

FP7 Cooperation Work Programme

Theme 6 **Environment (including climate change)**
ACTIVITY **6.3. ENVIRONMENTAL TECHNOLOGIES**
Sub-activity **6.3.1. Environmental technologies for observation, simulation, prevention, mitigation, adaptation, remediation and restoration of the natural and man-made environment**
3.1.3 TOPICS CALLED **ENV.2008.3.1.3.2 Technologies for high added value production from waste**

Proposal full title:

Municipal Solid Wastes - Advanced Technology for Recovering Energy & Useful Side-Products

Proposal acronym:

MSW-ATREUS

Type of funding scheme: **Collaborative project (small or medium-scale focused research project)**

Work programme topics addressed: **ENV.2008.3.1.3.2. Technologies for high added value production from waste**

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List of participants:

Participant no.	Participant organisation name	Country
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2.	University of Western Macedonia (UoWM)	Greece
3.	National Observatory of Athens (NOA)	Greece
4.	Ben-Gurion University of the Negev (BGU)	Israel
5	Geneva Institute of Technology/IMEC (IMEC)	Switzerland
6	Peras Group AG (PG)	Switzerland
7	Arcadian Financial Consultants (AFC)	Greece
8	Kallisti Extract & Energy Production MSW-SRL (KEEP)	Romania

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1. Scientific and Technical Quality

1.1. Concept and Objectives

The concept of the project MSW-ATREUS is summarised in the following: Plasma gasification can be used to treat wastes of varying quality, such as wastes with a high concentration of inorganic material and a very low heating value. Plasma is an ionised gas that conducts electricity. Many types of gases can be used, such as argon, helium, methane and steam. For waste gasification applications, air is the most commonly used gas. In order for air to conduct electricity, it must be subjected to a large electrical potential difference. This is achieved between two electrodes, which are separated by air. When this potential difference is large enough, electrons can be pulled from the normally neutral molecules in the air. These electrons then move with the electric field and impact other molecules, releasing more free electrons at an exponential rate. This phenomenon is called *electron cascade*, and once enough electrons are moving with the electric field, an arc is created between the electrodes. All of this happens within a fraction of a second. Viewed as an electrical circuit, the air gap, where the arc is created, can be seen as a resistance. While going through this resistance, the electrical current releases large amounts of heat. Several technologies have been developed to use this source of heat, which can reach temperatures from 5000°C to 10,000°C. Therefore, plasma is best suited to treat wastes of varying quality, such as wastes with a high concentration of inorganic material and a very low heating value. This is because most of the heat required for the gasification comes from the plasma and not from the oxidation of the waste. The following section describes two of these technologies – the plasma torch and the transferred-arc graphite electrodes.

The plasma torch: A basic plasma torch contains two electrodes – a cathode and an anode – which are typically made of copper, with a small amount of rare metals such as tungsten or hafnium. A gas flows between these two electrodes, while the voltage is applied. Once ‘sparked’, an arc is created. High-temperature gas is directed out of the torch tip and stretches across the electric arc, where it makes contact with the waste to be destroyed. In simple words, the plasma torch works like a hair dryer, where the electric arc acts as the heating element and air is pushed through this element, which heats the air up to very high temperatures of more than 5000°C. The flame that exits the torch is referred to as the *plasma ‘plume’*. The plasma torch can be used in an oxygen-deprived environment to gasify waste, creating mainly synthetic gas (syn-gas) from the organic components. It can also be used to heat up the inorganic components of the waste to a high temperature, therefore, melting or vitrifying the ash to an inert glassy material, known as *slag*.

The chemistry of gasification and oxidation: Plasma can be used in gasification to break down waste into gas. Although gasifiers such as fluidised-bed systems have existed for many years, the heat in plasma allows the use of low-energy fuels, such as household and industrial wastes that often cannot sustain their own gasification

without additional fuel. Gasification is the thermal degradation of carbon-based organic materials into a gas mixture at high temperatures (400°–1500°C), while inorganic components turn either into a solid char or liquid slag. This process is carried out in an oxygen-starved environment, preventing the oxidation of carbon to CO₂. When no oxygen is present at all, the process of breaking down large molecules into smaller ones by heat, not by flame, is called *pyrolysis*. When small amounts of sub-stoichiometric oxygen are present, the process is called *gasification*. The gas produced by gasification – called a *syn-gas*, synthesis gas or producer gas – consists mainly of CO and H₂, which are both in a reduced state (they are essentially a fuel) and can undergo further oxidation (combustion) to release energy. There are several advantages to producing a syn-gas rather than a fully combusted gas. For the same amount of waste, gasification will produce a smaller volume of gas since no fossil fuels are burned to generate heat and there is no need for excess oxygen as in most other thermal treatment processes. Of course, a smaller volume of gas costs less to clean. Also, a clean syn-gas can be turned into energy quite efficiently using either a turbine or an internal combustion engine or a fuel cell. The syn-gas can also be converted to other gases or chemicals, such as methane (similar to natural gas), hydrogen or methanol. The gas produced by the thermal treatment of the waste is typically subject to local and national emissions regulations. The main components being regulated worldwide are acid gases, carbon monoxide, nitrogen oxides, particulates as well as dioxins and furans. In North America and Europe, these standards are becoming increasingly strict. For example, in December 2005 the US EPA issued a new standard for the incineration of non-hazardous solid wastes (40 CFR Part 60), which reduces, for example, the emission limits for SO₂ from 30 ppm to 3.1 ppm and NO_x limits from 500 ppm to 103 ppm.

Great promise: Because of their high cost, plasma systems have so far been used primarily for the vitrification of high-end wastes such as military and low-level radioactive wastes. Some demonstration plants have also been developed and operated at relatively small scales. As plasma systems become more accepted and their design is simplified, their use will become more widespread. Plasma systems promise to offer a viable alternative to land filling and conventional incineration, with lower air pollution and virtually no by-products requiring final disposal. The syn-gas produced can be used for energy generation or can be converted for other applications, while the small amounts of vitrified solid can be used in the construction industry.

On the other hand, much development has focused on *solid oxide fuel cells (SOFC)*, both because they are able to convert a wide variety of fuels and because they do so with such a high efficiency (40-60% unassisted, up to 70% in pressurized hybrid system) compared to conventional engines and modern thermal power plants (30-40% efficient). SOFC technology dominates competing fuel cell technologies because of the ability of SOFCs to use currently available fossil fuels, thus reducing operating costs. Other fuel cell technologies (e.g. molten carbonate, polymer electrolyte, phosphoric acid and alkali) require hydrogen as their fuel. Widespread use of such fuel cells would require a network of hydrogen suppliers, similar to our familiar gas stations. High efficiency and fuel adaptability are not the only advantages of solid

oxide fuel cells. SOFCs are attractive as energy sources because they are clean, reliable, and almost entirely non-polluting. Because there have no moving parts and the cells are therefore vibration-free, the noise pollution associated with power generation is also negligible.

Stationary SOFC power generation is no longer just a hope for the future. Siemens Westinghouse has tested several prototype tubular systems, with excellent results. A plant in the Netherlands has been operational for two years and an earlier prototype installation has been operating for 8 years. The fuel cells have been through over 100 thermal cycles and the voltage degradation during the test time has been minimal less than 0.1% / 1000 hours. Siemens Westinghouse announced its first fully operational tubular fuel cell plant in place by October 2003¹. Meanwhile, in Australia, Ceramic Fuel Cells, Ltd. has been operating prototype planar fuel cell plants since 2001 and expects to be ready with market-entry products².

The objective of MSW-ATREUS collaboration for handling Municipal Solid Wastes, as being implied from the above, is to gasify them to plasma-converted-synthetic gas and produce electric power. An efficient power pilot-plant with topping *Solid Oxide Fuel Cells (SOFC)* and bottoming live-steam powered Rankine cycle is to be developed by the SMEs of the Consortium, intended to undertake intensive R&D efforts for the integration of known technologies, in close collaboration with the participating RTD teams, widely recognised in their field of expertise. Another important point is the *integration of technologies*, which are very close to being mature (plasma molecular dissociation-gasification reactor combined with SOFC), but have not been applied so far though they have clear advantages over other “classical” technologies, for example, pyrolysis. The MSW-ATREUS proposal intends to establish and operate one demonstration plant, in order to examine the feasibility of this approach; also to disseminate its environmentally and economically viable applications in many European Regions with varying climatic and socio-economic conditions. This demo-scheme is one of the main objectives of MSW-ATREUS. One demonstration plant with an MSW capacity of 10 tons/day is proposed to be installed close to existing MSW facilities in Greece (Arcadia).

Life Cycle Analysis (*LCA*) studies will be carried out to evaluate future waste management options. These studies will give much information about the benefit of the proposed waste management as compared to the traditional way. The LCA, or environmental assessment, will cover the environmental and resource impacts of alternative disposal processes, as well as other processes, which are affected by disposal strategies, different types of collection schemes for recyclables, advanced non-polluting technologies for significant energy recovery etc. The LCA studies intend to provide environmental data for the public, the local authority or the government.

The strategic importance of Environmental Technologies has been highlighted by the Environmental Technology Action Plan launched in 2004 by the Commission as a joint initiative between DG ENV and DG RTD. Priority in research will be given to innovative system solutions, which integrate front-end with in-process and end-of-

pipe components within a coherent organisational framework, having the objective to minimising the environmental impacts associated with economic activities and helping to closing the life cycle of materials. For this aim, appropriate methodologies for technology sustainability assessment need to accompany all research activities. The Theme is designed to attract industrial participants, putting specific emphasis on SME relevant research topics, namely within the areas of the Environmental Technologies activity. In this activity SME-targeted collaborative research topics have been introduced in areas, which are supporting the Strategic Research agendas of the relevant Technology Platforms and are specifically designed to encourage SME participation in research and innovation. The MSW-ATREUS approach belongs to the following topic: *ENV.2008.3.1.3.2 Technologies for high added value production from waste.*

The consortium is designed to satisfy all project objectives and deliver concrete final products. It comprises **3 universities** and **2 research institutes** responsible for process analysis, modelling and optimization including process sustainability, pre-processing of wastes, utilization and diathesis of by-products and finally the conjunction of plasma gasifier to power generation systems for the energy conversion of the produced syn-gas and **3 SMEs**, a high-tech SME providing the pilot plan unit and **2 consulting companies** contributing to management and dissemination issues. The countries involved are *Greece* (4 partners), *Switzerland* (2 partners), *Israel* (1 partner) and *Romania* (1 partner). This partnership, with good vertical integration, will be coupled to an efficient decision-making and project management structure in which partner companies will play an important role.

1.2. Progress beyond the state-of-the-art

Plasma waste converters can treat almost any kind of waste, including some traditionally difficult waste materials. It can treat medical wastes or chemically-contaminated ones leave behind nothing else but gases and slag. Because it breaks these dangerous wastes down into their basic elements, they can be disposed off safely. The temperatures generated by a plasma torch can be hotter than the surface of the sun (more than 6,000 degrees Celsius). At these temperatures, garbage doesn't stand a chance. Molecules break down in a process called *molecular dissociation*. When molecules are exposed to intense energy (like the heat generated by a plasma torch), the molecular bonds that hold them together, become excited and break apart. What are left are the elemental components of the molecules.

MSW-ATREUS will move the research and application capabilities of plasma waste converters one step further by focusing on the following open issues:

1. *Analysis of the sustainability of the process.* Plasma waste facilities have had several obstacles to overcome. First, they constitute a new technology. It can take many years for a new technology to go from discovery to commercial use. Sometimes this gap seems to coincide rather conveniently with the expiration of the initial patent on the idea. New technologies are also expensive; almost every plasma application requires a custom built facility. Until facility production can be

standardised, costs will be high for plasma plants. There are several parameters like the road network to the unit, the possible need for pre-treatment of the garbage, the energy consumption or how possible is to turn the unit into a power independent / self-sufficient one etc., that affect the overall output of the process. On the other hand, these costs can be efficiently balanced by maximising the incomes from the utilisation of both slag and syn-gas products. Thus, business plan and LCA on the basis of a local view of the plant has to be performed.

2. Simulation for pre-processing optimisation of waste treatment. The simulation of the whole process is very important in order to understand the mechanisms that should be optimised as to enhance the efficiency of the process. Simulation should take into account both macroscopic and microscopic parameters characterising the process.

3. Optimisation of the utilisation and diathesis of the by-products. There are three main by-products that are a result of the plasma gasification process: syn-gas, slag and heat. Syn-gas is a mixture of several gases but mainly comprises hydrogen and carbon monoxide. It can be used as a fuel source, and some plants use it to both provide power for the plant and sell excess electricity to the power grid. Garbage contains a great deal of potential energy; the gasification process enables engineers to convert the potential energy into electrical energy. The solid by-product from the gasification process is called *slag*. The weight and volume of the original waste material is dramatically reduced. The weight of the slag is about 20 percent of the weight of the original waste. The volume of the slag is about 5 percent that of the original waste's volume and can take different forms depending on how it is cooled. If slag is air-cooled, it forms black, glassy rocks that look and feel like obsidian, which can be used in concrete or asphalt. Molten slag can be funnelled into brick or paving stone moulds and then air cool into ready-to-use construction material. The heat created by plasma facilities is considerable, measured in thousands of degrees Centigrade. Heat from the molten slag helps maintain the temperature within the furnace. Some of the heat from gases can be used to convert water into steam, which in turn can turn steam turbines to generate electricity. Finally, slag can be sold in any of its forms. The rock form can be used as gravel or moulded into bricks. Sand can be mixed with concrete and used in various paving and construction projects. Rock wool can be used for insulation or to contain dangerous oil spills. If the molten slag is cooled by water, metal nodules can be separated from the slag and sold for scrap.

4. Low to self power capabilities of the unit. With the right capacity, a plasma plant can generate enough synthetic gas to run an engine or gas turbine and generate electricity. A 1,000-ton-per-day plant can generate enough electricity to power the plant itself and still have plenty of power to sell back to the grid. The hot gases can be used to generate steam, which can turn steam turbines for electricity or be used to generate heat for the plant and other facilities.

We have selected a series of technologies that we believe are state-of-the-art, are very efficient, and have a very high potential of being commercialised in a relatively short time. The following are the technologies selected and their advantages:

- a) Plasma gasification system, in which MSW is turned into gaseous atomic phase at extremely high temperatures (thousands of degrees) and syn-gas is produced according to the temperature and atomic concentrations within the gas phase. The main advantages are extremely high efficiency and absolute control of the syn-gas composition. The latter advantage is in particular important as one can tailor the plasma gasification process to fit the next stage of application.
- b) Solid oxide fuel cells (SOFC), in which syn-gas is electro-oxidised with oxygen anions (O^{2-}) and by means of the reverse process of electrolysis, electricity is produced as well as water, carbon dioxide and non-reactive syn-gas (CO and H_2) in the anode compartment and depleted air in the cathode effluent stream at high temperatures (800 - 1000 °C). This process has the potential of very high conversion yield since chemical energy can be directly converted to electricity bypassing the existing thermodynamic limitations of the conventional Carnot cycles. The flue gases of this process can be also used in a conventional steam-power-generation to further produce heat and power, boosting SOFC efficiency to 70-80 % with respect to syn-gas fuel low heating value (LHV).
- c) Steam and power generator system. In such a system we intent to use the steam produced from the plasma system and the high temperature flue gas (which is a water-fuel-oxygen-water mixture) from SOFC to produce steam from which power will be generated. This conventional system is just an addition to the two systems described above in order to maximise the output of the entire system.
- d) An integration system of all above technologies that requires a significant R&D effort in order to determine the algorithm and methods to optimise, operate, and control the entire system in real time to have the highest yield from the integrated system. Schematically the integrated system is shown in Fig. 1.

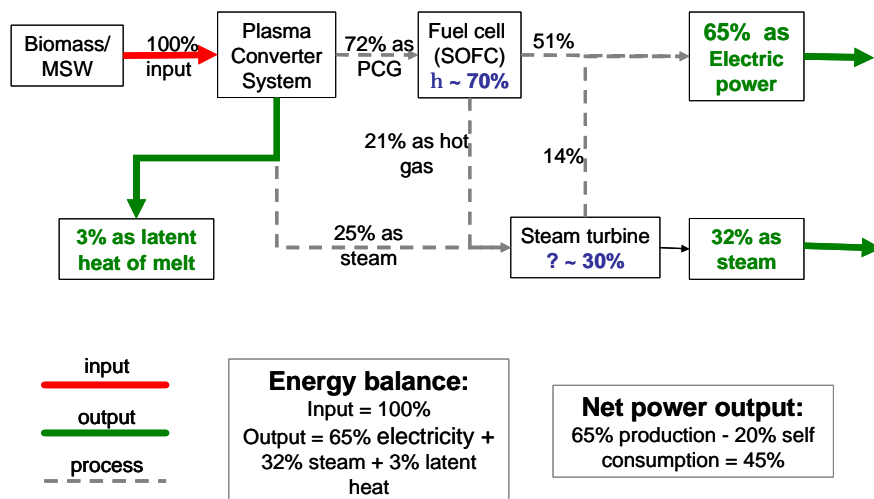


Figure 1. Schematic diagram of the integrated system to turn MSW into energy (power and steam).

