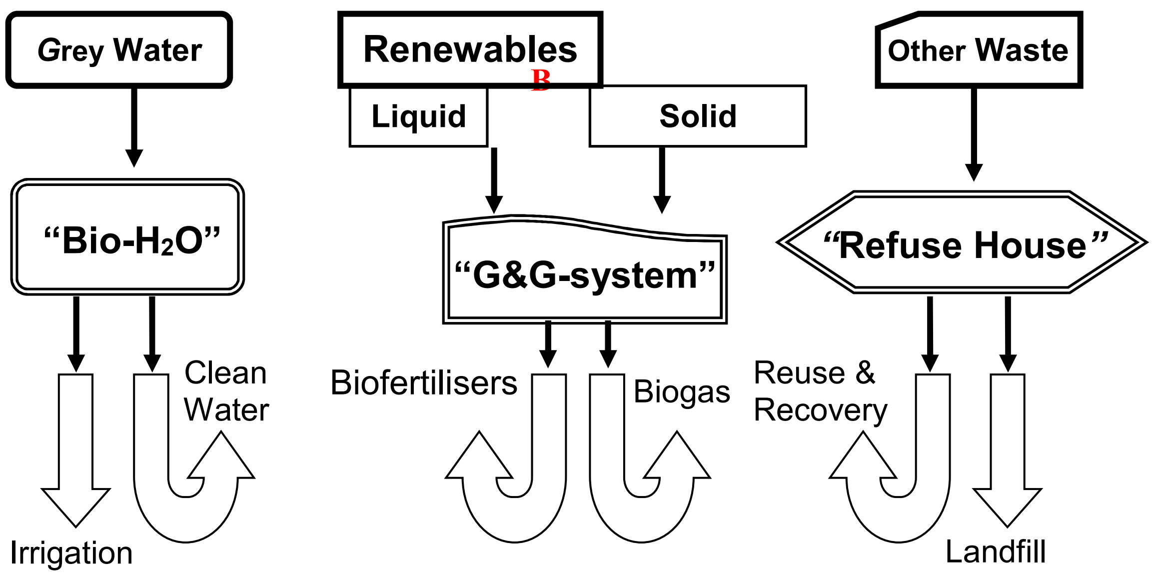

Figure 4: Concept ESOLIRE for the integrated waste and wastewater "at source" management of solid and liquid waste/residues in closed localised system.

Description of ESOLIRE

"Bio-H_2O"

Grey water is cleaned biologically. About 15 per cent less water will be polluted, as human excreta is collected in novel toilets. The cleaned grey water can be reused for irrigation or for other purposes.

"G&G-System"

An efficient batch system for bioconversion of renewables into biogas and biofertilisers. Raw materials for bioconversion are taken from renewable solid[3] and liquid[4] waste from households, from central markets, from the food and feed industry, slaughterhouses as well as from forestry, agri- and horticulture. Fuel crops mixed with other materials can also be used.

A mixture with a high content of dry matter is treated in a three-step process of bioconversion. Firstly, aerobic, then anaerobic and finally aerobic transformation is carried out in a new kind of closed bioreactors connected to a bio filters. The contents of the bio filters are reused in the process.

The biogas produced in the anaerobic step is converted into electricity and heat, used as fuel for vehicles, or both. Part of the electricity is used for equipment in the system.

Biofertilisers, adjusted for cultivation needs, contain energy rich organic structures, plant nutrients and beneficial microorganisms. Structures are important for soil organisms and as CO_2 sinks. The content and quality of biofertilisers can be modified with respect to needs of crops and the state of the soil.

"Refuse House"

Mixed waste of inorganic and non-renewable materials such as glass, plastic, metal and toxic waste are sorted, and then handled by specialists for reuse, recovery, destruction or burying on landfills.

Combined aerobic and anaerobic bioconversion in the "G&G-System" (Fig. 3 and 4) is microbial transformation in the model **biomass-to-energy-and-biofertilisers.** IP will follow this concept and make it transparent for users, manufactures and planners in whole Europe.

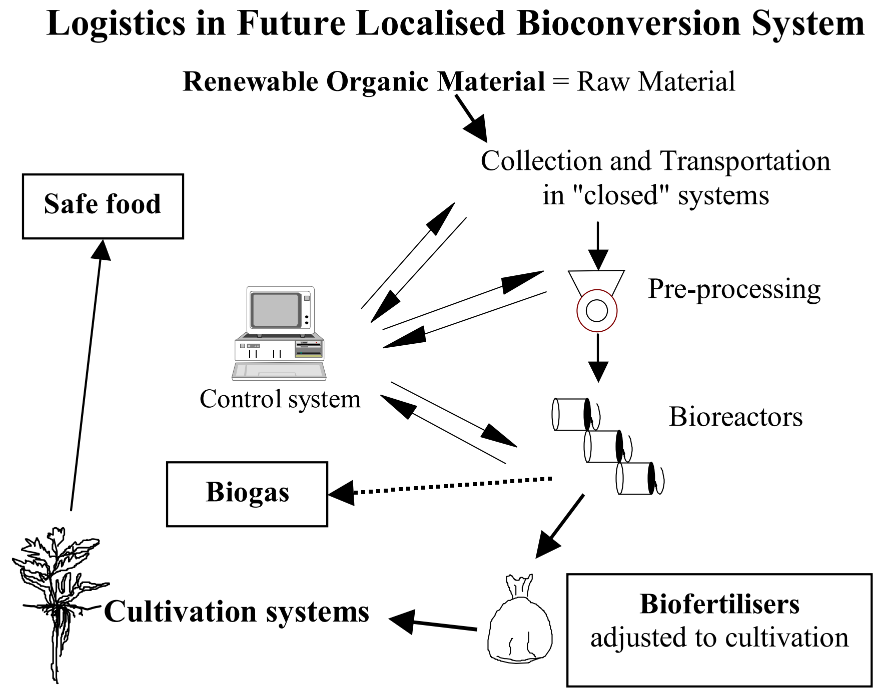

Figure 5: Flows in a modern system for bioconversion of renewable organic material in waste that is called "G&G-System" (Gas & Gödsel=Fertiliser) © R. Svedelius 2002.