5. *Optimisation of the usage of SOFC for energy production from the synthetic output gas.* Among the many commercial uses of Plasma Cell Gasifier (PCG) is its potential use to produce "green electrical power" and Gas-To-Liquid (GTL) fuels such as methanol and synthetic higher-alcohol "alternative" fuels. Hydrogen, for use and

sale, can also be separated and recovered from the PCG syn-gas mixture. After syn-gas is produced in the Plasma Gasifier, it should be cleaned before entering the fuel cell, or even an interceded reforming reactor. Syn-gas reforming will be studied over state-of-the-art Al_2O_3 and La_2O_3 catalysts, containing Ni, Ni/Mo and Ni/Mo/Rh as the active phase. Fuel reforming^{3,4} and steam reforming of hydrocarbons⁵⁻⁷ have been extensively investigated. Both steam excess and H_2 addition alert carbon deposition. Steam reforming of hydrocarbons is usually conducted over Ni/ Al_2O_3 ⁸⁻²⁰ catalysts with the addition of K²¹⁻²⁵ or Mo²⁶⁻³⁷ for coking and sintering prevention. Although K is more effective than Mo, its volatility prevents long-term stability. In order to increase activity and durability against coke deposition, Ru or Rh is often added to Ni-Mo/ Al_2O_3 catalysts^{38,39}. Other systems like Ni/Mg Al_2O_3 ^{40,41}, Ru/ Al_2O_3 and Ru/ Al_2O_3 -CeO₂⁴², Rh-Mo/ Al_2O_3 ⁴³, Ni-MgO/ Al_2O_3 ⁴⁴ Ru-Ni/ Al_2O_3 -MgOLa₂O₃⁴⁵ have also been examined. Similarly, dry reforming of hydrocarbons is primarily conducted over Ni based catalysts⁴⁶⁻⁵⁸ over various supports with La_2O_3 reported to exhibit quite unique activity and tolerance⁵¹⁻⁵⁸. Since coking during dry reforming is a more serious problem, the relevant research concerns extensively noble metal catalysts⁵⁹⁻⁸⁴, primarily Rh^{71-75,85,86} and Ir^{87,88}. Simultaneous steam and dry reforming has also been examined, over Ni/ Al_2O_3 catalysts with CH₄/CO₂/steam ratios in the range of 1.5:1.0:1-4,5⁸⁹⁻⁹².

Concerning *Solid Oxide Fuel Cells*, the proposed project aims to *estimate and optimise the performance of SOFCs fuelled by thermo-derived syn-gas or reformat gas*. Power density and fuel utilisation determines the overall efficiency of the cell, while these parameters are readily affected by the operational cell voltage⁹³⁻²⁹⁷. In the case of the wide range of biogas compositions, the dilution of H₂/CO/C_xH_y combustible agents results in a decrease of the voltage and the cells power density⁹⁸. In practice, SOFCs can tolerate a wide variety of H₂/C_xH_y/CO compositions; however the performance optimisation may require significant operating condition, and/or system design changes⁹⁹. Several groups have studied SOFC fuel flexibility, using theoretical analysis¹⁰⁰⁻¹⁰⁴. Thermodynamic simulation, supported by experimental investigation of a variety of fuels in a 25-kW tubular SOFC, was announced by Singhal in 2000¹⁰⁵. Furthermore, Alderucci¹⁰⁶ carried out a thermodynamic study of a gasifier integrated to a SOFC, and Kendall¹⁰⁷ powered a small tubular SOFC with simulated biogas. Even a rush literature survey can reveal a substantial lack of fundamental research concerning biogas utilisation in YSZ-based SOFCs, as those incorporated in the proposed project. Rare studies report power densities reduced to the 1/3 of the corresponding values concerning H₂, mostly due to the dilution of the combustible agents¹⁰⁸⁻¹¹¹. Thus, Sulzer & Hexis have announced efficiencies closed to 27%LHV, of a 1-kW SOFC, operating for 2,500 hours on bio-derived biogas^{112,113}, which is almost 1/2 of the regular SOFC efficiencies on H₂ or reformed natural gas. Bin Zhu⁹⁸ reported power densities reduced almost equally to the H₂ dilution (45% reduction for 45% dilution), in an innovative cell involving a mixed conducting electrolyte. Apart from these studies, most of which refer to bio-derived gases and the contiguous landfill gas¹¹⁴⁻¹¹⁶, there is a shortage of relevant data in literature. Studies of syn-gas utilisation in intermediate temperature CGO-based SOFCs (which are not included in this proposal), also reveal significant current

density reduction with H₂ dilution (almost 50% for H₂ dilution from 50 to 10%)¹¹⁷. Modelling studies of biogas utilisation in SOFCs predict efficiencies from 23%¹¹⁸ and 35%¹¹⁹ to 42%¹²⁰ and 50%¹²¹, the latest for theoretical fuel utilisations as high as 80%. Such utilisations is achievable in H₂ or CH₄/H₂O SOFCs, in which open circuit voltages can exceed -1.2 V, allowing operation at potentials as high as 0.8 V with almost optimum power densities¹²²⁻¹²⁷. This is hardly the case for syn-gas, for which the open circuit voltage might not even reach -0.6 V, and the optimum operational potential is not greater than 0.4 V¹²⁸.

Hopefully, sufficient research, to form a base and orientate the proposed project, has been devoted to SOFC operation on synthesis gas. Numerous studies report performance characteristics on steam dilution of H₂, while some of them also examine the effect of fuel composition¹²⁹⁻¹³². Furthermore, over Ni/YSZ anodes, Jiang¹³³ reported a 60% drop of the current density when CO was diluted to 50% by CO₂. Generally, H₂ electro-oxidation is 2 to 3 times faster than CO's^{134,135}, due to the insufficient spill over of the latter to the three phase boundary of the electrode-electrolyte interface¹³⁶. This results in up to 5 times lower CO contribution to the cell's power output, compared to H₂, over the most commonly used Ni/YSZ anodes^{137,138}. While CO is a poor fuel for Ni-based anodes, it can be used to produce additional H₂, through the gas-shift reaction, which is catalysed by Ni containing anodes. Apart from the H₂O produced by the electro-oxidation of H₂, additional steam can be introduced to the cell to improve performance, a case which coincides with internal reforming SOFCs¹³⁹⁻¹⁴³. In order to enhance SOFC performance and prevent carbon deactivation, several composite anodes have been tested¹⁴⁴⁻¹⁴⁷, including Cu¹⁴⁸, or alkali¹⁴⁹ addition to Ni-YSZ-, CeO₂¹⁵⁰⁻¹⁶⁰- or TiO₂^{161,162}-based oxides, Ni-Ca(Fe)TiO₃ oxides¹⁶³, Rh-YSZ¹⁶⁴ etc. Exceptional enhancement of CO contribution to the overall power density was observed over Cu/CeO₂/YSZ anodes¹⁶⁵, which are often tested for the direct C_xH_y oxidation in SOFCs, and exhibit high resistance to coking¹⁶⁶. Cobalt incorporation to these catalysts improves further their performance¹⁶⁷, and lead to CO power densities higher even than those of H₂¹⁶⁸. This was attributed to the expansion of electrochemically active zone of the anode, to the extended surface of O²⁻ conducting CeO₂¹⁶⁹. Nevertheless, they did not remarkably restrict the negative effects of fuel dilution¹⁷⁰. In this context, *Ni, Cu, Co, Fe*, as well as *Pt* and *Rh* active phases will be (solely or combined) incorporated with *CeO₂/YSZ* substrates in order to develop state-of-the-art composite anodes, for the *optimum CO contribution* to the overall cell performance (since CO is one of the major components in both syn- and reformat gas). A more detailed treatment can be found in¹⁷¹⁻²¹⁸.

6. Localisation of the process for special types of wastes like ashes and olive kernels. Since in the specific area of development of the MSW-ATREUS prototype unit, there is a special need for handling both ashes from a nearby brown-coal fuelled power plant and agro-industrial loads of wasted olive kernels, the need of customisation is necessary to optimise the whole process.

1.3. S/T Methodology and associated work plan

The project will start by erecting the building that will host the plasma gasification equipment. When the building is ready then the parts of the plasma gasification machinery will be shipped to the area and the assembly and possible modifications due to the suburban area will be performed. The overall duration of this effort is expected to be no more than twelve (12) months.

In the mean time the research groups will work on the process, that is either computer and/or laboratory experiments will be performed in the following: (i) input, work flow and output procedures, (ii) life cycle analysis, and (iii) laboratory experiments on the uptake of the produced gases (mainly H₂) by solid oxide fuel cells, (iv) design of an algorithm that will control all the mentioned technologies in an optimum manner and control the operation in a closed loop. In particular:

- (i) to enhance the capacity of the waste treatment as well the outputs contents a number of Monte-Carlo simulations will be performed by the UOP team. To that extent the parameters (temperature, pressure, etc.) needed to optimize the work flow will be adjusted as to both efficiently converted the requested amount of wastes and on the other hand to allow for the design of processes yielding output gases with the required composition.
- (ii) the life cycle analysis intended to provide enough details about the efficiency of the waste treatment method while at the same time will report on the environmental aspects of the project. A major task to be accomplished by the NOA team is the design of proper disposal processes, collection schemes for recyclables and in final to provide environmental data for the public and authorities.
- (iii) the purpose of the laboratory experiments of the UoWM team is to estimate and optimise the performance of SOFCs fuelled by thermo-derived syn-gas or reformat gas. In practice, SOFCs can tolerate a wide variety of H₂/C_xH_y/CO compositions; however the performance optimisation may require significant operating condition, and/or system design changes.
- (iv) The master algorithm that will be able to include all the parameters related to the process is to be designed by the BGU team. That is to take into account the results of the aforementioned studies and elegantly combine them combine them in an efficient algorithm (i.e., master equation) that will control the whole process.

The fruits of all these parts are to be published either as a part or as whole in leading scientific journals related to the fields of mathematical modeling, catalysis, operational research and software design.

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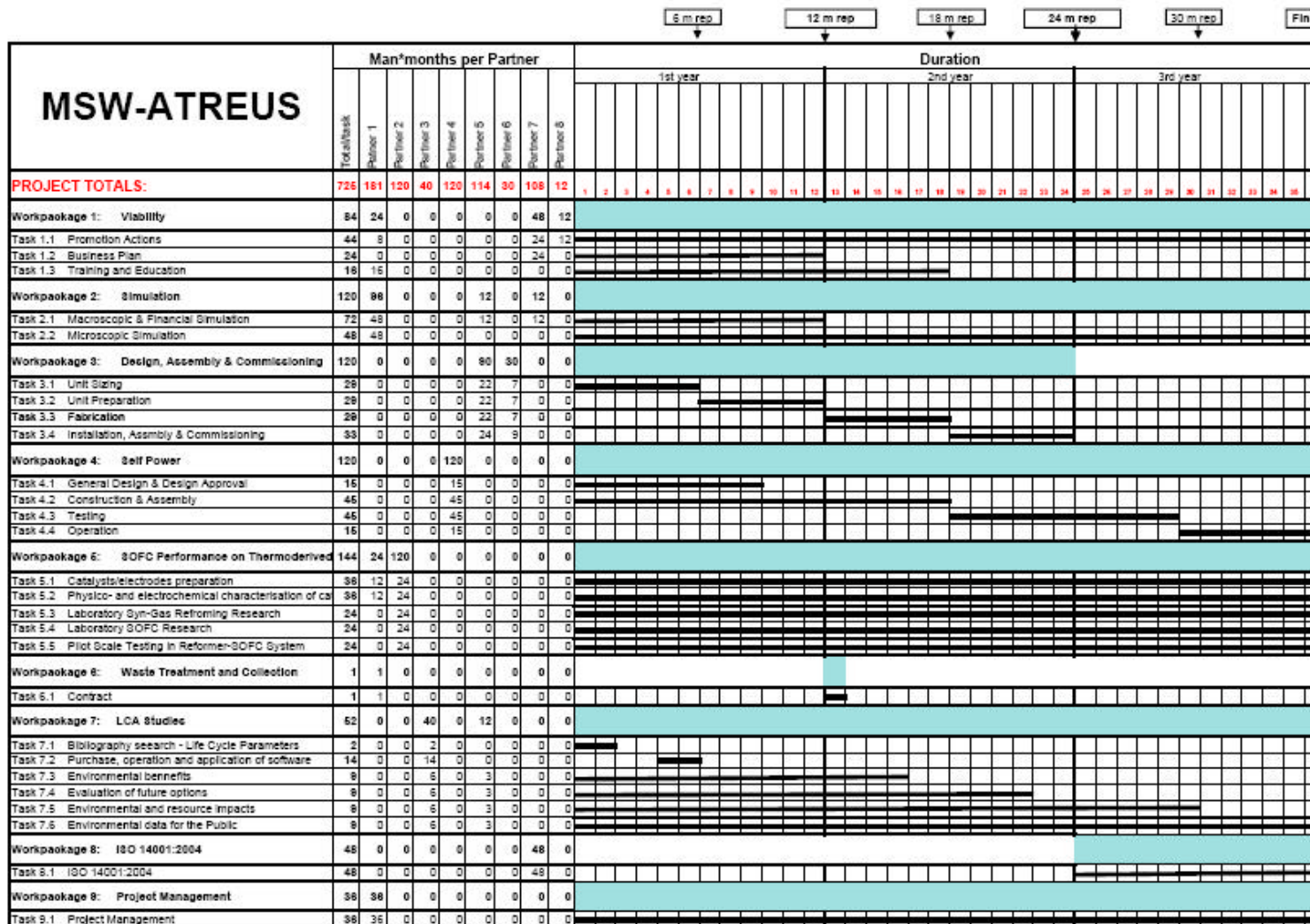


Table 1.3 a: Work package list

Work package No	Work package title	Type of activity	Lead participant No	Lead participant short name	Person-months	Start month	End Month
WP1	Viability	MGT,RTD	1	UoP	84	1	36
WP2	Simulation	RTD	1	UoP	120	1	36
WP3	Design, assembly & commissioning	DEM	5	IMEC	120	1	24
WP4	Self power	RTD	4	BGU	120	1	36
WP5	SOFC	RTD	2	UoWM	144	1	36
WP6	Waste treatment	OTHER	1	UoP	1	12	13
WP7	LCA studies	RTD, DEM	3	NOA	52	1	36
WP8	ISO 14001:2004 standard	MGT	7	AFC	48	24	36
WP9	Project Management	MGT	1	UoP	36	1	36
TOTAL					725		

Table 1.3 b: Deliverables List

Del. no.	Deliverable name	WP no.	Nature	Dissemination level	Delivery Date
D1.1	Proceeding of the Workshop #1	1	R	PU	3
D1.2.	Proceeding of the Workshop #2	1	R	PU	6
D1.3	Proceeding of the Workshop #3	1	R	PU	9
D1.4	Proceeding of the Workshop #4	1	R	PU	12
D1.5	Proceeding of the Workshop #5	1	R	PU	18
D1.6	Proceeding of the Workshop #6	1	R	PU	24
D1.7	Exhibition	1	D	PU	32
D1.8	Business Plan	1	P	CO	12
D1.9	Training Material	1	D	PU	18
D2.1	Report on Macroscopic and Financial Simulation	2	R	CO	12
D2.2	Report on Chemical Process Simulation	2	R	CO	36
D2.3	Report on chemical and heat-release balance of the plasma torch at the end of 36 th month	2	R	CO	36
D3.1	Preliminary sizing and logistics, sizing of peripheral systems	3	D	CO	2
D3.2	Environmental Impact Assessment for entire	3	R	CO	6
D3.3	Town Planning Permit	3	O	PU	6
D3.4	Building design, drawings, costing	3	O	PU	6
D3.5	Building Permit	3	O	PU	12
D3.6	Discharge permit (Air, Water, residues)	3	O	PU	6
D3.7	Electricity Generating System Regulator Permit	3	O	PU	12
D3.8	Electricity Distribution System Operator Permit	3	O	PU	18
D3.9	Insurance cover	3	O	PU	24
D3.10	Commissioned 10t/day demo plant	3	D	PU	24
D4.1	Block diagram, flow chart of the entire system and detailed design of the PLC	4	R	CO	9
D4.2	Report on status of construction and assembly	4	R	CO	12
D4.3	Report on finalizing construction and	4	R	CO	18

	assembly				
D4.4	Report on status of testing	4	R	CO	24
D4.5	Report on finalizing testing	4	R	CO	29
D4.6	Final report including operation of the whole system	4	R	CO	36
D5.1	Development of novel anodic composites	5	RPDO	PU	36
D5.2	Comprehensive study of syn-gas reforming	5	RPDO	PP	36
D5.3	Comprehensive study of the performance syn- and reformat gas mixtures fuelled SOFCs	5	RPDO	RE	36
D5.4	Reformer-SOFC pilot plant unit ready for use	5	RPDO	CO	36
D6.1	Contract with the agency responsible for collecting and delivering wastes to the pilot plant	6	O	PU	12
D7.1	Bibliography – Life cycle parameter definition	7	RD	PU	2
D7.2	Purchase, operation and application of software	7	RD	CO	4
D7.3	Environmental benefits	7	R	CO	16
D7.4	Evaluation of future options	7	R	CO	28
D7.5	Environmental and resource impacts	7	R	CO	30
D7.6	Environmental data for the public	7	R	PU	36
D8.1	ISO 14001:2004 standard	8	RPD	PU	36
D9.1	Initial Progress Report	9	R	CO	6
D9.2	Second Progress Report	9	R	CO	12
D9.3	Third Progress Report	9	R	CO	18
D9.4	Third Progress Report	9	R	CO	24
D9.5	Final Progress Report	9	R	CO	36

Table 1.3 c: List of milestones

Milestone number	Milestone name	Work package(s) involved	Expected date	Means of verification
M1	Town Planning Permit	WP3	6	Certificate
M2	Building Permit	WP3	12	Certificate
M3	Business Plan	WP1	12	Deliverable
M4	Contract for waste collection	WP6	12	Certificate
M5	Report on finalizing construction and assembly	WP4	18	Deliverable

Table 1.3 d(1): Work package 1 description

Work package number	1	Start date or starting event:				1	
Work package title	Viability						
Activity Type	MGT, RTD						
Participant number	1	7					
Participant short name	UoP	AFC	KEEP				
Person-months per Participant:	24	48	12				

Objectives

The objective of this work-package is to assure the viability of the investment through promotion, business planning and training and education.