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[3] Solid organic wastes can be dry or wet. Examples of dry organic materials are: paper, paper packages, straw, wood and wooden residues, bark, dry leaves. Examples of wet organic materials are: food residues, grass clippings, weed plants and crop residues. In today's Western Europe, household waste is being generated at a rate of over 1kg per person per day. *In Sweden 76 per cent are of organic origin (REFORSK, 1998)!*

[4] Liquid organic waste is both from human and animal excreta. Human excreta in developed countries averages 1.2 kg per person per day. *In Sweden, human excreta is diluted with 200 to 550 litres of wastewater per day!*

Inhabitants are involved in activities where they are dependent upon decision-makers that are influenced by lobbyists serving the present unsustainable out-of-date systems.

We want to make results available for planners and for applications. The novel systems and methods decrease environmental damage and let people know that management of waste and wastewater can be without direct or indirect negative impact on food and health, both now and in the future.

Our scientific objectives are

* To maximise the utilisation of energy and elements (plant nutrients) from **renewable organic material** (ROM) in solid and liquid waste and in fuel crops when producing biogas and biofertilisers (Fig. 4). The experimental equipment for bioconversion will be situated in mobile modules. That will increase possibility to test material and energy flows at many different localities. For example in housing areas, university campus, on farms, nearby industries or at tourist centres.

* To investigate the survival of plant, animal and human **pathogens and weeds,** during various methods of bioconversion of high solid substrate in batch bioreactors with modern control systems (Fig. 4).

* To study factors affecting the highest yield and lowest emissions/pollution from bioconversion and thus affecting **hygienic aspects** (Fig. 4). Hygienic safety should be the minimum in legislation for the handling of synthetic chemicals, waste, wastewater and fertilisers. All these materials have impact on soil, food, health and environment, and on **quality of life** of humans.

* To investigate the **function** of "Integrated Waste and Wastewater Management" according to concept ESOLIRE (Fig. 4). Mobile facilities, including combined aerobic and anaerobic operating systems, that are high-rate, simple to operate and have reliable performance are needed to make biological transformation of the ROM transparent and a useful tool for education, workshops and seminars. "Learning by doing" methods have the best impact on **training and education** activities and in long term on the improvement and development of new skills and expertise.

* To **evaluate the economic, environmental and social impacts** of "Integrated Waste and Wastewater Management" on sustainable development when – compare present systems with concept ESOLIRE (Fig. 2 and 3). In spatial planning, among others, are involved planners, politicians, architects and economists. They are to a greater extent responsible for the development of the whole society. Results from evaluation of all impacts will **influence** their **understanding** and their decisions that control economy, environment, and people's health and well-being both in urban and rural areas.

The suggested concept "ESOLIRE" is only one of possibilities to achieve sustainability in waste and wastewater management. Let's open the discussion on holistic solutions. Modernisation of infrastructure, systems and method need several smart solutions that are outcome from combination of knowledge and technicians skilfulness. We pay for the food, for drinking water, for the waste and wastewater management and we have right to ask for environmentally safe products and services.

Technological objectives of this IP are

* To design and construct several mobile **RTD facilities** that include all three parts of concept "ESOLIRE". Facilities for biological treatment of grey water "Bio H_2O"or water with similar impurities have to be chosen with regard to local needs.
Mixtures of renewable organic material (ROM) will be converted by microorganisms in a series of bioreactors in the "G&G-System". There will be carried out improvements on equipment and methods for increasing efficiency of the system. At the same time materials from local sources and impact on local and global environment will be studied.
Materials that are not suitable for bioconversion will be sorted and preserved in the "Refuse House" before transported for reuse, to recycling or to landfills.
All mobile facilities will be connected by Intranet and impacts on economic, environmental and social dimension will be documented and evaluated. Mobile facilities can be easily moved to various sources of ROM for adjustment to local conditions and for testing best logistics.

* To design and test novel equipment for the collection, transportation, pre-processing and processing of ROM. Energy-rich microbial metabolite methane in biogas and biofertilisers of a high and reproducible quality can be produced effectively only when basic requirements of the microorganisms are satisfied. The **radical innovations in treatment methods** expect development of novel equipment. For example for optimal utilisation of energy and nutrients in human excreta and for better hygiene during transport and treatment novel toilets have to be designed, tested and manufactured. Other products for every day use have to be adjusted to the modern systems for treatment of waste and wastewater. For example biodegradable packages without additives that disturbs bioconversion have to be created.

* To improve the system for separation, collection, pre-processing and equipment for aerobic and anaerobic **bioconversion, storage and utilisation of products** (biogas and biofertilisers) by innovation or re-engineering or technology transfer. The novel systems will include sub-systems, which are subjected to economically and ecologically efficient, long-term environmentally sound waste management. The system can be modified to meet the local needs and can be implemented in all countries.

* To create experiments where various substrates (mixtures of several ROM) are processed under **controlled conditions,** and where several variables can be modified during processing. Various additives and in different ways bioconversion stimulating amendments have to be studied.

* To **test and improve equipment** for biogas and biofertilisers including storage, distribution and usage. Computers, robots, analysators, control system and many other equipments are necessary to make localised facilities, including bioconversion systems with combined aerobic and anaerobic treatment, high-rate, simple to operate with reliable performance.