Description of work**Task 1.1. Promotion actions**

Under this task, the following actions will be taken in order to promote the use of the new technology. Two workshops will be organized during the sixth and twelfth month of the project. The first workshop will focus on the capabilities of the new technology and all the interested parts will be informed about the advantages, both economical and environmental, of the usage of the new plant. The second workshop will be organized after the beginning of the operation of the new plant, which is programmed to be at the end of the twelfth month of the project. The aim of the second workshop is to familiarize the interested parts with the new technology. The two workshops will be organized under the scientific co-ordination of the University of Peloponnese. Moreover, partner 8 (KEEP) is responsible to promote the actions taken under this project to Romania.

Task 1.2. Business plan

A detailed business plan must be evaluated for the next twenty years of operation of the new plant. The business plan will ensure that all necessary actions will be taken in order to protect the investment. The business plan will be evaluated by the partner 8 (Arcadian Financial Consultants, AFC).

Task 1.3. Training and Education

In order to familiarize the end users with the new technology, a series of training and education actions have been designed which will be integrated in an electronic multimedia presentation, freely distributed in schools, universities, local authorities, public places and accessible through the internet.. The development of this electronic material will be the joint action of University of Peloponnese (partner 1) and Arcadian Financial Consultants (partner 8).

Deliverables (brief description and month of delivery)

1. D1.1: Proceedings of the Workshop #1 at the end of 3rd month
2. D1.2: Proceedings of the Workshop #2 at the end of 9th month
3. D1.3: Proceedings of the Workshop #3 at the end of 12th month
4. D1.4: Proceedings of the Workshop #4 at the end of 18th month
5. D1.5: Proceedings of the Workshop #5 at the end of 24th month
6. D1.6: Proceedings of the Workshop #6 at the end of 30th month
7. D1.7: Exhibition at the end of 32nd month
8. D1.8: Business plan at the end of 12th month.
9. D1.9: Training material in the form of electronic presentation accessible through the internet at the end of 18th month..

Table 1.3 d(2): Work package 2 description

Work package number	2	Start date or starting event:			1		
Work package title	Simulation						
Activity Type	RTD						
Participant number	1						
Participant short name	UoP	AFC	IMEC				
Person-months per Participant:	96	12	12				

Objectives

The objective of this workpackage is to simulate the whole process in order to understand the mechanisms that should be optimised as to enhance the efficiency of the process. Simulation should take into account both macroscopic and microscopic parameters characterising the process.

Description of work**Task 2.1. Macroscopic and financial simulation.**

The objective of this task is to account for all those parameters that affect the financial planning for the protection of the investment. Since historical data are difficult to access, Monte Carlo simulations will be performed and worst case analysis will be considered. **The current task will be the responsibility of the AFC (partner 7) in agreement with the UoP (partner 1).**

Task 2.2. Microscopic simulation (chemical and physical).

Chemical process simulation (CPS) software has been widely used by chemical (process) engineers to design, test, optimize, and integrate process plants. It is expected that industrial ecologists to bring these same problem-solving benefits to the design and operation of industrial ecosystems can use CPS. In this task, CPS will be used to:

1. quantitatively evaluate and compare the potential environmental and financial benefits of material and energy linkages;
2. solve general design, retrofit, or operational problems;
3. help to identify complex and often counter-intuitive solutions; and
4. evaluate what-if scenarios.

CPS should be a useful addition to the industrial ecology toolbox. Each of the many disciplines that support industrial ecology has added its own tools, adapted and improved by a systems view and ecological principles, to the industrial ecology toolbox. A number of definitions refer to industrial ecology as including the study of the flows of materials and energy in industrial systems.

In the same way that the aircraft industry uses flight simulators to design and test aircraft, CPS will be used to design, test, optimize, and integrate process in the pilot plant. These processes are those that involve the physical or chemical transformation of raw materials and energy to products—materials and energy flow in; products, by-products, and unused energy flow out. The current task will be the responsibility of the UoP (partner 1).

Task 2.3. Plasma Gasification Simulation

In this task, simulation of the plasma gasification process in order to assess the impact of the feedstock quality (HCV, moisture content) on the conversion efficiency will be performed. The current task will be the responsibility of IMEC (partner 5).

Deliverables

- 1.D2.1: Report on Macroscopic and Financial Simulation at the end of 12th month
- 2.D2.2: Report on Chemical Process Simulation at the end of 36th month
- 3.D2.3.: Report on chemical and heat-release balance of the plasma torch at the end of 36th month

Table 1.3 d(3): Work package 3 description

Work package number	3	Start date or starting event:	1				
Work package title	Design, assembly and commissioning						
Activity Type	DEM						
Participant number	5	6					
Participant short name	IMEC	PG					
Person-months per Participant:	90	30					

Objectives

The objective of this workpackage is the design, assembly, installation, testing and commissioning of the type A plant in the predefined position of Arcadia. Except from the technical issues that have to be taken into account, there is a series of procedures that have to be followed according to the national laws. More specifically, a set of permits must be obtained in order that the plant can operate and in order that the outcomes of the new technology can be evaluated. Moreover, special effort has to be made in order that insurance contracts protect the investment.

Description of work

In order to install the particular type A of pilot/demonstration unit, the function of the facility must be taken into consideration along with the size of the available land and infrastructure. It will therefore be necessary to examine a fully engineered flow sheet in relation to an engineering plan of the physical installation with all its peripherals. Parameters like the physical size of layout will need to be considered as well as the requirements for access, cooling and process water, electricity, effluent handling and treatment. Certain modifications regarding machinery must be made (even prior to the start of fabrication) according to EU legislation. Bearing in mind that the pilot plant proposed for the particular project will need to be transportable as it will be relocated at the end of the testing/evaluation period, it is important that all possibilities are covered before the plant leaves the fabricator's establishment. This means that it may need to be constructed in ISO – container sized modules requiring the minimum in situ work. The proposed demo plant type A is supposed to be installed near existing private recycling premises for tires, plastics, batteries and used oils. The unit is located in a place called St. Constantine, inside the municipality of Skiritis, about 15 km away from the capital city of Tripoli. The Municipality of Skiritis (proposed demo plant location) is one of the ten Arcadian municipalities that participate in the project MSW-ATREUS.

Current waste management system - description.

The current waste management system of Arcadia has severe problems concerning its functionality and environmental sustainability. There is not a well-organized waste management network of cooperation between several municipalities and, as a consequence, each municipality has simply defined a place inside its governing boundaries, so as to dispose the daily waste production.

The locations are arbitrarily chosen without land-planning surveys. These places do not have the typical landfill structure, as there are no processing facilities and the waste mass is not even buried. In addition, the areas are not distinctly delimited or fenced, allowing the animals to access and transmit diseases.

Waste flow data

The Arcadian prefecture consists of 23 municipalities the 10 of which have already agreed to participate in the MSW-ATREUS project. The total population of these municipalities is 24.023 inhabitants (2001 census), while the waste production in the same year was 8.187 tons as presented in the following table. The figure below depicts the relevant positions of those 10 municipalities as well as the proposed demo plant MSW-ATREUS type "A" location.

Waste composition data

Material type	% of total weight
Domestic sewage	47%
Papers	25%
Plastics	7,40%
Aluminium-metals	3,40%
Fabrics	2,10%
Tires	0,60%
Woods-greens	3,70%
Inert materials	5%
Glass	2,60%
Other	3%
Total	100%
Task 3.1. Unit Sizing	
Sizing of unit and all peripheral subsystems, costing (preliminary). Duration 6 months.	
Task 3.2. Unit Preparation	
Preparation and submission of all applications for permits. Follow up till all permits are in place. Sourcing of equipment. Duration 6 months.	
Task 3.3. Fabrication	
Design and erection of building after receipt of funding. Ordering of all outsourced equipment. Expediting fabrication. Duration 6 months	
Task 3.4. Installation, assembly and commissioning	
Installation, assembly and testing of all basic systems and subsystems (including grid connection if required). Duration 6 months	

Deliverables

- 1.D3.1. Preliminary sizing and logistics, sizing of peripheral systems, at the end of the 2nd month
- 2.D3.2. Environmental Impact Assessment for entire project at the end of the 6th month
- 3.D3.3. Town Planning Permit at the end of the 6th month
- 4.D3.4. Building design, drawings, costing, at the end of the 6th month
- 5.D3.5. Building Permit, at the end of the 12th month
- 6.D3.6. Discharge permit (Air, Water, residues), at the end of the 6th month
- 7.D3.7. Electricity Generating System Regulator Permit, at the end of the 12th month
- 8.D3.8. Electricity Distribution System Operator Permit, at the end of the 18th month
- 9.D3.9. Insurance cover, at the end of the 24th month
- 10.D3.10 Commissioned 10t/day demo plant at the end of the 24th month

Table 1.3 d(4): Work package 4 description

Work package number	4	Start date or starting event:	1				
Work package title	Self power						
Activity Type	RTD						
Participant number	4						
Participant short name	BGU						
Person-months per Participant:	120						

Objectives

The major objective of this work-package is to ensure that the whole system, from MSW feed to power, will operate as one unit ensuring smooth and integrated operation providing self power after the start-up of the system.

Description of work**Task 4.1.** General design of power plant & Design approval

In this task we will make the detailed and final block diagram, flow chart and detailed design of the entire system with all components. Consequently, the design will be approved by the project executive committee

Task 4.2. Construction & assembly

In this approval of beginning construction & assembly will be given by the executive committee. Work on PLC and construction and assembly will commence. Finally approval for assembly and construction will be given.

Task 4.3. Testing

Testing of the PLC and each of the components will be carried out and upon satisfactory completion will be given by the executive committee

Task 4.4. Operation

Finally, the whole system will operate as one unit from feed of MSW to generation of power through all components ensuring self power of the system

Deliverables

- 1.D4.1. Block diagram, flow chart of the entire system and detailed design of the PLC, summarized in a report – Month 9
- 2.D4.2. Report on status of construction and assembly Month 12.
- 3.D4.3. Report on finalizing construction and assembly – Month 18
- 4.D4.4. Report on status of testing – Month 24
- 5.D4.5. Report on finalizing testing – Month 29
- 6.D4.6. Final report including operation of the whole system – Month 36

Table 1.3 d(5): Work package 5 description

Work package number	5	Start date or starting event:	1				
Work package title	Solid Oxide Fuel Cell (SOFC) performance on thermo-derived gas mixtures						
Activity Type	RTD						
Participant number	2						
Participant short name	UoWM	UoP					
Person-months per Participant:	120	24					

Objectives

1. Develop highly efficient and carbon tolerant novel anodic formulations with atomic architecture
2. Maximization of H₂ content in syn-gas reforming stage by the use of novel reforming catalysts
3. Maximization of fuel utilization and power density of syn- and reformat gas mixtures fuelled SOFCs
4. Broadening of oxygen depletion at the SOFC's cathode compartment
5. Construction and testing of a Reformer-SOFC pilot plant unit fed with syn-gas mixtures

Description of work**Task5.1 Catalysts/electrodes preparation**

Novel bi-metallic cermet anodes of the type Cu-M (X1,X2), where M stands for the second metal, X1 for the support and X2 stands for additional component to the support, will be prepared at UoWM. The catalysts will be prepared via various techniques such as dry impregnation and combustion synthesis methods in order to obtain thin (~20µm) films on the solid electrolyte surface. These electrodes will be deposited on the solid electrolyte surface by using conventional and advanced techniques. Preparation parameters will be optimized by taking into account all characterizations and catalytic and electro-catalytic experiments in order to optimize the adherence, the conductivity and finally the electrocatalytic activity of the electrode.

Task5.2 Physico- and electrochemical characterisation of catalysts/electrodes

The catalysts synthesized will be characterized by a series of physico-chemical techniques, in order to assess changes in texture (porosity, surface area) and chemistry (nature and amount of surface chemical groups) during preparation stages, to ensure effectiveness of preparation and the homogeneity and reproducibility of the fresh samples. Also, most promising catalysts will be characterized to seek for insights of deactivation to gauge the effect of potential poisoning (coke) on used samples. Fresh as well as used catalysts-electrodes samples will be characterized in terms of: BET (total surface area), XRD, SEM, ICP (metal loading) and FTIR (chemisorptive properties) measurements. These techniques represent the current state of the art in catalyst characterization and standard instruments and procedures will be used in their employment.

The construction of electrolytic cells will give us the ability to measure the electrochemical properties of the anode or cathode electrodes, i.e., their exchange current density and charge transfer coefficients. For that, electrode polarization measurements will be performed and the exchange current density and charge transfer coefficients will be calculated. Oxygen-helium and Oxygen-Fuel (H₂, CO, C_xH_y)-Helium mixtures will be used as the gaseous environment. We will study the effect of temperature (600-900°C), oxygen and fuels partial pressures. Analysis of these measurements by classical Tafel method will be conducted. All the above information is directly related with the electrode affinity to perform charge transfer reactions as well as with the mechanism of these reactions. Special focus will be given to the ionic conductivity of the most promising materials by performing AC-impedance measurements. After finishing tasks 1.1-1.3 the method and treatment protocol which optimize all the physical, structural and electrochemical characteristics of the anodic electrodes will be selected as basic method for anodic electrode preparation.

Task5.3 Laboratory Syn-Gas Reforming Research

State of the art Al₂O₃ and La₂O₃ catalysts, containing Ni, Ni/Mo and Ni/Mo/Rh active phases will be elaborated in order to study syn-gas reforming. The wide range of possible syn-gas compositions

results several alternatives regarding the effect of dry reforming, the necessity for additional steam supply and the contribution of water gas shift to the overall reaction. Evaluation of various catalyst formulations will be carried out in Task 5.3. The activity of the prepared catalysts, in terms of steam and dry internal reforming of artificial syn-gas mixtures will be estimated in lab-scale reactors coupled with a suitable gas analysis system, under a range of operating conditions. Detailed kinetic studies will be carried out over the most promising catalyst electrodes to estimate the intrinsic reaction characteristics. Long-term experiments will be also performed. The kind and the amount of carbon deposition onto the electrode as well as the influence of the presence of sulfur in the feed will be also examined in this task. Accelerated deactivation tests will also be performed to simulate any possible deactivation of catalysts during their exposure to real gases (coke formation, presence of sulphur compounds). These tests lead to an initial screening of potentially resistant catalyst systems.

Task5.4 Laboratory SOFC Research

Using the most promising electrode systems we will construct the SOFC units. We will measure the current-voltage and current-power density characteristics of the internal reforming or direct oxidation solid oxide fuel cells fed with either syn- or reformat gas mixtures. Their ability for energy production will be estimated. Specifically, we will measure the effect of feed, carbon/steam ratio, flow-rate, temperature etc. on the current-voltage and power density-current characteristics of the cell. We will also perform stability tests at conditions where maximum output performance is obtained in order to examine the effect of the presence of sulphur compounds and coke deposition on the overall effectiveness of the cell.

Task5.5 Pilot scale testing in Reformer-SOFC system

Simulated syn-gas mixtures will be fed up to a Reformer-SOFC (60W) pilot scale plant. The effect of operation parameters such as temperature, syn-gas composition, N₂ and CO₂ dilution, etc on the overall fuel cell efficiency, will be evaluated. These tests will provide useful information for the construction of demonstration pilot plants.

Deliverables

- 1.D5.1: Development of novel anodic composites tolerant to carbon deposition at the end of the 36th month
- 2.D5.2: Comprehensive study of syn-gas reforming at the end of the 36th month
- 3.D5.3: Comprehensive study of the performance syn- and reformat gas mixtures fuelled SOFCs at the end of the 36th month
- 4.D5.4: Reformer-SOFC pilot plant ready for use at the end of the 36th month

Table 1.3 d(6): Work package 6 description

Work package number	6	Start date or starting event:	12				
Work package title	Waste Treatment and Collection						
Activity Type	OTHER						
Participant number	1						
Participant short name	UoP						
Person-months per Participant:	1						

Objectives

The objective of this Workpackage is to subcontract the collection and delivery of domestic and industrial wastes to the pilot plant.

Description of work

Subcontracting will be performed by an open competition of bids according to National Laws and the policy followed by the University of Peloponnese.

Deliverables

1.D6.1: Contract with the agency responsible for collecting and delivering wastes to the pilot plant by the end of the 12th month.

Table 1.3 d(7): Work package 7 description

Work package number	7	Start date or starting event:	1				
Work package title	LCA studies						
Activity Type	RTD, DEM						
Participant number	3						
Participant short name	NOA	IMEC					
Person-months per Participant:	40	12					

Objectives

- To give much information about the benefit of the proposed waste management technique as compared to the traditional way.
- To cover the environmental and resource impacts of the new technique.
- To provide environmental data for the public, the local authority or the government.

Description of work**Task 7.1. Bibliography search – Life cycle parameters**

A survey in the international literature will be carried out in order to acquire the latest scientific news about MSW software programmes and results. Besides, the life cycle of the intended MSW unit will be defined taking into account all parameters involved (goals and scope, life cycle inventory, life cycle impact assessment, interpretation of results). The cradle-to-cradle kind of assessment is very likely to be selected for the specific application of the new MSW unit.

Task 7.2. Software selection – application - modification

The whole WP will be based on simulations by appropriate LCA software programme and comparison with real data to assess its efficiency. Such suitable LCA programmes are *Umberto* (www.ifu.de), *SimaPro 7.0* (www.pre.nl), *TEAM* (www.ecobalance.com) or *KCL-ECO 4.0* (www.klc.fi). There will set the criteria for purchasing the most appropriate commercial software in terms of flexibility, efficiency (options) and conformation to the ISO 14040 and 14044 standards. Upon receiving the programme, familiarisation with its environment and requisites will be done. The next step will be to run the code against real data from a case of a traditional MSW unit and compare the results. Possible adjustments in the programme parameters (namely its inputs) may be made in order to adapt it to the Greek reality. Second run will take place with hypothetical (but expected) data during the design phase of the MSW demo unit. This exercise will give valuable information to the project about what to anticipate from such a unit.

Task 7.3. Benefits from proposed MSW methodology

Upon starting the operation of the new MSW demo unit in Arcadia, the software will run again with the real data of the unit. Comparison between the new simulation and the data from the unit will be made in order to find out the differences between the design and the operational phases of the unit. This will give valuable information for the design and implementation for new units in Greece or in Europe. The simulation will also provide the environmental benefits of the new unit as compared to the old traditional waste treatment.

Task 7.4. Evaluation of future waste management options

In order to show how the demo unit can be improved, the programme will be applied by altering the input parameters (sensitivity analysis) and performing various LCAs (scenarios). Such results will be extremely useful to the authority or organisation supervising the unit and give information about how to improve its efficiency and capability further.

Task 7.5. Environmental and resource impacts

At every stage of the life cycle of the unit there will be emissions and consumption of resources. The environmental impacts from the entire life cycle of the products and services of the unit will be addressed by using the (modified, if necessary) software programme and examining alternative disposal processes, as well as other processes, which are affected by disposal strategies, different types of collection schemes for recyclables, advanced non-polluting technologies for significant

energy recovery. This way a variety of scenarios with the unit in question will be produced in order to find out alternative ways for improving the environmental impact of the unit by examining new input materials and new waste disposal strategies. These results together with those of Task 7.4 will give to the author or organisation supervising the unit a lot of possibilities to choose from in order to improve the efficiency of the unit further.

Task 7.6. Environmental data to the public

A report in non scientific language will be prepared containing information about the environmental and energy benefits from the utilisation of the new MSW unit. Such a report will provide valuable information suitably oriented for use by the public, local authorities and the government.

Deliverables

D 7.1. Bibliography – Life cycle parameter definition. Delivery: month 2.

D 7.2. Purchase, operation and application of software. Delivery: month 4 (purchase), 6 (application).

D 7.3. Environmental benefits. Delivery: month 16.

D 7.4. Evaluation of future options. Delivery: month 28.

D 7.5. Environmental and resource impacts. Delivery: month 30.

D 7.6. Environmental data for the public (report). Delivery: month 36.

Table 1.3 d(8): Work package 8 description

Work package number	8	Start date or starting event:	24				
Work package title	ISO 14001:2004 standard						
Activity Type	MGT						
Participant number	7						
Participant short name	AFC						
Person-months per Participant:	48						

Objectives

The Facility/Plant Name Environmental Management System (EMS) provides a mechanism for environmental management throughout all areas and departments. The environmental management system ISO 14001:2004 is designed to cover environmental aspects which a facility can control and directly manage, and those it does not control or directly manage but can be expected to have an influence.

Description of work**Environmental Policy**

The Facility/Plant Name Environmental Policy (Policy) is endorsed by the Facility/Plant Manager. The policy covers all activities at the facility. The Policy includes a commitment to continual improvement and prevention of pollution, as well as a commitment to meet or exceed relevant environmental legislation, regulations and other requirements. The Policy will be reviewed annually by top management, communicated to all employees and made available to the public in accordance with the Environmental Communication procedure.

Reference Material

ISO 14001 Standard (4.2)

Applicable Procedures

EP-010 Environmental Communication

Environmental Aspects

The Facility/Plant Name Cross Functional Team (CFT) identifies the environmental aspects which the facility controls and over which it may be expected to have an influence, and determines which of those aspects are considered significant. Discussions regarding significance are recorded in CFT meeting minutes. These aspects are reviewed at least semi-annually by the CFT or when there is a new or changed process or activity at the facility. The Environmental Management Representative maintains CFT minutes and other records.

Reference Material

ISO 14001 Standard (4.3.1)

Applicable Procedures

EP-002 Environmental Aspects, Objectives and Targets, and Management Programs

EP-008 Environmental Review of Projects

Legal and Other Requirements

The Facility/Plant Name has established an environmental procedure for the purpose of identifying, accessing and communicating legal and other requirements that are applicable to the facility. Additional information is also available through legal publications. Local regulations are identified, accessed and communicated by the Environmental Coordinator. At least annually the Environmental Coordinator will review the most current national, regional, provincial, state and local legal and other requirements as applicable to Facility/Plant Name.

Reference Materials**Legal and Other Requirements****ISO 14001 Standard (4.3.2)****Applicable Procedures****EP-007 Environmental Regulations and Other Requirements****Environmental Objectives and Targets**

The Cross Functional Team has developed objectives and targets for each significant environmental aspect. These objectives and targets define:

1. the performance objectives (Investigate/Study, Control/Maintain, or Improve) for each significant environmental aspect;
2. the specific, quantified targets which define those performance objectives; and
3. the planned deadlines for the achievement of those targets.

Objectives and targets are developed considering significant environmental aspects, technological options and financial, operational and business plans, and the views of interested parties.

Reference Material**ISO 14001 Standard (4.3.3)****Applicable Procedures****EP-002 Environmental Aspects, Objectives and Targets, and Management Programs****EP-008 Environmental Review of Projects****Environmental Management Programs**

The CFT establishes environmental management programs (EMPs) as a means for achieving objectives and targets. These programs define the principal actions to be taken, those responsible for undertaking those actions and the scheduled times for their implementation.

Organizational Structure and Responsibility

Environmental management system roles, responsibilities and authorities are defined at relevant functions and levels within the organization. The Facility/Plant Management Team jointly provides the resources essential to the implementation and control of the environmental management system, including: training, human resources, specialty services, financial resources, technical and informational services. The Environmental Management Representative has primary responsibility for establishing, operating and maintaining the EMS. A Cross Functional Team provides routine EMS support and reports directly to the EMR.

Emergency Preparedness and Response

The Facility/Plant Name has an environmental procedure to identify potential for and respond to accidents and emergency situations, and for preventing and mitigating the environmental impacts that may be associated with them. Emergency methods are reviewed by the CFT on an annual basis and after the occurrence of accidents or emergency situations.

Monitoring and Measurement

The Facility/Plant Name has established an environmental procedure to monitor and measure the key characteristics of its operations and activities that can have a significant impact on the environment. This procedure includes calibration and maintenance requirements and ensures that records will be retained.

Nonconformance and Corrective and Preventive Action

The Facility/Plant Name has an environmental procedure for defining responsibility and authority for handling and investigating nonconformances, for taking action to mitigate impacts, and for initiating and completing corrective and preventive action. Any changes in procedures resulting from corrective and preventive actions are implemented and recorded. The Audit Program Leader maintains these records.

Records

The Facility/Plant Name has an environmental procedure for the identification, maintenance and disposal of environmental records. These records include training records and the results of audits and reviews. They are readily retrievable and protected against damage, deterioration and loss. The Areas and Departments maintain their own environmental records. Record and document retention is also specified in the procedure.

Deliverables

1. D8.1: ISO 14001:2004 standard at the end of 36th month

Table 1.3 d(9): Work package 9 description

Work package number	9	Start date or starting event:	1				
Work package title	Project Management						
Activity Type	MGT						
Participant number	1						
Participant short name	UoP						
Person-months per Participant:	36						

Objectives

The objective of this work-package is to ensure that the outputs from the project are of high quality, delivered to time, are relevant and provide maximum impact and to ensure that the Project runs according to time and budget plan.

Description of work

The co-ordinating partner, UoP, will provide the project and technical management. The Project Management will ensure the effective completion of the programme of work. It will provide the direction for the project and the interface to the Commission, both for contractual issues and ones related to the work programme. The management structure of the project will be lightweight. The structure will consist of:

- Project Manager
- Workpackage managers
- Office managers

It will be the responsibility of the Project Manager to:

- Plan and monitor the project
- Ensure deliverables are produced on time and of the required quality
- Co-ordinate the reporting to the Commission
- Organise and run the project meetings

The Project Manager will have overall responsibility for the Project in ensuring that the Project achieves its objectives and that the Deliverables are relevant and consistent with the overall objectives. Each Workpackage has a nominated leader who is responsible for its delivery. The Workpackage leader is responsible for all the deliveries of that Workpackage.

It is anticipated that external reporting will be every 6 months with internal reports in the intervening 3-month periods. Face-to-face meetings will occur primarily to finalise the external reports, that is:

- Month 1: Start-up Meeting
- Month 5: First Review Meeting
- Month 14: Second Review Meeting
- Month 23: Third Review Meeting
- Month 35: Final Review Meeting

Teleconference meetings of the Workpackage leaders will occur bi-weekly. Each Work Package will define an appropriate meeting structure.

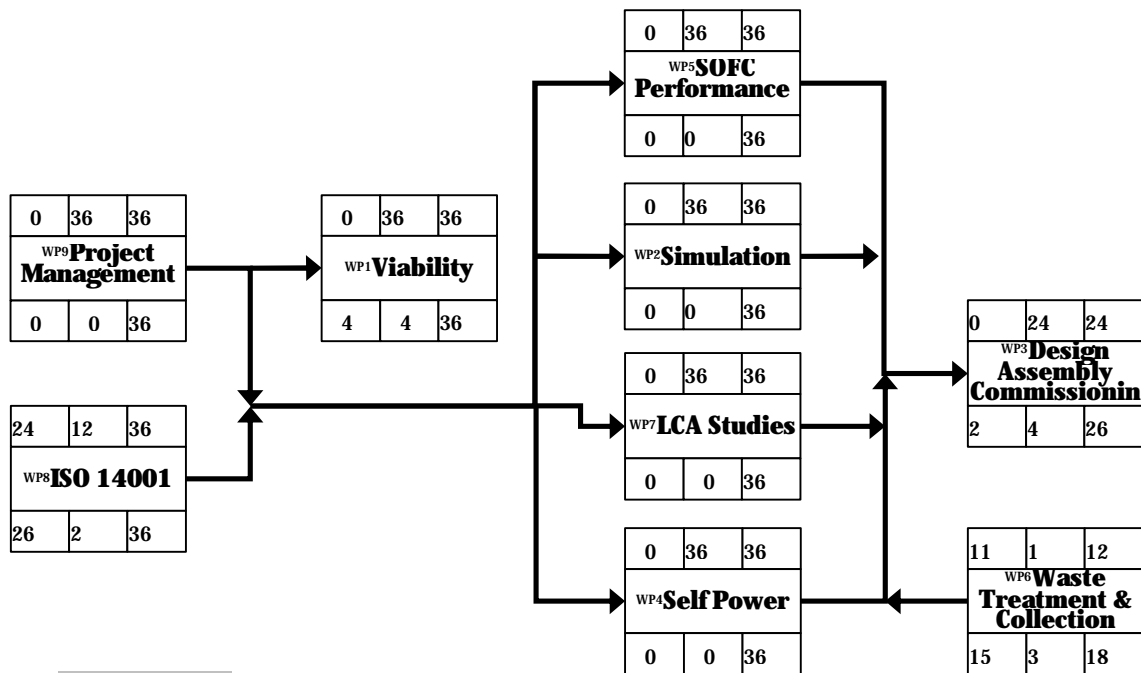
Deliverables

1. D9.1: Initial Progress Report, Month 6
2. D9.2: Second Progress Report, Month 12
3. D9.3: Third Progress Report, Month 18
4. D9.4: Third Progress Report, Month 24
5. D9.5: Final Progress Report, Month 36

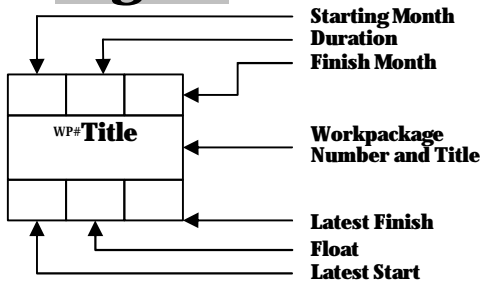
Table 1.3 e Summary of staff effort

Participant no./short name	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total person months
Part.1 UoP	24	96	0	0	24	1	0	0	36	181
Part.2UoWM	0	0	0	0	120	0	0	0	0	120
Part.3NOA	0	0	0	0	0	0	40	0	0	40
Part. 4 BGU	0	0	0	120	0	0	0	0	0	120
Part. 5 IMEC	0	12	90	0	0	0	12	0	0	114
Part. 6 PG	0	0	30	0	0	0	0	0	0	30
Part. 7 AFC	48	12	0	0	0	0	0	48	0	108
Part. 8 KEEP	12	0	0	0	0	0	0	0	0	12
Total	84	120	120	120	144	1	52	48	36	725

Graphical presentation of the components showing their interdependencies (Pert diagram)



Legend



Significant risks, and associated contingency plans.

Each party undertakes to follow the production schedule and budget specified in the technical provisions of the EC grant agreement. In view of the evolving character of this project, these production timetables are generally subject to change. However, the risk of uncontrolled time and cost escalation is very real in many projects. To limit this risk, it is desirable to provide for a strict and effective inspection and supervision system (possibly via input from scientific or technical committees) managed by the steering committee, including:

- frequent progress meetings (ranging from once a month to once per quarter);
- frequent technical and financial progress reports (actions completed and results obtained);
- optional extraordinary meetings as soon as agreed estimated deadlines have been overrun, including the right for the parties to review their position within the co-operative venture based on clearly stated reasons .
- where and how the resources will be made available).

It is recommended that in their own interests the parties should not establish irrevocable schedules unless they are absolutely sure that these can be met , and to include instead contingency plans for delays or missed deadlines. An irrevocably accepted production schedule could be considered to be a guaranteed commitment and may involve payment of indemnities if not met.

On the other hand minimum compliance with deadlines can be guaranteed by other methods, as discussed in the section on Managerial Provisions.

2. Implementation

2.1. Management structure and procedures

The overall aim of the management of MSW-ATREUS is to ensure a smooth running of the project, by setting mechanisms that:

1. Ensure cooperation and communication between workpackages and workpackage leaders.
2. Ensure that the outputs from the project are of high quality, delivered to time and are relevant and provide maximum impact.
3. Ensure that the project runs according to time and budget plan.

In order to achieve this, the following management structure and procedures have been designed.

Management structure

Management structure of MSW-ATREUS is proposed to cover all possible problems and aspects of the smooth running of the project using maximum of the human resources and - at the same time - minimizing the overhead associated with project management in both a general and a technical sense. The organizational hierarchy of the project is outlined in the following:

The Project management will be assured by the following relevant roles:

- a) Project Manager,
- b) Workpackage Leaders,
- c) Team Leaders, and
- d) by means of the Scientific Steering Group.

The MSW-ATREUS coordinator is responsible for the overall management of the project as will be specified in the contract with European Commission (EC). For this purpose, the coordinator will nominate:

Project Manager, who will resume overall responsibility for all the day-to-day project coordination matters, assisting and supporting the coordinator. The project manager will be responsible for:

- monitoring the performance and progress of the project against time and cost plans
- making proposals to amend the plans if unexpected situations arise
- scheduling meetings and distributing minutes
- disseminating and promoting project activities and results

Each partner will nominate a Team Leader (TL) who is responsible for managing the team within his company. The TL will be the official appointee of his institution for

management communication and matters with the Coordinator or Project Manager. WP Leaders (WPL) represent their WPs in the Scientific Steering Group (SSG). The SSG will be co-chaired by the Project Coordinator and the Project Manager.

The SSC will monitor progress against time and cost and will co-ordinate and direct the overall project work and activities. Decisions taken by the SSG are binding for the consortium for the duration of the project. Every reasonable effort will be made to have all SSG decisions unanimous. However, after a reasonable amount of time has been allowed to illustration and defense of conflicting positions, in order to avoid deadlock in project operational progress, the approval of a two third majority of SSG will be sufficient. If the decision being taken is unacceptable to partners found in the minority positions, the resolution of the conflict will be elevated to each Partner's higher executive level. Either the SSG or the Project Manager can initiate the conflict resolution procedure.

Workpackage Leaders (WPLs) are responsible for the performance of work packages. Specific tasks for Work package leaders are to ensure accomplishment of the technical objectives of the Workpackage, to report to the Project Manager, to log major decisions related to the progress of the work package, to co-ordinate the issue of deliverables associated with the WP, to flag insufficient quality or unacceptable delays in the contribution of individual members, to co-ordinate the production of external papers in topics dealing with their activities. For each workpackage, the WL will be appointed by the partner, which is designated as responsible partner for the specific WP.

Workpackage Teams (WPTs) are formed by specialized staff provided by the Partners. Each Workpackage Team will be chaired by a Workpackage Leader, and it will be in charge of carrying out the technical work as described in the Technical Annex. Each key deliverable of the project will be reviewed by the SSG.

Project Communication Flow

The communication flow between the partners will be continuous. Extensive use of e-mail will be made for the day to day communication between partners of the consortium. A web site promoting the MSW-ATREUS results and disseminating information about the project is already constructed ([http://www.fp-7.msw-atreus.ro/.](http://www.fp-7.msw-atreus.ro/))

An extranet site will ensure a broader and more efficient communication. Regular meetings will be held at least every nine months, but in case of unexpected and/or extraordinary circumstances additional meetings can be held in between regular meetings. The locations of these meetings will rotate through the partners' locations.