* To treat grey water and water containing similar impurities by biological methods in well designed facilities.

There are still technical limitations caused mostly by misunderstanding of information given by biologists and technicians. Doing research together in IP where the common objectives are clear will be a breakthrough in new applicable knowledge.

Most of innovations are made on the border between various specialities or areas of expertise. Therefore closed collaboration between researchers and engineers is one of the most important tasks in this IP. Also collaboration between partners, exchange of information, material, facilities, researchers, teachers and students will be strong supported.

RTD facilities will be open for all interested. We want to invite whole society to participate in dialogue. There are tremendous possibilities to get input of ideas from interested visitors and to explain our efforts. Social acceptant .

The **RTD approach** is multidisciplinary and contain both fundamental and applied research.
As researchers and technicians come from various countries and do not have the same resources for doing experiments is it important to test research methods on different levels. Valuable improvements can be made by enthusiastic and creative staff from one country in equipment in the other countries.

Most of the participants find EoI worth effort and therefore we started to communicate without previous personally meeting. Our scientific experience tell us that we can open new "doors" to better understanding our co-workers microorganisms and their needs. With increased precision in processing and with modern logistics we receive many positive effects.

To achieve the objectives with this IP, activities will be needed to integrate the diverse range of skills. When these skills are integrated joint research activities and extension of results will be undertaken. The integration activities will include:

* Workshops and courses to update all partners on the state of the art of the individual scientific fields;

* Information about resources available in the network e.g. ongoing research projects, technical equipment, accredited labs, field experiments, data;

* Identification of knowledge gaps and establishment of shared databases and shared websites;

Results from ESOLIRE will support future cost-effective, high quality, fault-tolerant, eco-friendly and more flexible manufacturing systems for biogas and biofertilisers, including control systems and innovative automation by **integrating various innovative technological approaches.** We anticipate that the improvement of environmental technologies based on bio-processes will offer sound and human-friendly working conditions and safety aspects for prevention of accidents and diseases.

New design and engineering concepts used for effective development are important for a number of industrial sectors. These concepts will be created by the IP partners' scientific and engineering excellence, as well as the identification of best practices. Through planned collaboration between research and industry the industrial breakthroughs will accelerate and thus also hasten construction of knowledge-based industries.

The stages of implementation and the results expected in each one of them

- Research and technical improvements of microbial transformation of renewables to energy rich biogas and energy rich biofertilisers, include both equipment and methods resulting in efficient processing, minimising pollution, in products of high quality, in increased employment and increased social acceptance.

- Research and technical improvements of collection, transportation and pre-treatment of renewables in solid waste, and human excreta is needed to improve logistics and minimise emissions that are losses of energy and nutrients. Novel systems have to be constructed to improve the environmental impact with regard to emissions, noise and vibrations from present vehicles used for the collection of solid waste, and emissions from the unsustainable sewage systems. Designers, manufactures and planners will use results from the technical improvements.

- Biogas is a renewable energy source, and investigations have to be made on its integration in the energy system, including storage, distribution and use. Results will lead to improvements of infrastructure. Vulnerability of society will decrease.

- Biofertilisers are fresh materials containing energy in remainded structures and in living organisms, and thus investigations have to be made on the quality, energy amount, and BAT including storage, distribution and land application. This is important for measurements, and efforts with an aim to improving the savings and efficiency of the system.

Effects of biofertilisers on the soils biological, chemical and physical properties needs to be followed-up and evaluated. In addition the soils capture and sequestration of CO_2. Results can be used as feedback information, for the improvements of equipment and methods in the system as a whole.

The main lines and timetable

Stage I.

1. Build several mobile RTD plants including alternative wastewater treatment “Bio-H2O”, equipment for “Bioconversion” and “Refuse House” (Example in Fig. 6) . Design various models of source separation of waste and human excreta. Create suitable equipment for collection, transportation and pre-processing. Manufacture different prototypes of bioreactors. Design storage system for biogas and biofertilisers. Check BAT for use of biogas, improve equipment for application of biofertilisers, and provide cultivation tests for evaluation of quality of biofertilisers. To build mobile RTD plants and make improvements will take 2 years.
2. Provide research, investigations, studies and evaluations (including feed-back) to develop best management practices (BMPs) to reduce losses and pollution. That will go on at the same time and will continue 3 more years.
3. Training and information will go on during all 5 years.

Stage II.

1. When mobile RTD plants are well tested and adapted to local needs, full-scale plants can replace them. Full-scale plants can start after approximately four years, and require several years of continuous evaluation and feedback, in order to make improvements to equipment and methods.
2. Investigations, studies and evaluations will continue as well as research, improvements and training. It is estimated that it will take totally 8 to10 years to reach satisfactory results.

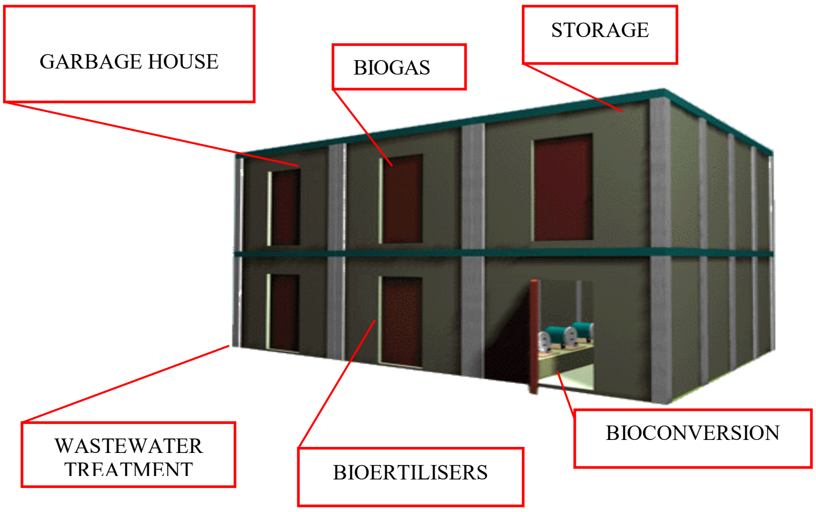


Figure 6.
Mobile experimental/pilot plant for local integrated management of renewables and wastewater contains six modules.