Links with other related projects will be established through an active information exchange process and - if possible - by attending other projects' technical review meetings, as well as through the usual Commission concentration process. The Project Manager will be responsible for establishing these links with other related projects.

All technical documentation generated by the Project should be exchangeable in electronic format, according to a set of guidelines to be agreed very soon at project start-up. Adherence to these guidelines will be enforced by the Project Manager. Only strictly formal correspondence will be exchanged by ordinary mail and telefax. Exchange of information will mainly occur by e-mail and file transfer over Internet.

A WEB project document repository will be made available by the Coordinating Partner. Telephone and fax will be used for urgent needs only. Urgent correspondence over e-mail will be sent with a request for explicit acknowledge. Ordinary mail will be used for strictly formal correspondence, i.e. when executive signatures are required. Adherence to the agreed communications standards will be enforced by the Project Manager.

Project Reporting and Quality Control

Periodical Progress Reports (PPRs) shall be issued by the Project Coordinator with the purpose of describing the work done during the past period by each partner, and compare results with the established work program. The Project Manager shall be in charge of collecting relevant information from all the partners, and Project Coordinator shall prepare progress reports to be forwarded to the Commission. The structure of such Reports shall correspond to the rules of the Commission and should contain:

- Executive Summary (updated “Project Snapshot”)
- Description of work undertaken, work completed and work delayed
- Milestones accomplished
- Deliverables completed and issued, and percentage of completion of each deliverable
- Task delays, corrective actions taken, and changes to the programme (if any)
- Work to be undertaken during the immediately following period
- Actions for dissemination of (partial) results
- Revised work schedule (if applicable)
- Indicative effort spent per partner, per task
- Updated exploitation plan (if applicable)

Confidentiality and Intellectual Property

Matters related to Confidentiality and IPR handling will be defined in the "Consortium Agreement for MSW-ATREUS". Project-related publications will require a notification to SSC. These should contain an acknowledgement of support by project together with a disclaimer that the views are not necessarily those of the Consortium.

Management and Project Meetings

Progress in the work on the project as well as management issues will be discussed on Management Meeting held in connection with Project meetings which are

supposed to be scheduled at least each months and they will be followed by technical workshops in order to co-ordinate our work. The meetings will include review of any reports due to be delivered shortly afterwards, so that Formal Document Reviews will be the principal quality control that will be exercised on the project. Reports will be written to a project standard using a common word processor.

The use of Project Planning software and regular reviews is designed to measure and to help achieve realistic measurable targets. The Project Manager will define an outline risk management plan, covering any WPs on whose outcome other work packages are dependent.

Various unplanned events can take place during the Project duration, and it is planned to allocate some people in the Project as deputies to others (e.g. illness or holidays may make this necessary). Similarly, the Project Coordinator may need to stand in for the Project Manager on occasion. As well as providing for unforeseen contingencies, this will also have the benefit of familiarizing partners with work that others are undertaking, and allowing appropriate synergies to develop.

In the following diagram, the management structure of the project is summarized.

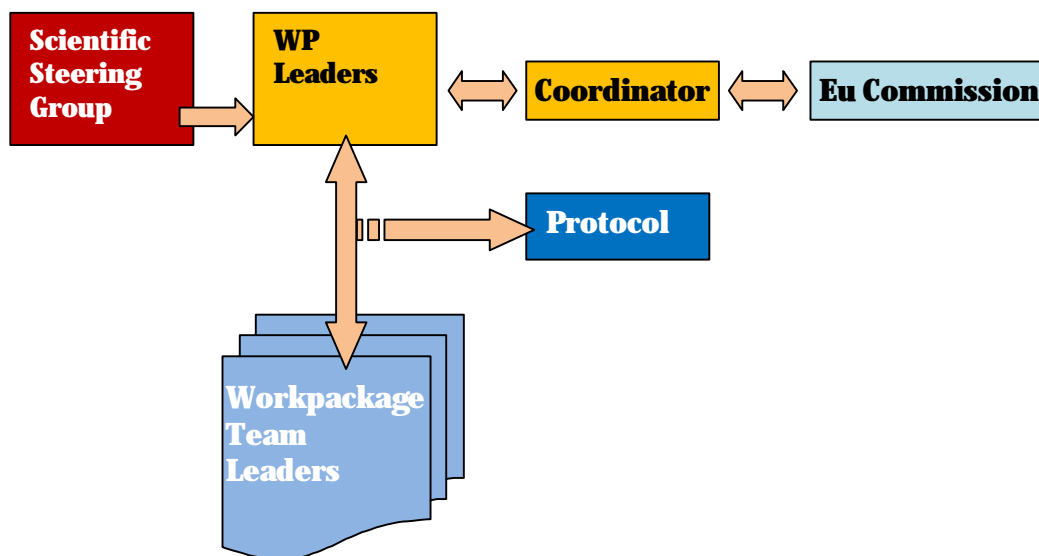


Figure 2. Management structure of MSW-ATREUS

2.2. Individual participants

2.2.1. University of Peloponnese (UoP), Greece (contact Prof. T.E. Simos)

The University of Peloponnese (UoP) is located in the city of Tripoli, Greece. The Faculty of Science and Technology of the University of Peloponnese was established in May 2002. At the same year, the Department of Computer Science and Technology was established too. Prof. Theodore E. Simos is today the President of this Department. Prof. Simos is Academician of the EASA, EAS, EAASH Editorial Board of the Annals of the European Academy of Sciences-http://www.eurasc.org/edi_board.asp, he is President of the European Society of Computational Methods in Sciences and Engineering (ESCMSE), an Active Member of the European Academy of Sciences and Arts (EASA), Corresponding Member of the European Academy of Sciences (EAS), Corresponding Member of European Academy of Arts, Sciences and Humanities (EAASH), Fellow of the Royal Society of Chemistry (FRSC), Editor-in-Chief and Founder of Journal of Computational Methods in Sciences and Engineering (JCMSE), Journal of Numerical Analysis, Industrial and Applied Mathematics (JNAIAM) and Computing Letters (COLE). His research group consists of 3 assistant Professors, and 8 PhD candidates. He is the author of more than 250 papers in Computational Science. Prof Simos is the director and founder of Computational Science Laboratory in the University of Peloponnese.

Dr Dimitrios S. Vlachos is an Assistant Professor in the University of Peloponnese, an active member of the Computational Science Lab. Dr Vlachos is the author of more than 100 papers published in scientific journals and conference proceedings.

Dr Demetrios Xenides is a Fellow Lecturer in the University of Peloponnese, an active member of the Computational Science Lab. Dr Xenides is the author of more than 50 papers published in scientific journals and conference proceedings.

The Computational Science Laboratory of University of Peloponnese is directed by Prof. Simos. The aim of the Laboratory of Computational Science and Technology is to produce knowledge in the fields of: Numerical Analysis, Computational Methods in Physics, Computational Methods in Chemistry, Computational Methods in Biology, Computational Methods in Medicine, Computational Methods in Economics, Computational Methods in Material Science, Computational Geometry, Computational Methods in Mechanics and Constructions, Super-Computing, Parallel and Distributed Computations, Mathematical Modelling, Neural Networks, Fuzzy Logic, Expert Systems etc. The Lab's infrastructure consists of: Fifty (50) work stations, Sixteen (16) personal computers, Six (6) portable computers, ! Cluster with 32 nodes, Software, Proper and Safe Working Environment, Ergonomic Furniture, On-line access to International Libraries, Giga-Byte Internet access. The personnel of the Lab is: *Head*: Professor Theodore E. Simos, *Ternary Researcher*: D.S. Vlachos, Assistant Professor, *Fellow Researchers*: D. Xenides and Z. Anastasi, *Researchers*: 7 researchers, *Technician*: D.P. Sakas, *Lawyer*: A.G. Rallis and *Secretary*: Helen Ralli-Simou.

Role in the project: Coordination both managerial and scientific and process simulation.

2.2.2. University of Western Macedonia (UoWM), Greece (contact G. Marnellos)

UoWM is located in the city of Kozani, Greece. The Environmental Technology Laboratory is established at the Department of Engineering and Management of Energy Resources of UoWM and includes the Center for Hydrogen Technologies (CHT), which is involved in theoretical and experimental research on hydrogen production and storage and on “clean” energy applications. Dr. George Marnellos is a Lecturer at UoWM and is coordinating the research group (2 post-doc researchers, 4 Ph.D. candidates and 1 Technician) of Sustainable Technologies on Renewable & Alternative FUELS (STAR FUELS). He is conducting research in the area of heterogeneous catalysis and electrochemical reaction engineering with emphasis on fuel cell technology for hydrogen applications. He has participated in various Greek and European research projects. He is the co-author of more than 25 papers in catalysis, electrochemistry and chemical reaction engineering. Other key personnel in the project is also Dr. C. Athanasiou.

STAR FUELS research group is full equipped with all necessary devices in order to be capable to employ the most common used catalytic and electrochemical measurements. Specifically, the following facilities-equipments are available in the STAR FUELS research group:

Three full equipped flow systems (including mass flow controllers, water bath, heating wires, steam saturators, water traps, particulate filters e.t.c.)

1 60W SOFC station (HTceramix)

1 commercial catalytic reformer along with systems for the dechlorination and desulphurization of gas mixtures fed in the reformer (HELBIO)

1 PEM Fuel Cell station along with its temperature controlled furnace (NuVant Technologies)

2 Gas Chromatographs (SHIMADJU 14B – SRI 8610B)

1 FTIR (NICOLET)

1 Oxygen analyzer (OXYNOS 100)

4 Galvanostats-Potentiostats (3 AMEL 2053 – EG&G Princeton Applied Research 273)

1 LCR Analyzer (Agilent 4284A Precision LCR Meter)

1 Frequency Response Analyzer (SOLARTRON FRA 1250)

1 Resistance Box (Time Electronics Resistance Box 1051)

Various Voltmeters

Role in the project: lab scale catalysts testing (kinetic and mechanistic studies) in steam and dry syn-gas reforming, testing (effect of operational parameters on current-voltage characteristics) of fuel cells fed directly with syn-gas or with the reformat gas mixture, testing of Reformer-SOFC (60W) pilot scale plant.

2.2.3. National Observatory of Athens (NOA)

NOA is a Research Centre comprising five institutes: the *Institute of Astronomy & Astrophysics*, the *Institute of Environmental Studies & Sustainable Development*, the *Institute of Space Applications & Remote Sensing*, the *Geodynamical Institute* and the *Institute of Astro-Particulate Physics "Nestor"*.

NOA will participate through IERSD and more particularly with its *Atmospheric Research Team (ART)*. IERSD is active in many fields of atmospheric research (solar and wind energy, air pollution, climate change, weather forecast) as well as physics of buildings and sustainable energy aspects. ART is specialising in meteorology, climatology and atmospheric physics. The Head of ART is Dr Harry Kambezidis. More about ART can be found in its website http://www.noa.gr/ENG/iersd_art.htm.

Some members as well as collaborators of ART will participate in the MSW-ATREUS project, if funded. These will be:

Harry Kambezidis. Apart from the Head of ART, Dr Kambezidis is a Research Director of IERSD and expert in the field of atmospheric physics with long research experience, particularly experimental. He has participated or coordinated a large number of international and national projects. He has more than 200 works published in international scientific journals, conferences and books. He has been ex President of the Hellenic Physicists Union and current President for the second time of the Hellenic Illumination Committee.

Basil Psiloglou. He is a Senior Researcher in IERSD, member of ART. His experience is in solar radiation transmittance through the atmosphere and GIS applications. He has taken part in various experimental or theoretical projects. He has a very good knowledge in operating various software programmes and modifying them, if necessary.

Two PhD students. These will be selected from the PhD candidates pursuing their PhD with ART. They will have a great ability in computer programming and software manipulation and will assist the team with all necessary secondary work needed for carrying out the tasks of NOA within MSW-ATREUS project.

ART has participated in the INTERREG IIIB RISCMASS project recently completed with similar tasks as far as the calculation of the refraction index in the atmosphere. Apart from this, the members or collaborators of ART have participated in studies or projects with atmospheric direction (MEDCAPHOT-TRACE, CLIMED, EUROBIONET, ICAROS-NET, ISOLE, MICE, PRIMAVERA, MANTLE) including modelling and GIS applications. Therefore, the general experience of ART in FP projects guarantees the success of the tasks undertaken.

NOA will carry out all of WP7.

2.2.4. Ben-Gurion University of the Negev

Ben Gurion University of the Negev is located in Beer-Sheva Israel. It is one of seven research universities in Israel with almost all disciplines of Science, engineering, humanities, social sciences and medical studies. It has an enrolment of about 19,000 students. Our team is specializing in great many aspects of energy and power stemming from fossil fuels. We have carried out numerous projects in this area and are working closely with the power industry in Israel. We also serve as consultants to all authorities in Israel in energy and power. To mention a few projects conducted in the last few years: (1) Development of a methodology to evaluate the use of various fuels in large utility boilers for power production. This undertaking involved testing of various fuels (mostly coals) and developing computer codes to simulate the physico-chemical processes undergoing in utility boilers. (2) Help strategy makers in the power industry on operating and retrofitting of existing utility boilers. This is done by using huge numerical codes to simulate and demonstrate the operation of these boilers. (3) Optimization of operation conditions of large utility boilers. (4) "Problem solver" for undesired incidents and proposing diagnostics and ways to solve the problem. (5) Operating various fuels in the same boiler for better efficiency and lowering emissions of NO_x and SO_x and development of adsorption techniques of these pollutants. (6) Participating in national committees to propose energy and power policy for the State of Israel (7) Economics of environment and energy for utility boilers applying fossil fuels. (8) Development of various gasification technologies.

Prof. Bar-Ziv has experience in coal combustion, gasification and related areas, for over 25 years, including: At present: Director of R&D group (mostly Ph.D.s) that developed: (i) a small power plant using coal, gas fuel and diesel, integrating various technologies, in order to obtain characteristics of fuels; (ii) a methodology for the power industry to predict the operation of coal-fired plants for coal combustion and gasification for operation, pollution reduction, process optimization and retrofitting. Development was done at Ben Gurion University, Israel (BGU) during 1998-2007. Providing routine services to Israel Electric Corporation (who generates 11,000 MW electricity to Israel and the Palestinian Authorities) on increasing efficiency and reducing pollutant emissions and other related services. At present: (i) Director of R&D group in coal gasification in Israel; and (ii) co-directing, jointly with Prof. Oscar Farías, a group of scientists and engineers at Universidad de Concepción on coal gasification as a energy alternative in Chile. In the past: Director of an R&D group (over 40 engineers) developing a petrochemical process using inorganic catalysts to turn bitumen into a solid feedstock for propulsion applications, starting from a laboratory-scale, through a pilot plant and turn it into a full-scale plant. Work was done during the employment at Nuclear Research Center - Negev. In the past: Director of an R&D group (over 25 engineers and scientists) developing a process based on plasma jet turning methane into carbonaceous materials for a variety of applications, such as catalysts, hard coatings, and thermal management. The development started from a laboratory scale, through the pilot scale and turned into a full scale plant. Commercialization work was carried out in a start-up company Torch Temed, Ltd., managed by Dr. Bar-Ziv (1990-1995). Over the year, Prof. Bar-Ziv carried out: (i) Comprehensive studies on high temperature coal related topics, work carried out at BGU and MIT, Cambridge. (ii) Comprehensive knowledge of state-of-the-art technologies on coal combustion and gasification. (iii) Comprehensive economic evaluations of various coal gasification and IGCC technologies. (iv) Over 130 publications specialized in the topic.

BGU's task in this undertaking is to develop an integration algorithm and a system that would operate all the above mentioned technologies in an optimum manner and control the operation in a closed loop. Our experience in this area is quite extensive as we have carried out integration of technologies in small-, medium-, and large-size in the field of energy and power. One of the recent developments in integration we carried out recently is a small power plant that comprised feeding, combustion and gasification of solid, liquid, and gaseous fuels as well as other additives such as steam, sorbents and other materials. The system is operating with 95% availability and is fully automated and requires very little manpower.

2.2.5. Geneva Institute of Technology/IMEC (IMEC)

The Geneva Institute of Technology is part of the University of Applied Science Western Switzerland (HES-SO) and provides high level education for engineers and architects; the institute is equipped with sophisticated and technologically advanced laboratories. They are used for teaching as well as for research and development, providing students with opportunities to build knowledge and skills and accommodating the schools growing research and development initiatives. GIT also provides specialisation courses for industry professionals. GIT has 600 students in Geneva and all HESSO campus has more than 10'000 students. EIG participation will be carried by "Institut des procédés de fabrication, des matériaux et de la mécanique des fluides", IMEC a team of 6 professors and 7 researchers and technicians. www.eig.ch.

Key persons: Prof. Jean-Bernard Michel, Mech. Eng. Degree from "Institut National Polytechnique de Grenoble" (FR, 1976), Ph.D. in energetics, Valenciennes University (1984); 26 years of R&D experience in various fields especially in combustion and high temperature technologies: Main investigator, International Flame Research Foundation (IFRF) www.ifrf.net. 1981-1985 R&D Project manager, Battelle Geneva Research Center. Educational program manager, Digital Equipment International Europe. Senior Project Manager, Swiss Center of Electronics and Microtechnology. www.csem.ch. 2004 to present Professor with a 50% R&D activity on energy conversion systems.