Implementation of concept ESOLIRE with focus on renewables will have great positive impact on all the most important environmental issues. These are described in EEA's *State & Outlook report on EU`s environment*: greenhouse gases and climate change, ozone depletion, hazardous substances, transboundary air pollution, water stress, soil degradation, waste, biodiversity, human health, urban areas, coastal and marine areas.

B.4.1 Research, technological development and innovation activities

RTD/Innovation activities	Partners involved	Partners responsible
I. - Design (using the CAD 3D software), construction and testing of experimental mobile lines with computerised sub-systems A, B, C, D and E (Fig. 1) for efficient microbial conversion of energy and elements in renewables to biogas and biofertilisers Improvements and adjustments of experimental set-ups and selection of the analytical equipment and control system.	1, 10, 12	1
II.A – Selection of the most appropriate equipment and devices for the collection and pre-processing of solid and liquid renewables for bioconversion in batch system – including novel toilets (sanitation) and logistics, studying the possibility of raw material parameters adjustment according to some specific applications and customer needs (for efficient local bioconversion).	1, 14, 20	1
II.B – Processing in bioreactors, elaboration of new methodologies and techniques required in efficient bioconversion of renewables to biogas and biofertilisers, research concerning transfer phenomena involved in the process, construction of efficient bio filters, observation of bio filter functionality by infra-red-thermographic technique, combination of the bio filter technique with other purification methods in order to increase efficiency and to develop a system with more capacity (not only reducing odour emissions but also specific waste gases), testing of additives, activators, and studies on inactivation of pathogens and weeds; kinetic studies of the anaerobe methanation in high solid digestion system. Enzymatic hydrogen production combined with microbial degradation of bio-residues.	1, 3, 6, 8, 9, 13, 17, 18	8, 9
II.C – Biogas. Collection, quality, treatment and use. Biogas conversion to synthesis-gas in the process of steam reforming and partial combustion.	14, 17, 18	17
II.D – Biofertilisers. preserving, improvement of quality, and use in biotests; study of the methods for conditioning of biofertilisers; selection of the appropriate technique; studying the possibility of biofertilisers parameters adjustment according to some specific applications and customer needs; evaluation of biofertilisers in various cultivation systems - include chemical analysis of biofertilisers, soils/substrates, crops and pathogens and weeds; studies on “Safer Food” from crops grown with addition of biofertilisers (without synthetic agrochemicals); studies concerning effects of biofertilisers on restoration of damaged soils.	1, 2, 4, 5, 8, 18	1
II.E – Control system. Logistics. Modelling, and simulation and optimisation of the equipment an methods in all sub-systems. Enzymatic hydrogen production from waste water (e.g. from sugar and pulp industry).	6, 12, 18	12
II.F - Technological and engineering research concerning the biological wastewater and grey water treatment and reuse.	4, 5, 7, 10, 17	7, 17
II.G - Studies on energy and element flows in ESOLIRE and comparison with present systems in waste and wastewater management. Energy recovery and savings. As a final step a holistic Life Cycle Inventory will be generated in order to compare innovative with common systems.	1, 3	1
II.H – Studies on emissions affecting health, environment and climate (CO2 sequestration) using the novel concept in comparison with present waste and wastewater management. As a final step a holistic Life Cycle Impact Assessment will be generated in order to compare innovative with common systems.	1, 2, 3, 4, 12, 14, 17	1, 12
II.J - Socio-economic research -acceptance of novel concept and novel concept compared with present waste and wastewater management by applying the Social Compatibility Analysis developed by ZHW.	14, 16	14, 16
II.K - Dissemination of the knowledge: writing papers, organizing workshops, participating the conferences and activities relating to the protection of knowledge as well as activities to promote the exploitation of the results.	1, 2, 4, 5, 8, 9, 10 12, 14, 16, 17, 18	1
II.L - Advertising activities: broadening the knowledge among energy producers, potential users of renewable energy sources and local governments interested in technology implementation.	4, 5, 9, 12, 14, 16	12

B.4.2 Demonstration activities

Demonstration activities	Partners involved	Partners responsible
III.A - Feasibility study for bioconversion pilot plant design, design and construction of the pilot plant.	17	17
III.B – Pilot plant experiments in order to demonstrate the reproducibility of the parameters established on laboratory scale devices, optimisation of the plant operation and evaluation of the data collected in pilot plant experiments. Elaboration of the operation protocols on the studied stages of the technological process.	8, 7, 14, 17	17
III.C – Biogas. Treatment and use for electricity, heating and as fuel in vehicles.	17	17
III.D – Biofertilisers. Selection of the equipment for the biofertilisers preserving - studies on the post-treatment of biofertilisers. Use of biofertilisers in cultivation experiments – including analysis. Studies concerning effects of biofertilisers on soil physical, chemical and biological properties in short and long term and on cultivated crops.	1, 2, 4, 5, 8, 18	1
III.E – Exchange of information with IP members, common actions towards successful implementation of the process in participating countries, evaluation of the implementation possibilities.	4, 5, 6, 7, 12, 14	12
III.F – Assessment of the proposed technology, final recommendation for further process implementation. Developing an urban and rural level planning to optimise the proposed system. Assistance of the designers of pilot scale plants.	1, 7, 10	1, 10
III.G - Participation in the elaboration of prospects regarding the process and the characteristics and the manner of use of the main products (biogas, biofertilisers, treated wastewater).	1, 4, 5, 6, 7, 8, 14, 18	1
III.H - Developing an urban and rural level planning to optimise the proposed system.	1	1

B.4.3 Training activities

Training activities	Partners involved	Partners responsible
IV.A – Workshops and courses for researchers and key staff participating in IPat the start.	1, 2, 3, 4, 5, 7, 8, 9, 14, 16, 17	1, 12
IV.B - Workshops and courses for teachers, students, manufactures and owners.	1, 2, 4, 5, 7, 8, 9, 12, 14, 16, 17, 18	1, 12
IV.C – Exchange of the visits of key researches to collaborating institutions, combined with training.	1, 2, 3, 4, 5, 7, 8, 9, 12, 14, 17, 18	1, 14
IV.D – Create "Database Centre" for **biomass-to-energy-and-fertilisers conversion technology** with training possibilities.	1, 2, 4, 5, 8, 10, 12, 17	10, 12
IV.E– Exchange of information with IP members, common actions towards successful implementation of the process in participating countries, evaluation of the implementation possibilities	1, 2, 4, 5, 8, 9, 12, 14, 17, 18	1, 12
IV.F – Establish an energy and nutrient account system based on market prices for biogas and biofertilisers.	2, 12	1, 12

B.4.4 Management activities

Management activities	Partners involved	Partners responsible
V.A – Planning of activities needed for successful project implementation. Documentation of the project, reporting to the EC.	1, 4, 7, 8, 17	1, 8,
V.B - Management on the consortium level: coordination of research and technical activities essential for fast development of the novel system, exchange of information via INTERNET, organizing the meetings, courses and workshops.	1, 5, 7, 12, 14, 16, 17	1, 12, 14
V.C – Management on the Institute level: completing financial documentation, collecting research reports from the subsequent experiments, internal meetings, preparation of the organizational procedures, contacting subcontractors.	1, 2, 3, 4, 5, 6, 7, 8, 9, 16, 17	1
V.D – Keeping in permanent contact with coordinator and institutions involved in the same actions: organizing the meetings, exchange of information via INTERNET, mutual reporting of the results	1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 16, 17, 18	1, 12
V.E– Exchange of information with IP members, common actions towards successful implementation of the process in participating countries, evaluation of the implementation possibilities	1, 2, 4, 5, 6, 7, 12, 14, 16, 17	1, 12
V.F – Contacting existing industrial partners and future contractors. Looking for potential users of the technology; implementing institutions, investors, etc.	1, 2, 4, 5, 7, 10, 14, 17	1, 10

B.5 Description of the consortium

In the table below is shown how the participants collectively constitute a consortium capable of achieving the project objectives.

Name of the organisation	Type of the organisation	Country	Number of employees	The role in the activity/project
1 AKTION SKÅNE-MILJÖ **AS-M** (NGO)	Others	Sweden	1 (500-600 members)	Coordinator Contractor: WP1, WP7
2 Department for Environmental Biotechnology **IFA-Tulln**	Higher education	Austria		Partner
3 Darmstadt Technical University TUD	Higher education	Germany	> 500	Contractor: WP9
4 Dipartimento di Agronomia Ambientale e Produzioni Vegetali **DAAPV**	Higher education	Italy	80	Partner
5 Department of vegetal productio science DSPV-IT	Higher education	Italy	75	Partner
6 Istituto di Chimica del Riconoscimento Molecolare (ICRM-CNR)	Higher education	Italy	50-60	Partner
7 Instituto Superior de Agronomia **ISA**	Higher education	Portugal	350	Contractor: WP5
8 Department of Crop Sciences SLU	Higher education	Sweden	160	Contractor: WP4
9 Technical University Lodz TU Lodz	Higher education	Poland	3 000	Contractor: WP6
10 European Engineering Services for International Cooperation EURES-IC	Others	Italy	6	Partner
11 Catedra de Inginerie Chimica, Laboratorul de Transfer de Masa UPBTM	Higher education	Romania		Partner
12 Department of Environmental Engineering FEE SK	Higher education	Slovakia	100	Contractor: WP10
13 Poltegor Institute of Open Cast Mining POLT	Others	Poland	(100-120)	Contractor: WP2
14 European Center of Excellence for the Environment ECEE - RO	Higher Education	Romania	2100	Partner
15 Department of Environmental Engineering DEU	Higher education	Turkey		Partner
16 Zurich University of Applied Sciences Winterthur (ZHW)	Higher education	Switzerland	50	Contractor: WP8
17 Department of Chemical Technology GDATECH	Higher education	Poland	2400	Contractor: WP3
18.King Mongkut's University of Technology Thonburi KMUTT	Higher Education	Thailand	Approx. 1500	Partner
19 University of Veterinery Medicine, Research Institute of Veterinary Medicine UVM-SK	Higher education	Slovakia	(550)	Partner

Complementarity between participants is presented in tables connected to B.4 and in WPs.

Sub-contractors are needed for design, construction, manufacturing and implementation of equipment/hardware for the experimental mobile lines and for creation of software in cases there these activities are missing or poorly presented in the consortium.

Participation of SMEs plays not the significant role because that approach of concept ESOLIRE is new and needs more research.

The participants based outside of the EU are important for exchange of knowledge and experience.

Consortium agreement will be signed later.

B.6 Description of project management

The management of the project will lie with ???. The Project co-ordinator will take care of the overall project management and of the effectiveness of know-how transfer and experience interchange among the Participants in the course of the project implementation, will be responsible of the project towards the E.C. and will represent the partners towards external bodies.