He participated to more than 20 national and EU funded projects as Researcher, WP leader and/or project manager (Swiss CTI Eureka, IMS, FP5, FP6, Energy and IST programs) in particular the EU projects EDIFICIO, BIOFLAM, IMOS. Member of the International Flame Research Foundation, Member of the CTI National Network on Energy and Environment; founder, past president and advisory board member of the Swiss Association of Project Managers (www.project-management.ch), Assessor for the certification of project managers. Member of the advisory committee of the "Clean Air" conferences. <http://rgesd.ist.utl.pt/cleanair/>

Prof. Jacques Richard, Diplôme of Physics University of Geneva (1983). More than 20 years of R&D experience in industrial processes and technologies: 1984-1986: CAD/CAM R&D engineer, Battelle Geneva Research Center. 1986-1991: CAD/CAM R&D engineer, Charmilles Technologies SA. 1992-1998: R&D Project manager Fidia KMR SA. 1999-2003: Senior scientist at EIG-HES Geneva Institute of Technology in charge of Industrial project. 2004-to present: Professor with a 50% R&D activity on PLM and new manufacturing processes. He participated national and EU funded projects as Researcher, (Swiss CTI, IMS, FP5, FP6, - NMP programs) in particular the EU projects STEP-NC/IMS.

Prof. Patrick Haas, Mech. Eng. Degree from "Geneva Institute of Technology" (1985), M.Sc.A., in aeronautics, Polytechnic Montreal (1989); More than 15 years of R&D experience in fluid mechanics, CFD and energy systems: 1989 - 1993 Aerodynamic engineer, Bombardier Inc., Canada. 1994 - 2004 Owner ARD SA - Geneva, company working in fluid dynamics and thermal system engineering. Main customers: Bombardier Inc., Tetra Pak. 2004 to present Professor with a 50% R&D activity on fluid dynamics engineering, CFD and thermodynamics.

Selected recent relevant publications and conferences

J.-B. MICHEL et al. Combined heat and power and heat pump for residential use. System design for minimum CO₂ emissions and best economy. 9th International Conference on Technologies and Combustion for a Clean Environment, Portugal, Jul. 2007.

J. RICHARD et al. Lifecycle analysis aspects of biofuels (Paper) PLM07: International Conference on Product Lifecycle Management - Polytecnico di Milano, Jul.2007

J. RICHARD Biofuels LCA aspects based on a practical case of inland waterways transport, LCM 2007: 3rd International Conference on Life Cycle Management - Zurich, University of Zurich - Aug. 2007

J.-B. MICHEL et al. Intelligent combustion control; from myths to reality, Keynote paper at 6th European Conference on Industrial Furnaces and Boilers, Lisbon, Apr. 2002

2.2.6. PERAS GROUP OF COMPANIES AG – Switzerland (PG)

Steven M. Peras
President

PERAS Swiss Holding Company that has been established to assist governments, local authorities and various industries meet the environmental standards that will come into fruition in the very near future.

Peras Group is comprised of Peras Asset and Environmental Mgt AG, Peras Investments AG, Peras Environmental Energy UK Ltd, and Peras Power. **PAEM** is the authorized European Representative for Startech Environmental and covers all of Europe, Africa, Russia and the Middle East.

Peras Investments AG has been established in purchasing feedstock related companies for various Startech projects and for the investment of Startech's Plasma Converter System for the front end and various backend technologies either to electricity, ethanol, diesel or hydrogen.

Peras Environmental Energy UK Ltd. Has been established to cover the UK marketplace for consulting, equipment sales and lease own operate systems. **Peras Power AG** has been established for the management of syn-gas as is, ethanol, diesel, hydrogen and electricity capabilities inherent to syngas conversion using either the Modified Fischer Tropsch Process, Starcell or power systems.

Peras Group promotes the use of the Startech Process in its use for waste as feed stocks and its conversion to electricity power generation, fuels and other useable byproducts.

The reason is obvious. High Temperature Plasma Gasification is one of the cleanest processes available in the world today. It is the solution to the environmental issues that plague the world. Startech's web site is www.startech.net.

Large Presentations

May 2006

London, UK

City of London, Ministry of Defence (waste disposal agency)

Various Universities and Financial Institutions

June 2006

Bio Energies Investing

Guest Speaker

Geneva, Switzerland

Various Clients and Banks

Oct 2006

Bio Diesel Expo

Newark, Nottingham UK

Guest Speaker

Various Clients and Banks

(attended by over 1,200 people)

2.2.7. ARCADIAN FINANCIAL CONSULTANTS (AFC)

PROFILE

Our office was established in 1992 by a group of Scientists and Collaborators, whose long-lasting experience on the development and accomplishment of National and Community programs, make them efficient and reliable in providing advising services to Organisms of Local Authorities and Enterprises of the Private Sector.

The basic activities of AFC are:

- Clinching of subsidizing deals which are beneficial either to Local authorities or to Enterprises of the Private Sector
- Projects on renewable sources of energy and the protection of the environment
- Support of the developmental policy of Local Authorities.

AIM

The aim of Arcadian Financial Consultants is to inform the clients, in due time, about potential investment programs, so that they achieve the biggest possible exploitation of allocated resources for the achievement of their investment goals. The Essential requirement for participation in such subsidized investment programs is the careful planning of investment strategy according to the special needs of the enterprise. The final step is the preparation and submission of the proposal with a complete description of investment project, relative elements of the financial study and viability – profitability assessment.

Our office, depending on the needs of the enterprise, determines the most suitable investment program for the customer undertakes the preparation of submission file and supports the enterprise to take full benefit from the investments.

2.2.8. Kallisti Extract and Energy Production MSW-SRL (KEEP)

Our Romanian Company "KALLISTI EXTRACT & ENERGY PRODUCTION (MSW) S.R.L" founded in 2005, and in cooperation with another related Company in Greece which is specialized in such of projects as well in cooperation with the Athens Polytechnic University, wishes to get involved and participate in the research and in actions related under the Seventh Framework Program (FP7) of European Union (Brussels 18th December 2006, [PE-CONS 3668/2/06 Rev 2] [RECH 322 CODEC 1329]).

Our intention is to participate and provide (after due investigation) of our own proposal under the scope and hope that we can get funded from EU funds for the establishment in Romania a gasification Plant for Power Generation through Municipal Solid Waste (MSW).

In fact we would think that, through local Romanian expertise assistance, we would need to look into the aspect of Activity Area (ENV.2007 3.1.3.1 & 3.1.3.2 & 3.1.3.3) for the Development of integrated waste management technologies, i.e. New Technologies for waste shorting, Networking and preparatory action(s) in view of developing cost-effective, environmentally-safe waste treatment technologies and services adapted to the needs of developing countries, with a targeted life cycle approach. Our effort will be targeted to maximize material and energy recovery/recycling of the organic (humid) fraction wide-range of Municipal Solid Waste (MSW), and/or Agro-Industrial Feedstock.

We have very good reasons to believe that we will soon be able to join forces with at least 6-7 Municipalities close to the City of Bucharest who would like to identify as to whether such possibility would benefit the lives and living standards of their population.

Activities

The collaborative project is aiming at

1. significant advance beyond the established state of the art, 2. scientific coordination and/or demonstration (like prototype Biodiesel commercial plant adapted to Mediterranean feedstock) 3. management activities, over and above the technical management of individual work packages, linking together all the project partners and maintaining communications with the Commission 4. training of researchers and key staff, including research managers and industrial executives (in particular for SMEs) and 5. training of potential users of the knowledge generated by the project.

The training and dissemination actions should aim to improve the quality level of the established public services offered by Local & Regional Authorities and contribute to the professional development of their personnel concerned.

2.3 Consortium as a whole

The consortium has been established bearing in mind that each one of the members will contribute to the whole effort as to cover every possible aspect may arise in the specific project. In particular there is the AFC member who is responsible for the land and the erection of the building that will host the plasma gasification machinery. Given the fact this member has been involved in the management of many European Union and National programs they will also be responsible for the business plan of the project. The IMEC partner has a proven experience in the assembly and operation of such a unit and along with the Peras Group who is the machinery supplier will be responsible for the respective part of the procedure. The major scientific part related to basic and applicable research is going to be performed by the following scientific teams: UOP, UOWM, NOA, BGU, IMEC, each one from them has shown great scientific achievements in the following:

- a) operational research and mathematical modeling (UOP), thus the pros and cons of the process will be investigated while at the same time a mathematical model for the whole process is going to be constructed. By doing so, one will be able as to guide the process to produce the desired output.
- b) catalysts design as to efficiently uptake the produced gases (UOWM). The same group is to develop a method that will be combine solid oxide fuel cells in to order to store the produce H₂ gas.
- c) the NOA member is going to report on the design of efficient ways of collecting wastes and disposal processes as well as they on environmental data valuable for the public and authorities.
- d) development of software by the BGU member as to efficiently control the procedure. To construct the algorithm the feedback from both the UOP and UOWM studies is of major importance.

We note the specific importance of its individual partner and the harmonic combination of their activities as to build a consortium on the one hand well balanced and on the other able to accomplish the tasks that have been set in respect to this particular project.

The **University of Western Macedonia (UoWM)**, with acknowledged efforts in the heterogeneous catalysis and SOFC research fields, will use its expertise on SOFC fundamentals and assessment with the truly outstanding and easily scaled-up techniques of preparation and characterisation of highly advanced catalysts/electrodes with the desired architecture. This opportunity does not simply lies on the fact that novel and explicable materials will be for the first time applied as electrodes in SOFCs but also and more important, these materials will be developed according to the special needs of their SOFC application.

Finally, as it was mentioned at the description of Workpackage #6, the collection and delivery of wastes will be subcontracted. The necessity of this action is dictated by the special equipment and trained personnel that must be committed.

2.4 Resources to be committed

Partner #1 – University of Peloponnese. Three senior researchers plus 2 PhD students plus one faculty member will be employed for the research and management activities. The total personnel cost is 484,000.00€. Moreover, 40,000.00€ will be subcontracted for the collection and delivery of waste. The equipment that is necessary for the simulation activities consists of power computers and special software. This cost plus the cost of consumables is 100,000.00€. The cost for the management activities of the UoP which acts as coordinator of the project is 120,000.00€ which corresponds to the cost for the meeting preparation, the workshop organization, the exhibition organization etc. Finally, the indirect cost of the UoP is 60% excluding the subcontracting cost. The total requested fund for the UoP is 1,092,800.00€.

Partner #2 – University of Western Macedonia. One senior researcher plus 2 PhD students plus one faculty member will be employed for the research and management activities. The total personnel cost is 142,200.00€. The equipment that is necessary for the SOFC characterization activities consists of measuring devices and consumables. The total cost is 45,000.00€. The cost for travels for dissemination is 10,000.00€. Finally, the indirect cost of the UoWM is 60%. The total requested fund for the UoWM is 240,640.00€.

Partner #3 – National Observatory of Athens. One senior plus one faculty member will be employed for the research and management activities. The total personnel cost is 111660.00€. The equipment that is necessary for the Life Cycle Analysis activities consists of power computer and consumables. The total cost is 130,480.00€. The cost for management actions is 10,000.00€. Finally, the indirect cost of the NOA is 60%. The total requested fund for the NOA is 262,374.00€.

Partner #4 – University of Ben-Gurion of the Negev. One senior researcher plus 3 technician and/or research members will be employed for the research and management activities. The total personnel cost is 616,000.00€. The equipment that is necessary for the capabilities and integration of self power mode of operation of the pilot plan consists of power computers, measurement devices and special hardware parts. This cost plus the cost of consumables is 289,000.00€. Finally, the indirect cost of the BGU is 60%. The total requested fund for the BGU is 1,085,200.00€.

Partner #5 – Geneva Institute of Technology. Three specialized faculty members will be employed for the construction and assembly of the pilot plan. The total personnel cost is 285,000.00€. The cost of the necessary consumables is 15,000.00€. Finally, the indirect cost of the IMEC is 60%. The total requested fund for the IMEC is 240,000.00€.

Partner #6 – Peras Group AG. Three specialized faculty members will be employed for the construction and assembly of the pilot plan. The total personnel cost is 90,000.00€. The cost of the necessary hardware plus the transportation is

8,000,000.00€. Finally, the indirect cost of the PG is 20%. The total requested fund for the PG is 45,000.00€.

Partner #7 – Arcadian Financial Consultants. Three specialized faculty members will be employed for the construction of the business plan and the ISO certification of the pilot plan. The personnel cost is 320,000.00€. On the other hand, one faculty member will be employed for management activities is 80,000.00€ while for demonstration activities is 130,000.00€. RTD actions concerning the construction of the business plan require equipment and consumables with cost 100,000.00€. Finally, the indirect cost of the AFC is 20%. The total requested fund for the AFC is 426,000.00€.

Partner #8 – Kallisti Extract and Energy ProductionMSW-SRL. One specialized faculty member will be employed for the dissemination of the project results in Romania. The cost for consumables is 14,000.00€. Finally, the indirect cost of the KEEP is 20%. The total requested fund for the KEEP is 60,000.00€.

Table 2.1. Total Cost

	RTD	DEM	MGT	Other	Total
Personnel	1,655,680	375,000	54,180	0	2,084,860
Subcontracting	0	0	0	40,000	40,000
Other Direct Costs	565,480	8,145,000	224,000	209,000	9,143,480
Indirect Costs	1,106,208	1,716,000	106,508	125,400	3,054,116
Total Costs	3,327,368	1,023,6000	384,688	374,400	14,322,456
Requested EC Contribution	2,369,526	363,000	384,688	334,800	3,452,014

3. Impact

3.1 Expected impacts listed in the work programme

It has been well understood that any action against environmental problems needs the joint efforts of diverse fields of science and technology. What is not yet well established is the fact not only the solution but the fruits of any such action may have an interdisciplinary character. In this proposal it is presented a vertical scheme showing how diverse fields as science and technology, on the one hand, and community, on the other, can be benefited by the application of an efficient, environmentally friendly and prosperous technology: that is a plasma waste converter. The aforementioned machinery can treat almost any kind of waste, including some traditionally difficult waste materials. It can treat, among others, medical wastes or chemically-contaminated ones leave behind nothing else but gases and slag. Without any problem it can also treat municipal solid wastes and given the specialization of the local agriculture it can also treat olive kernels and ash produced by a nearby coil power-house.

The expected impact of the MSW-ATREUS project will contribute substantially both to local region and to the whole with:

- The positive impact to the municipals located in arcadia is more or self proven because both the domestic wastes as well as medical and agrochemical wastes will be converted.
- The results should provide solid "field data" to evaluate how the diversion targets foreseen in the Landfill Directive 99/31/EC can be reached in different regions of Europe.
- Improved knowledge on the environmental, economic, and social implications of source separation on the recovery/recycling of biodegradable waste.
- Increase of materials and energy recovery and GHG reduction by integration of different technologies.
- The environmental and resource impacts of alternative disposal processes, as well as those other processes which are affected by disposal strategies, different types of collection schemes for recyclables, advanced non polluting technologies for significant energy recovery etc. LCA may be intended to provide environmental data for the public or for government.
- Providing useful data related to the application of this new technology bridging the gap between a potentially applicable technique to an efficiently working method.
- Producing energy by converting non reactant gases into power either implicitly, meaning by using the heat as to produce steam that in turns will move a turbine, or explicitly by using solid oxide fuel cells where physicochemical processes are taking place.

- An integration system of all above technologies that requires a significant R&D effort in order to determine the algorithm and methods to optimise, operate, and control the entire system in real time to have the highest yield

On the other hand, major technological and scientific results are expected to be the outcomes of the project. More specifically:

- The integration of all components of the power plant and insure smooth operation. The BGU (partner 4) group has extensive experience in integration of various equipment and components for power production. We believe that the present power plant can be indeed constructed, integrated, tested and operated in the time frame allocated for the project.
- The contribution of IMEC (partner#5) will be the detailed design of “Type A” demo. plant (including civil work, electricity, isometric, etc.) . Together with PG (partner #6) they will manage the demo installation, assembly, operation and testing of all basic systems and subsystems including grid connection. Operation of the plant will serve as input for the other WPs.

The general benefits of the SOFC system that it will be developed include:

- *Energy security*: reduce oil consumption, cut oil imports, and increase the amount of the European available electricity supply.
- *Reliability*: achieves operating times in excess of 90% and power available 99.99% of the time.
- *Low operating and maintenance cost*: the efficiency of the SOFC system will drastically reduce the energy bill (mass production) and have lower maintenance costs than their alternatives.
- *Constant power production*: generates power continuously unlike backup generators, diesel engines or Uninterrupted Power Supply (UPS).
- *Choice of fuel*: allows fuel selection and especially allows the use of available commercial fuels such as natural gas and gasoline fuels.

Table 3.1: Typical SOFC air emissions from one year of operation

Air emissions*	SO _x	NO _x	CO	Particles	Organic compounds	CO ₂
Fossil fuelled plant	12.740	18.850	12.797	228	213	1.840,020
SOFC system	0	0	32	0	0	346,300

* kgs of emissions per 1650 MWh from one year full operation (Data from The International Fuel Cells, a United Technology Company. Fuel Cells Review (2000).

The high efficiency of SOFC results in less fuel being consumed to produce a given amount of electricity, which corresponds to a lower emission of carbon dioxide CO₂, the main ‘greenhouse gas’ responsible for global warming. A reduction of carbon dioxide emissions by more than 1 million kg per year could thus be obtained. Moreover, emissions from SOFC systems will be very low with near-zero levels of NO_x, SO_x and particulates, therefore eliminates 20,000 kg of acid rain and smog-causing pollutants from the environment. In any case SOFCs generally provide the lowest emissions of any non-renewable power generation method such as traditional thermal power plants, as shown in Table 3.1. This is very important with regard to energy related environmental concerns. When combined with a gas turbine, SOFCs

are the most clean and efficient devices available for this purpose.