Monitoring activities will check the effectiveness of know-how transfer and experience interchange, proposing, if the case, modifications of and/or integration to the programme of work in order to assure the achievement of objectives set. Specific tasks of the co-ordinator will be:

- the co-ordination of the work to be developed in each of the participants sites;
- the co-ordination of the shared work of the participants;
- the definition of the decision structures;
- the supervision of the qualitative and quantitative indicators necessary for the monitoring and evaluation of the project actions;
- the organisation and implementation, in collaboration with the other participants, of the M&E activities;
- the preparation of the project budget following the E.C. instruction;
- the preparation of all reports (M&E reports, technical, administrative and financial reports, etc.);
- the integration of the project with other actions and programmes being carried out or in phase of elaboration;
- the allocation of the financial contribution received from the E.C. between the participants, for the amount corresponding to their expenses, accordingly to the E.C. rules and regulations;
- the control of the preparation of the contracts and terms of reference for the sub-contractors (construction and installation of systems components, prototype realisation, etc);
- the dialogue with the E.C. and the experts elected by the Commission.

A co-operation agreement will be signed by all participants at the commencement of the project implementation.

Since the project will be developed in the same location, the communication among participants will be facilitated; however, periodic meeting are planned, particularly in correspondence of the elaboration of the half-year reports. Integration among partners will moreover occur throughout the whole project, by means of the communication channels, among which the internet channel to be used for internal communication and joint elaboration of documents.

A mid-term Assessment Report (combined with the periodical progress report) on the progress of the research and the partner's plans for future exploitation strategy is to be submitted before the end of the 10th month from T0. In this respect, the co-ordinator will organise a Mid - Term assessment meeting at the end of the 8th month with all the partners and the EC 's representative. The purpose of this meeting will be to report on the progress to date and to redefine –if necessary- the Project programme for the remaining part of the contract; procedures for managing future exploitation of results will be discussed and approved.

For setting-up and presenting progress and final technical reports, some guidelines and common EC rules have been established (to be distributed by EC in due time). When applicable, any publication delivered in the framework of this contract and especially for the final publishable report will follow the EC guidelines for publications. The contractor will also send the EC, in addition to the copies, the original of the reports on electronic form and/or CD-ROM.

Management of research activities

I: Design and construction of the mobile experimental line with sub-systems A, B, C, D and E.
II: Description of work carried out in sub-systems:
A – collection and pre-processing; B – processing in bioreactors, improvement of methods, bio filters with high precision, testing of additives, inactivation of pathogens and weeds; C – biogas collection, quality, treatment and use; D – biofertilisers preserving, improvement of quality and use; E – control system, logistics, modelling, and simulation and optimisation of the equipment an methods.