SOFC can also provide high-quality waste heat that can be used for domestic heating or provide refrigeration and air conditioning without harming the environment.

Public benefits derived from the present research project are assessed within the following context:

- Reduced environmental impacts of the electricity supply or transmission or distribution system
- Increased public safety of the electricity system
- Increased reliability of the electricity system
- Increased affordability of electricity

In conclusion the technology that will be developed in this project advances fuel-cell development in general, which is considered a key technology for distributed generation. The use of fuel cells in distributed generation offers the following potential benefits: (a) reduces harmful environmental emissions that result from central power plants using combustion technologies, (b) reduces the need for power-distribution infrastructure, (c) increases grid reliability, (d) increases the quality of the power grid and eliminates power-line losses.

In addition to the general benefits derived from distributed generation, the specific technology that it will be developed in this project has the potential to reduce the capital and operating costs of Solid Oxide Fuel Cells, which will accelerate commercialization. We will try to make a significant progress in designing a fuel cell to run directly on natural gas or gasoline. That eliminates the need for an expensive and complex reformer, and it allows the fuel cell to be connected directly to existing natural gas lines or gasoline infrastructures to serve as the fuel source. SOFCs also can be configured to generate hot water or heat, further increasing their energy efficiency.

Fuel cells generally have high thermal efficiency. When compared to conventional electric generators, this means that a higher percentage of the fuel is converted to electricity. Less fuel is consumed and less carbon dioxide gas is produced. The reduced greenhouse emissions and the lower consumption of expensive imported fuel are benefits which extend beyond the electric ratepayer to the population in general.

Another relevant impact derives from the possibility of substituting Ni in the electrodes with other **not-toxic** elements, being toxicity of Ni a critical problem of the industrial development of SOFC electrodes. This will contribute to the **improve quality of work and workers health** in the manufacture of SOFC cells.

3.2 Dissemination and/or exploitation of project results, and management of intellectual property

All participants in project MSW-ATREUS by signing the collaboration agreement take the responsibility to disseminate the results obtained using the resources of the project in the following way:

1. In order to avoid duplication of Research and Developments efforts and to ensure that results are promoted as swiftly and effectively as possible, scientific publications and conference participation is strongly encouraged. High impact factor scientific journals are preferred in order that the results of the project meet the highest standards for review and publication. Spreading the results of the MSW-ATREUS simulations and real-scale operational data to non participating institutes and countries of targeted region can significantly increase the efficiency of the project. Beyond the published material, simulations and real-scale operational procedures generated in-situ will be made available via open web access and will be available on CD-ROMs and DVD's freely submitted upon request. In this way, environmental impact data will be used for further impact research and policy studies and the results of these studies will be available as well. Both the reports and data generated during the project will contribute to the development of the assessment report and, of course, the results will be shared and inter-compared with other projects.
2. Since the environmental impact of the application of the project is extremely important and the successful operation of the suggested pilot plant can be the occasion of the spread of the use of the new technology in other areas too, six workshops will be organized. Each workshop is addresses to both users and government agencies which are responsible for waste treatment. The necessity of the presentation, through the organization of workshops, of the environmental impact of the application of the pilot plant is dictated by the fact that the application of new technologies may arise skepticism among people. This effect was firstly noticed in the area of Arcadia, Greece, by the application of wind generators, where an extremely large amount of time (more than 10 years) spent to overcome public counteractions.
3. Workshops will be supported by press releases. Local Radio and TV stations will be continuously informed for the project status and there will be made special efforts to convince local media to systematically report the progress of MSW-ATREUS.
4. After the installation of the pilot plant, an exhibition will be organized. As mentioned above, the MSW-ATREUS project shall provide a contribution to the improvement of the scientific basis for implementation of the European Environmental Policy for waste treatment and reduce emissions of greenhouse gases. The MSW-ATREUS team will provide the experience and knowledge based on the analysis of local and regional impacts of the proposed waste treatment methodology to end users interested, as well as stakeholders or decision makers. Appropriate contribution to mass-media

will be provided to support the exhibition as well, to spread the awareness of the possible consequences of inadequate waste treatment and to help Local Authorities and Public Opinion to better understand, as well as to encourage the political effort towards the definition of future EU environmental and energy policies. For this purposes, reliable information and results from the project shall be available for policymakers and local authorities. Although presentations of the partners in their countries and at different local public workshops may be scheduled, the event under discussion will be of an international nature and will integrate all the experience available.

5. All the aforementioned activities will make use of electronic media, like newsletters, forums and web pages.

Each participant is responsible for disseminating the results it owns. However, participants may jointly decide on the means and ways of dissemination for the use and sharing of the necessary efforts and costs. A special case arises when a participant transfers its foreground to a third party. In this case, the transferring participant must pass on all its obligations to the new owner, including the obligation to provide for swift dissemination of the transferred foreground. As far as the resources of the project are concerned, every participant is responsible for its own expenses to participate in a dissemination action, while the coordinator and his institution is responsible to cover all the organization costs.

Rights and duties in disseminating the results

Dissemination of the results must be carried out as swiftly as possible, but also must comply with some conditions. In particular, dissemination should not hamper the protection and use of the result. Moreover, any planned dissemination activity must be communicated to the consortium participants, must comply with some formal requirements and must be accurately reported in the *plan for the use and the dissemination of results*.

- *Protection*: participants that own results capable of industrial or commercial application must provide for its adequate and effective protection. If the results consists of an invention and participants consider applying for patent protection, for instance, they should never forget that patents can only be granted if the subject-matter is new, meaning that it has not been disclosed to the public before the date of filing for protection. For this reason, dissemination activities should not take place or be delayed until a decision on how to protect such foreground is made. If a participant does not intend to protect its results, nor to transfer it to another participant or third party, no dissemination can take place until the Commission is informed in order to decide whether or not to assume the ownership of such result and provide for its protection.
- *Use*: participants are required to *use* the results they own (or ensure that it will be used by third parties). Such an obligation may be negatively affected by undue dissemination, e.g. where participants intend to keep the foreground confidential for protection reasons, further research, secret production or commercial marketing. The legitimate interests of the

foreground owners, as well as the existence of any confidentiality obligations, must be properly taken into account by the whole consortium when disseminating the results. In case of conflict, dissemination should be limited in extent or postponed. Notification to other participants: a participant planning to disseminate its results by any medium has to give at least 45 days prior notice (together with a sufficient description of the planned dissemination activity) to the other participants in order to enable them to exercise their objection right in case their legitimate interest could be impaired. The participants may decide to set (in writing) different time-limits.

- *Formal requirements:* any dissemination action concerning results must include a statement acknowledging the financial support of the European Community. Any publicity concerning the project must also display the EU emblem and specify that it reflects only the author's view, exempting the Community from any liability.
- *Reporting:* any dissemination activity must be reported in the *plan for the use and dissemination of results* in order to inform the Commission of how participants intend to disseminate the generated results. Each participant should provide enough details/references about the proposed communication strategy, appropriate means and concrete actions to reach the target audience. Furthermore, abstract, details/reference and an electronic copy of any scientific publications related to the results must be provided to the Commission.

Intellectual property (IP) management becomes important for the specific research project, since it combines research results with business actions. The consortium's plans for the management of IP are designed in a way to ensure good communication with the other participants when exchanging information regarding the technical part of the proposal. More specifically

- Whenever the expected outcome of the project goes beyond the state of the art, participants should carry out searches in patent documents and scientific literature to ensure that they are not going to duplicate research efforts and that their project may indeed yield innovative results. Proving that the research work to be carried out by the project goes beyond the state of the art effectively contributes to the scientific merit of a proposal. In this case, participant leaders in association with the project co-ordinator apply for national or international patents.
- Participants should demonstrate that they properly address the issue of confidentiality of information brought into or resulting from the project. Any necessary confidentiality agreements signed during negotiations, any confidentiality clauses in the consortium agreement and any other measures taken to protect confidential information (e.g. contractual agreements with employees and third parties) are followed up by the workpackage leaders and by the project co-ordinator.

- If the nature of a task, the nature of the research work (work in close cooperation between participants) or even the will of the participants are likely to lead to a joint ownership situation, participants should mention that they are willing to reach an agreement for the effective management of the jointly owned results. If they have already agreed on the main features of their agreement (ownership shares, exploitation, licensing to third parties, etc.) they may also provide an overview of their plans. The leaders of the partners are responsible to sign this type of agreement while the coordinator of the project must request them whenever a joint action is taken.
- Participants may show that they are aware of the adequate IP rights to serve the protection and exploitation of the expected results, and, in addition, that they would consider the application of the most adequate policy, making use of internal or external resources.
- Participants should refer to their plans for the use of the project results. They may indicate whether they plan to use the results directly or license them to third parties, create and sell products and/or services, etc. They can also mention the sectors they consider relevant.
- Participants may identify the target public to which they shall disseminate their results and show how their dissemination plans (websites, workshops, publications, etc.) will ensure maximum impact. - Third party rights. If participants are aware of technologies, work methods or other information held by third parties that could be useful or necessary to their work, they may mention that they already have a strategy for obtaining any necessary licences.

Every participant in the MSW-ATREUS project has signed a confidentiality agreement before entering project negotiations. These confidentiality agreements identify the classified information to be communicated and the purpose of communication, i.e. the setting up of the project and the drafting of the proposal. They generally establish restrictions and limits regarding the use of confidential information by the receiving parties and may also include penalty clauses for defaulting parties. At times, confidentiality obligations are included in a separate agreement that establishes the frame of the negotiations, known as a Memorandum of Understanding or Letter of Intent. In these agreements, participants tackle issues such as meetings for proposal preparation, good faith during negotiations, legal and other costs, etc. It is normally signed at the very beginning of the negotiations.

4. Ethical Issues

The project does not raise any ethical issues, except from the fact that the collection and pre-processing of domestic waste can be considered as an action of observation of people. Since it is not the purpose and the intention of the project to access any information from domestic waste, the following actions will ensure that this information will not be accessible by anyone: (1) Since the identification of domestic waste can be obtained only in the phase of collection of wastes, the users will be informed to pack their waste in obscured bags. (2) The transportation of waste will be evaluated with special vehicles which ensure that the identification of the waste after the collection is impossible. In the phase of pre-processing, any identification of the type of the waste will be invaluable, since it will be impossible to identify the origins. Furthermore, the company or organization which will be responsible for waste collection, will accord with the national laws which assure privacy.

ETHICAL ISSUES TABLE

	YES	PAGE
Informed Consent		
• Does the proposal involve children?		
• Does the proposal involve patients or persons not able to give consent?		
• Does the proposal involve adult healthy volunteers?		
• Does the proposal involve Human Genetic Material?		
• Does the proposal involve Human biological samples?		
• Does the proposal involve Human data collection?		
Research on Human embryo/foetus		
• Does the proposal involve Human Embryos?		
• Does the proposal involve Human Foetal Tissue / Cells?		
• Does the proposal involve Human Embryonic Stem Cells?		
Privacy		
• Does the proposal involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)		
• Does the proposal involve tracking the location or observation of people?	YES	This Page
Research on Animals		
• Does the proposal involve research on animals?		
• Are those animals transgenic small laboratory animals?		
• Are those animals transgenic farm animals?		
• Are those animals cloned farm animals?		
• Are those animals non-human primates		
Research Involving Developing Countries		
• Use of local resources (genetic, animal, plant etc)		
• Impact on a local community		
Dual Use and potential for terrorist abuse		
• Research having direct military application		
• Research having the potential for terrorist abuse		
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	YES	

5. Consideration of gender aspects

In appreciation of the fact that the perception of equality between the sexes is an ongoing process, the adopted approach is to turn away from positive discrimination and to replace it with efforts to raise awareness of the wider issues involved. Under this consideration, the following plan will be followed:

1. The coordinator of the project is responsible to follow up with the number of women scientists participating in the project. There will be an introductory statement of each partner on the number of participating women in comparison with the number of female graduates in the respective scientific fields. This action will be taken in the first meeting of the partners.
2. Every partner Institute that has not childcare facilities is responsible to shoulder this cost for participating mothers. This is to ensure that childcare cost will not influence the income of the working mothers.
3. Part time working and working from home will be support whenever it is possible. This is to ensure that mothers or people with special needs may participate in specific tasks of the project.
4. Efforts will be made in order to integrate female doctorates within the project.

Moreover, in order to increase women's participation in the project, the project coordinator will contact the "European Academy of Women in Politics and Economy Berlin", a European female scientist network, to request for candidacies for scientific work within the project.

In the BGU group Dr. Nadine Spitz will be working in the project. She got her Ph.D. with Prof. Ezra Bar-Ziv, in Environmental Engineering, where she carried out a comprehensive study on combustion of coal blends. Her study was published in archival journal, in a chapter of a book, in reports submitted to Israel Electric Corporation and in many international meetings.

References

1. Siemens, <http://www.pg.siemens.com/en/fuelcells>
2. Ceramic Fuel Cells Limited, <http://www.cfcl.com.au/>
3. Tsiakaras, C. Athanasiou, G. Marnellos, M. Stoukides, J.E. ten Elshof and H.J.M. Bouwmeester, *Applied Catalysis A: General*, Vol. 169(2), 1998, 249-261.
4. J. Larminie, A.L. Dicks, *Fuel Cell Systems Explained*, Wiley, New York, 2000, 308 pp.
5. R.J. Farrauto, R.M. Heck, Environmental catalysis into the 21st century, *Catal. Today* 55 (1-2) (2000) 179-187
6. J.R. Rostrup-Nielsen, Production of synthesis gas, *Catal. Today* 18 (4) (1993) 305-324.
7. J.N. Armor, The multiple roles for catalysis in the production of H₂, *Appl. Catal. A: Gen.* 176 (1999) 159-176.
8. A.L. Dicks, Advances in catalysts for internal reforming in high temperature fuel cells, *J. Power Sources* 71 (1) (1998) 111-122.
9. J.T. Richardson, M. Lei, B. Turk, K. Foster, M.V. Twigg, *Appl. Catal. A* 110 (1994) 217.
10. B. Scheffer, P. Molhoek, J.A. Moulijn, *Appl. Catal.* 46 (1989) 11.
11. J.T. Richardson, B. Turk, M.V. Twigg, *Appl. Catal. A* 148 (1996) 97.
12. J. Zielinski, *J. Chem. Soc. Faraday Trans.* 93 (1997) 3577.
13. J.A. Mieth, J.A. Schwarz, *Appl. Catal.* 55 (1989) 137.
14. J. Ryczkowski, *React. Kinet. Catal. Lett.* 51 (1993) 501.
15. P.H. Bolt, S.F. Lobner, J.W. Geus, F.H.P.M. Habraken, *Appl. Surf. Sci.* 89 (1995) 339.
16. P. Salagre, J.L.G. Fierro, J.E. Sueiras, F. Medina, *J. Mol. Catal. A* 106 (1996) 125.
17. R. Lamber, G. Schulz-Ekloff, *J. Catal.* 146 (1994) 601.
18. S.H. Seok, S.H. Han, J.S. Lee, *Appl. Catal. A* 215 (2001) 31.
19. D.L. Trimm, *Catal. Today* 37 (1997) 233.
20. C.H. Bartholomew, *Appl. Catal. A: Gen.* 212 (2001) 17.
21. B. Stasinska, A. Golebiowski, T. Borowiecki, in: B. Delmon, G.F. Froment (Eds.), *Catalyst Deactivation*, Elsevier, Amsterdam, 1999, p. 431.
22. M.C. Demicheli, D. Duprez, J. Barbier, O.A. Ferretti, E.N. Ponzi, *J. Catal.* 145 (1994) 437.
23. Tadeusz Borowiecki, Grzegorz Giecko, Monika Panczyk "Effects of small MoO₃ additions on the properties of nickel catalysts for the steam reforming of hydrocarbons II. Ni-Mo/Al₂O₃ catalysts in reforming, hydrogenolysis and cracking of *n*-butane" *Applied Catalysis A: General* 230 (2002) 85-97
24. M.C. Demicheli, D. Duprez, J. Barbier, O.A. Ferretti, E.N. Ponzi, *J. Catal.* 145 (1994) 437.
25. Chen, F.-L. Chen, *Ind. Eng. Chem. Res.* 29 (1990) 534.
26. J.R. Rostrup-Nielsen, in J.R. Anderson and M. Boudart (Editors), *Catalysis - Science and Technology*, Springer, Berlin, 1984, vol. 5, p. 1.
27. Tadeusz Borowiecki, Wojciech Gac, Andrzej Denis "Effects of small MoO₃ additions on the properties of nickel catalysts for the steam reforming of hydrocarbons III. Reduction of Ni-Mo/Al₂O₃ catalysts" *Applied Catalysis A: General* 270 (2004) 27-36
28. T. Borowiecki, B. Stasińska, A. Golebiowski, *Appl. Catal. A* 153 (1997) 141.
29. B. Delmon, *Surf. Rev. Lett.* 2 (1995) 25.
30. A.E. Aksoylu, A.I. Isli, Z.I. Onsan, *Appl. Catal. A* 183 (1999) 357.
31. D.M. Hercules, A. Proctor, M. Houalla, *Acc. Chem. Res.* (1994) 27.
32. J.A. Mieth, J.A. Schwarz, *Appl. Catal.* 55 (1989) 137
33. T. Borowiecki, A. Golebiowski, *Catal. Lett.* 25 (1994) 309.
34. T. Borowiecki, A. Golebiowski, B. Stasinska, *Appl. Catal. A* 153 (1997) 141.
35. J.-S. Choi, K.-I. Moon, Y.G. Kim, J.S. Lee, C.-H. Kim, D.L. Trimm, *Catal. Lett.* 52 (1998) 43.
36. Tadeusz Borowiecki a*, Andrzej Golebiowski b, Beata Stasifiska "Effects of small MoO₃ additions on the properties of nickel catalysts for the steam reforming of hydrocarbons" *Applied Catalysis A: General* 153 (1997) 141-156
37. B. Delmon, *Surf. Rev. Lett.*, 2 (1995) 25.
38. E.Z. Wang, C.H. Rochester, J.A. Anderson, *J. Catal.* 184 (1999) 21.
39. C.E. Scott, P. Betancourt, M.J. Pezer Zurita, C. Bolivar, J. Goldwasser, *Appl. Catal. A* 197 (2000) 23.
40. Jens Sehested "Sintering of nickel steam-reforming catalysts" *Journal of Catalysis* 217 (2003) 417-426
41. J.N. Armor, The multiple roles for catalysis in the production of H₂, *Appl. Catal. A: Gen.* 176 (1999) 159-176
42. Qimin Ming, Todd Healey, Lloyd Allen, Patricia Irving "Steam reforming of hydrocarbon fuels" *Catalysis Today* 77 (2002) 51-64
43. E.Z. Wang, C.H. Rochester, J.A. Anderson, *J. Catal.* 184 (1999) 21.
44. D.L. Trimm, *Catal. Today* 37 (1997) 233
45. Atsushi Ishihara*, Eika Weihua Qian, Ida Nuryatin Finahari, I. Putu Sutrisna, Toshiaki Kabe "Addition effect of ruthenium on nickel steam reforming catalysts" *Fuel* 84 (2005) 1462-1468
46. Richardson, J. T., and Paripatyadar, S. A., *Appl. Catal.* 61, 293 (1990).
47. Effendi a*, K. Hellgardt b, Z.-G. Zhang a, T. Yoshida "Characterisation of carbon deposits on Ni=SiO₂ in the reforming of CH₄-CO₂ using xed- and uidised-bed reactors" *Catalysis Communications* 4 (2003) 203-207
48. V.R. Choudhary, A.M. Rajput, *Ind. Eng. Chem. Res.* 35 (1996) 3934-3939
49. L. Mleczko, S. Malcus, T. Wurzel, *Ind. Eng. Chem. Res.* 35 (1997) 4459-4465.
50. Xenophon E. Verykios "Catalytic dry reforming of natural gas for the production of chemicals and hydrogen" *International Journal of Hydrogen Energy* 28 (2003) 1045- 1063
51. Zhang ZL, Verykios XE, *J Chem Soc Chem Commun* 1995:71
52. Zhang ZL, Verykios XE, MacDonald SM, A5orssmann S. *J Phys Chem* 1996;100:744