LOCAL BIOCONVERSION

OF SOLID AND LIQUID RENEWABLES

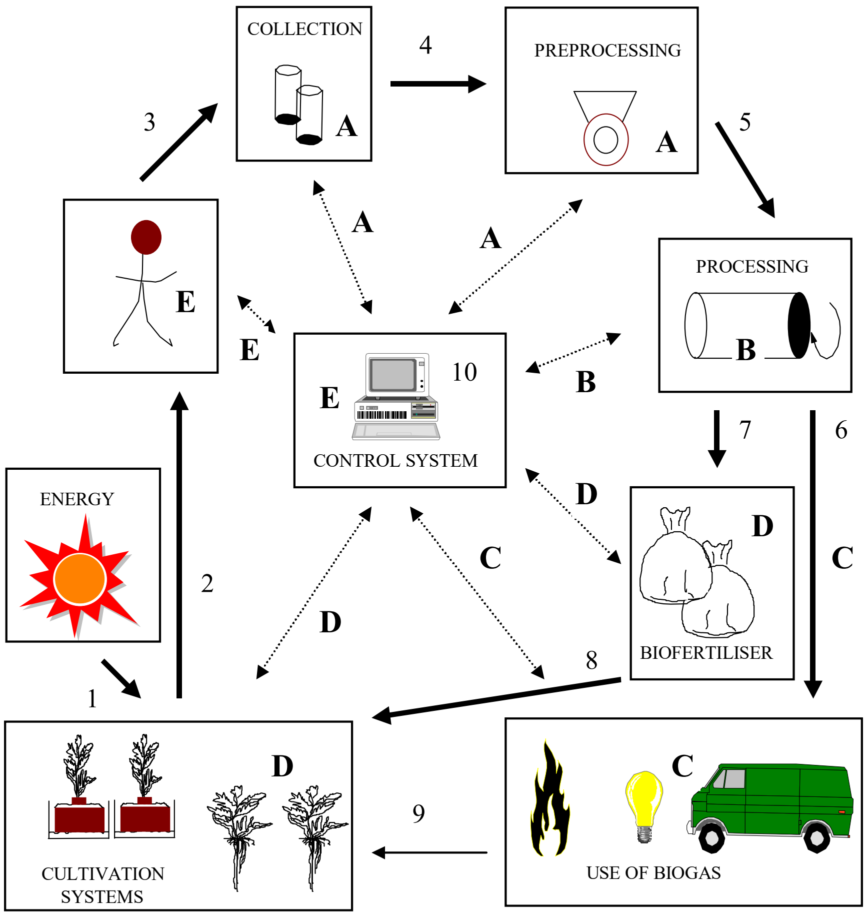


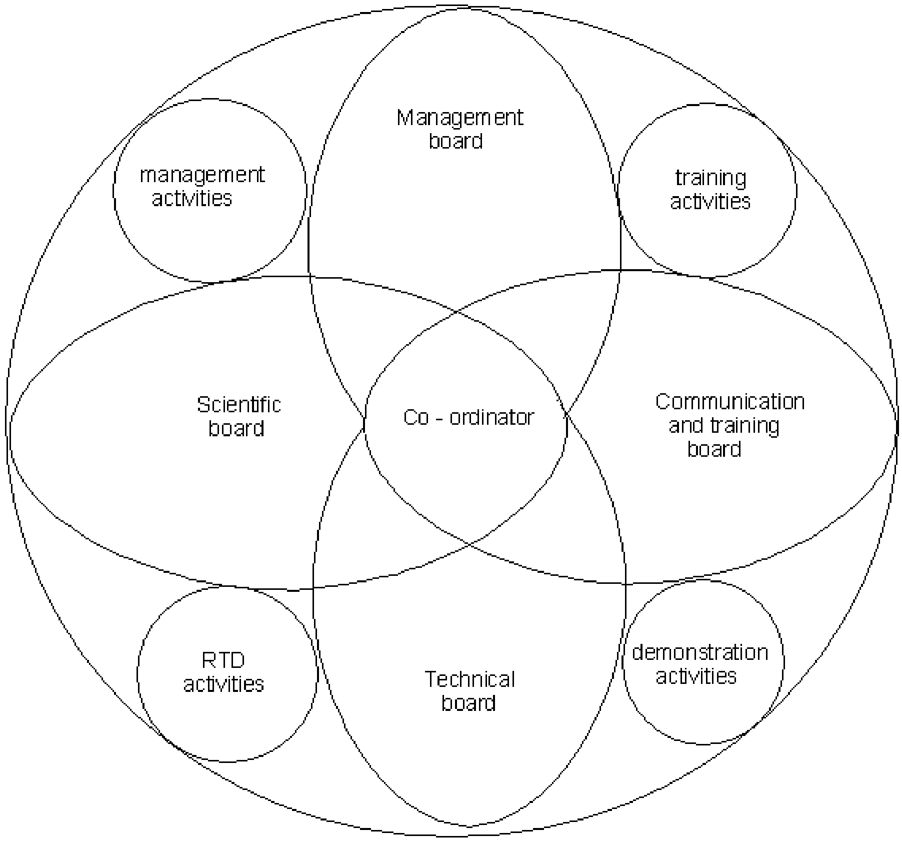
Figure 7: Model of computerised system for local bioconversion of solid and liquid renewables. The flow of energy and elements.

1 - energy from the sun is used in various cultivation systems and is biochemically bound with elements in organic structures in the biomass; 2 - the biomass is utilised by humans; 3 - energy and elements in renewable waste/residues are collected in closed equipment; 4 - the renewables are in pre-processing subsystem prepared for treatment; 5 - during processing the energy from renewables is transformed to energy-rich methane in biogas and to biofertilisers where a part of the energy is still bound in organic structures; 6 - biogas can be used for heating, transformed to electricity and heat (”co-generation”) or as fuel in vehicles; 7 - energy and elements are bound in biofertilisers; 8 - biofertilisers become the substrate, which microorganisms in various cultivation systems utilise and thus promote plant growth; 9 - biogas can also be used in cultivation systems. 10 - steering and regulation of all subsystems is made by operators who use information from the control system.

The loop is closed and new plants will use the elements from biofertilisers during photosynthesis and with energy from the sun new biomass will be produced.

General management and activities

The overall management structure will contain “Co-ordinator” (with co-workers), “Management board” where all partners will be presented, “Board for Communication and Training”, “Scientific board” and “Technical board”.



Note: The circle represents the partners

The circle can describe best the equidistance between all partners, and between the partners, the coordinator and the boards. The boards will be in permanent contact keeping in the same time the closer contact with the specific activity. At the same time, the partners are linked by the conjunction of their fields of competence.

During the life of the project, the jobs for every partner can evolve:
- on horizontal plan, that means that the same partner can work on different field of competence for example biological kinetics may be studied at the same time with chemical kinetics, and the nutritive value of biofertilisers can be studied both from biological and chemical point of view;
- on vertical plan, the importance and the value of the work and results of one partner can make possible to situate him in one of the boards.

The project is characterized by a permanent feed-back. The technology and design will evolve depending on the concrete results, from the economic efficacy and environmental impact.

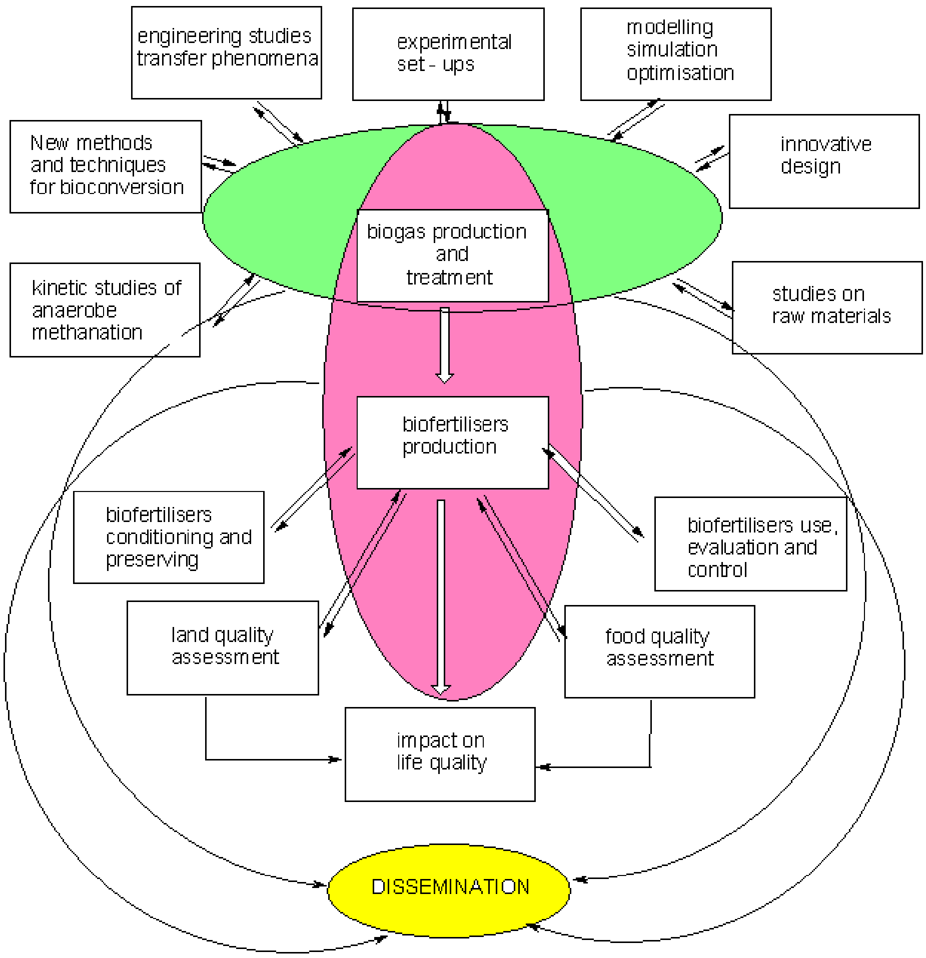
The multidisciplinary study will optimise the general process from: energetic, environmental and economic point of view. At the same time, the economic and social study will reflect if the research direction is good or not.

The convergence of these multiple factors will be studied in a several concrete cases.

The most important part of this investment is building a several mobile plants for microbial conversion of renewables with production of biogas and biofertilisers.

The consortium from the project will be involved from the beginning at all the steps from the implementation of the novel system.

RTD organisation and management are presented in the figure below.



RTD organisation and management
rectangle = basic components
elipse = major steps

Co-management
FEE-SK are ready to co-organise seminars, conferences, meetings, training-workshops and share the ESOLIRE project management in areas:

- project communication (e-management, www. ESOLIRE.eu, e-worshops...)
- overseeing science and society issues, related to the research activities conducted within the project as well as knowledge management and other innovation-related activities at consortium level with strong support of the Td-centre.

B.7 Project resources

Resources available

Short name of the organisation	Personnel	Equipment
1 AS-M	1 researcher	Prototypes of bioreactors, shredder, computer, Siemens hardware - control system
2 IFA-Tulln	1 researcher	Experimental field, experimental greenhouse, laboratory, computer
3 TUD	1 professor, 2 researchers, 2 technicians	Technical equipment for infra-red-thermographic-based observation of bio filters functionality License of software tool for modelling flows of energy and materials and to evaluate impacts on health and environment (Umberto© Life Cycle Assessment tool). Laboratory analysis equipment
4 DAAPV	4 researchers, 3 technicians	Facilities available at the Experimental farm to carry out field experiments; instruments for monitoring nutrient losses under fertilization treatments; lysimeters; chemical and soil physics laboratories; computers;
5 DSPV-IT	3 researchers	Computers, soilless system, experimental field, physiology, metereological station, experimental greenhouse, chemical laboratory
6 ICRM-CNR	3 researchers	Microbiological laboratory equipped with: Bioreactors, fermentor. Biochemical laboratory equipped with: HPLC/UV-vis detector, UV-spectrophotometer, Gas Chromatography/Mass spectrometry
7 ISA	1 researcher	Wastewater analytical laboratory facilities, monitoring instruments, lab scale bioreactor, experimental farm facilities
8 SLU	1 researcher	Microorganisms laboratory equipped with chemicals and instruments for isolation, monitoring and growth of plant pathogens re-isolated from biofertilisers, interference compound microscopy with digital camera system, sterile benches, autoclave, growth chambers in controlled environment, greenhouse chambers, computers.
9 TU Lodz	2 researchers	Prototypes of bioreactors, control set-up, analytical equipment, elemental analyser CE Instruments, Hach and Büchi analysing systems, Waters HPLC, gas chromatograph, ICP-AES spectrometer, spectrophotometer UV-VIS, thermal balance Mettler-Toledo, computer
10 EURES-IC	2 Engineers	Computer, software.
11. UPBTM	6 researchers and 1 technician	Laboratory and micropilot devices for experiments concerning all mass transfer phenomena involved in the process, laboratory bioreactors, physico-chemical analytical apparatus, computers.
12 FEE-SK	1 researcher	Computer, software
13 POLT	4 researchers, 4 assistants	Chemical and Environmental Engineering laboratory, computers, controlling equipment
14 UGALCE	5 researchers, 5 assistants, 10 PhD and master students (there is a special master specialisation)	Analytical equipment, computers, chemical laboratory, acces to pilot installations, applications on an ISPA project, instrumental analysis, good network with specialised enterprises
15 DEU	2 researchers, 4 assistants	Laboratory equipment, analytical apparatus,

		computers.
16 ZHW	4 researchers	Computers equipped with necessary tools like the Social Compatibility Analysis, Geographic Information Systems, etc.
17 GDATECH	2 researchers, 1 technician, 2 students	Prototypes of bioreactors (horizontal and vertical design) air-sparged hydrocyclone reactor for rapid mass transfer between liquid-gas phases, large-scale photoreactor (2.5W UV lamp) for aqueous phase treatment, particle-size analysers (Fritch, Malvern), reometers, thermal analysis instruments, size reduction and classification equipment
18 KMUTT	1 assistant professor	Computer, culture pond, evaporating cooling greenhouse
19 UVM-SK	5 researchers, 1 technician	Chemical and microbiological laboratory equipment, computer, experimental field