53. Zhang ZL, Verykios XE. *Appl Catal A* 1996;138:109.
54. Zhang ZL, Verykios XE. *Catal Lett* 1996;38:175.
55. Slagtern A, Schuurman Y, Leclercq C, Verykios X, Mirodatos C. *J Catal* 1997;172:118.
56. Tsipouriari VA, Verykios XE. *J Catal* 1999;187:85.
57. Vaso A, Tsipouriari, Xenophon E. Verykios "Kinetic study of the catalytic reforming of methane with carbon dioxide to synthesis gas over Ni/La₂O₃ catalyst" *Catalysis Today* 64 (2001) 83–90
58. Tsipouriari VA, Verykios XE. *Catal Today* 2001;54:83.
59. M. Wisniewski, A. Boreave, P. Gelin "Catalytic CO₂ reforming of methane over Ir/Ce_{0.9}Gd_{0.1}O_{2-x}" *Catalysis Communications* 6 (2005) 596–600
60. Z. L. Zhang, V. A. Tsipouriari, A. M. Efstathiou, and X. E. Verykios "Reforming of Methane with Carbon Dioxide to Synthesis Gas over Supported Rhodium Catalysts" *JOURNAL OF CATALYSIS* **158**, 51–63 (1996)
61. Erdohelyi, A., Crese´nyi, J., and Solymosi, F., *J. Catal.* **141**, 287
62. Erdohelyi, A., Crese´nyi, J., Papp, E., and Solymosi, F., *Appl. Catal. A*, **108**, 205 (1994).
63. Nakamura, J., Aikawa, K., Sato, K. and Uchijima, T., *Catal. Lett.* **25**, 265 (1994).
64. Xenophon E. Verykios "Mechanistic aspects of the reaction of CO₂ reforming of methane over Rh/Al₂O₃ catalyst" *Applied Catalysis A: General* 255 (2003) 101–111
65. V.A. Tsipouriari, A.M. Efstathiou, Z.L. Zhang, X.E. Verykios, *Catal. Today* 21 (1994) 579.
66. Z.L. Zhang, V.A. Tsipouriari, A.M. Efstathiou, X.E. Verykios, *J. Catal.* 158 (1996) 51.
67. A.M. Efstathiou, A. Kladi, V.A. Tsipouriari, X.E. Verykios, *J. Catal.* 158 (1996) 64.
68. V.A. Tsipouriari, A.M. Efstathiou, X.E. Verykios, *J. Catal.* 161 (1996) 31.
69. M. Efstathiou, A. Kladi, V. A. Tsipouriari, and X. E. Verykios "Reforming of Methane with Carbon Dioxide to Synthesis Gas over Supported Rhodium Catalysts" *JOURNAL OF CATALYSIS* **158**, 64–75 (1996)
70. Richardson, J. T., and Paripatyadar, S. A., *Appl. Catal.* **61**, 293 (1990).
71. Ashcroft, A. T., Cheetham, A. K., Green, M. L. H., and Vernon, P. D. F., *Nature* **352**, 225 (1991).
72. Solymosi, F., Kutsan, G., and Erdohelyi, A., *Catal. Lett.* **11**, 149 (1991).
73. Rostrup-Nielsen, J. R., and Bak Hansen, J.-H., *J. Catal.* **144**, 38 (1993).
74. Rostrup-Nielsen JR, Back Hansen J-H. *J Catal* 1993;144:38
75. A.T. Ashcroft, A.K. Cheetham, M.L.H. Green, P.D.F. Vernon, *Nature* 352 (1991) 225.
76. J.T. Richardson, S.A. Paripatyadar, *Appl. Catal.* 61 (1990) 293.
77. F. Solymosi, G. Kutsan, A. Erdohelyi, *Catal. Lett.* 11 (1991) 149.
78. J.R. Rostrup-Nielsen, J.-H. Bak Hansen, *J. Catal.* 144 (1993) 38.
79. K. Nagaoka, K. Seshan, K. Aika, J. Lercher, *J. Catal.* 197 (2001) 34.
80. M.V.M.M. Souza, A.G.D. Aranda, M. Schmal, *J. Catal.* 204 (2001) 498
81. Erdohelyi A, Cserenyi J, Solymosi F. *J Catal* 1993;141:287.
82. V.R. Choudhary, A.M. Rajput, *Ind. Eng. Chem. Res.* 35 (1996) 3934–3939
83. Zhang ZL, Tsipouriari VA, Efstathiou AM, Verykios XE. *J Catal* 1996;158:51.
84. Efstathiou AM, Kladi A, Tsipouriari VA, Verykios XE. *J Catal* 1996;158:64.
85. Zhang ZL, Verykios XE. *Catal Today* 1994;21:589
86. Rostrup-Nielsen JR, Back Hansen J-H. *J Catal* 1993;144:38
87. M. Wisniewski, A. Boreave, P. Gelin "Catalytic CO₂ reforming of methane over Ir/Ce_{0.9}Gd_{0.1}O_{2-x}" *Catalysis Communications* 6 (2005) 596–600
88. M. Wisniewski, A. Boreave, P. Gelin "Catalytic CO₂ reforming of methane over Ir/Ce_{0.9}Gd_{0.1}O_{2-x}" *Catalysis Communications* 6 (2005) 596–600
89. Zhan-Guo Zhang *, Guangwen Xu 1, Xin Chen, Kazunori Honda, Tadashi Yoshida "Process development of hydrogenous gas production for PEFC from biogas" *Fuel Processing Technology* 85 (2004) 1213– 1229
90. R.L. Keiski, O. Desponds, Y.-F. Chang, G.A. Somorjai, *Appl. Catal., A Gen.* 101 (1993) 317.
91. Effendi, Z.-G. Zhang, K. Hellgardt, K. Honda, T. Yoshida "Steam reforming of a clean model biogas over Ni/Al₂O₃ in fluidized- and fixed-bed reactors" *Catalysis Today* 77 (2002) 181–189
92. N. Yoshida, T. Yamamoto, F. Minoguchi, S. Kishimoto, *Catal. Lett.* 23 (1994) 237.
93. Bockris, A. Reddy and M. Gaboa-Aldeco in "Modern Electrochemistry" vol IIA, Kluwer Academic/Plenum Publishers, New York 2001
94. B. Conway, B. Tilak *Adv. Catal.* 38 (1992) 1
95. Appleby in "Fuel Cell Systems", L. Blomen and M. Mugerwa eds., p 179, Plenum Press, New York 1993
96. K. Kordesch and G. Cimer in "Fuel Cells and their Applications" p13, VCH, Weinheim 1996
97. W. Vielstich, A. Lamm and H. Gasteiger in "Handbook of Fuel Cells, Fundamentals Technology and Applications", vol II, Wiley. N. York 2003
98. B. Zhu, X. Bai, G. Chen, W. Yi and M. Burcell "Fundamental Study on Biomass Fuelled Ceramic Fuel Cell" *Int. J. of En. Res.* 26 (2002) 57
99. Y. Yi, A. D. Rao, J. Brouwer, G. S. Samuelsen "Fuel flexibility study of an integrated 25kW SOFC reformer system" *J. Power Sources* 144 (2005) 67–76
100. F. Marsano, L. Magistri, M. Bozzolo, O. Tarnowski "Influence of fuel composition on Solid Oxide Fuel Cell hybrid system layout and performance" *ASME Turbo Expo GT2004-53853*, Vienna, Austria
101. K. Eguchi, H. Kojo, T. Takeguchi, R. Kikuchi, K. Sasaki "Fuel flexibility in power generation by solid oxide fuel cells" *Solid State Ionics* 152–153 (2002) 411–416
102. F.A. Coutelieres, S. Douvartzides, P. Tsiakaras "The importance of the fuel choice on the efficiency of a solid oxide fuel cell system" *J. Power Sources* 123 (2) (2003) 200–205
103. S.L. Douvartzides, F.A. Coutelieres, A.K. Demin, P.E. Tsiakaras "Fuel options for solid oxide fuel cells: a thermodynamic analysis" *AIChE J.* 49 (1) (2003) 248–257
104. *Fuel Cell Handbook*, NETL, U.S. Department of Energy, 2000

105. S.C. Singhal "Advances in solid oxide fuel cell technology" *Sol. St. Ionics* 135 (2000) 305–313
106. Alderucci, P. Antonucci, G. Maggio, N. Giordano, V. Antonucci, *Int. J. Hydrogen Energy* 19(4) (1994) 369
107. J. Staniforth, K. Kendall, *J. Power Sources* 71 9(1998) 275
108. M. Pfaffnerodt, P. Heidebrecht, M. Stelter, K. Sundmacher, Model-based prediction of a suitable operating range of a SOFC for an Auxiliary Power Unit, *J. Power Sources* 149 (2005) 53.
109. J. Staniforth and K. Kendall, Biogas powering a small tubular SOFC, *J. Power Sources*, 71(1998) 275
110. M. Jenne, T. Zahringer, A. Schuller, G. Piskay and D. Moos, Sulzer Hexis SOFC systems for biogas and heating oil, 5th European SIFC Forum, 1,460.
111. J. Staniforth and K. Kendall, Cannock landfill gas powering a small tubular SOFC-a case study, *J. Power Sources*, 86(200)401
112. M. Jenne, T. Zahringer, A. Schuller, G. Piskay, D. Moos, Sulzer Hexis SOFC systems for biogas and heating oil, in: U. Bossel (Ed.) *Proceedings of the 5th European SOFC Forum*, Lucerne, Switzerland, July 2002, 460
113. J. Van herle, Y. Memrez, O. Bucheli, Biogas as fuel source for SOFC cogenerators, *J. Power Sources*, 2003
114. J. Staniforth and K. Kendall, Biogas powering a small tubular SOFC, *J. Power Sources*, 71(1998) 275
115. M. Jenne, T. Zahringer, A. Schuller, G. Piskay and D. Moos, Sulzer Hexis SOFC systems for biogas and heating oil, 5th European SIFC Forum, 1,460
116. J. Staniforth and K. Kendall, Cannock landfill gas powering a small tubular SOFC-a case study, *J. Power Sources*, 86(200)401
117. S. Baron, N. Branton, A. Atkinson, B. Steele and R. Rudkin "The impact of wood derived gasification gases on Ni-CGO anodes in intermediate temperatures SOFCs" *J. Power Sources* 126 (2004) 58
118. Omosun, A. Bauen, N. Brandon, C. Adjiman, D. Hart „Modelling System and Costs of Two Biomass Fuelled SOFC Systems“ *J. Power Sources* 131 (2004) 96
119. J. Van herle, F. Marechal, S. Leuenderger, D. Favrat, Energy balance model of a SOFC cogenerator operated with biogas, *Journal of Power Sources* 118(2005) 375
120. J. van Herle, Y. Memrez, O. Bucheli "Biogas as a Fuel Source for SOFC Cogenerators" *J. Power Sources* 127 (2004) 300
121. J. Van herle, F. Marechal, S. Leuenderger, Y. Memrez, O. Bucheli, D. Favrat, Process flow model of SOFC system supplied with sewage biogas, *J. Power Sources* 131 (2004) 127
122. Omosun, A. Bauen, N. Brandon, C. Adjiman, D. Hart „Modelling System and Costs of Two Biomass Fuelled SOFC Systems“ *J. Power Sources* 131 (2004) 96
123. N. Sammes, Y. Bove, Design and fabrication of a 100kW anode supported micro-tubular SOFC stack, *J. Power Sources* 145(2005)428
124. R. Kikuchi, N. Koashi, T. Matsui, K. Eguchi, T. Norby, Novel anode materials for multi-fuel applicable SOFC, *Journal of Alloys and Compound*, 2005
125. C. Chung, Y. Chung "Performance Characteristics of Micro Single Chamber Solid Oxide Fuel Cell" *J. Power Sources* (2005)
126. S. Jung, H. He, K. Ahn, R. Gorte, J. Vohs, Influence of composition and Cu impregnation method on the performance of Cu/CeO₂/YSZ SOFC anodes, *Journal of Power Sources*, 2005
127. R. Sidwell, W. Grover Coors, large limits of electrical efficiency in hydrocarbon fueled SOFCs, *Journal of Power Sources* 143(2005)166
128. Omosun, A. Bauen, N. Brandon, C. Adjiman, D. Hart „Modelling System and Costs of Two Biomass Fuelled SOFC Systems“ *J. Power Sources* 131 (2004) 96
129. M. Brown, S. Primdahl, M. Moggensen, *J. Electrochem. Soc.* 147(2000)475
130. Y. Matsuzaki, I. Yasuda, *J. Electrochem. Soc.* 147(2000)1630
131. K. Sakaki, Y. Hori, R. Kikuchi, K. Eguchi, A. Ueno, H. Takeuchi, M. Aizawa, K. Tsujimoto, H. Tajiri, H. Nishikawa, Y. Uchida, *J. Electrochem. Soc.* 149(2002)1630
132. Y. Jiang, A. Virkar, *J. Electrochem. Soc.* 150 (2003) A942
133. Y. Jiang, A. Virkar, *J. Electrochem. Soc.* 150 (2003) A942
134. M. Brown, S. Primdahl, M. Moggensen, *J. Electrochem. Soc.* 147(2000)475
135. Y. Matsuzaki, I. Yasuda, *J. Electrochem. Soc.* 147(2000)1630
136. C. Lu, W. Worrell, J. Vohs, R. Gorte, *J. Electrochem. Soc.* 150 (2003)A1357
137. Y. Jiang, A. Virkar, *J. Electrochem. Soc.* 150 (2003) A942
138. O. Costa-Nunes, R. Gorte, J. Vohs, Comparison of the performance of Cu-CeO₂-YSZ and Ni-YSZ composite SOFC anodes with H₂, CO and syngas, *J. Power Sources* 141(2005) 241
139. N. Sakai, K. Yamaji, T. Horita, Y. Xiong, H. Kishimoto, H. Yokokawa, *J. Electrochem. Soc.* 150(2003) A689
140. A. Jiang, S. Badwal, *Sol. St. Ionics* 123 (1999)209
141. A. Ringuede, D. Bromine, J. Frade, *Sol. St. Ionics* 146(2002) 219
142. C. Wen, R. Kato, H. Fukunaga, H. Ishitani, K. Yamada, *J. Electrochem. Soc.* 147 (2003) 2076
143. Z. Xia, S. Chan, K. Khor, *Electrochem. Solid State Lett.* 7(2004)A63
144. W. Vielstich, A. Lamm and H. Gasteiger in „Handbook of Fuel Cells, Fundamentals Technology and Applications“, vol II, Wiley. N. York 2003
145. J. Collins and U. Stimming in "Catalysis and Electrocatalysis in Nanoparticles". A. Wieckowski, E. Savinova and C. Vayenas eds, p. 531, Marcel Decker Inc., N. York 2003
146. L. de Haart, K. Mayer, U. Stimming and I. Vinke *J. Power Sources*, 71 (1998) 302
147. F. M. Boser, R. Dittmeyer, Catalytic modification of conventional SOFC anodes with a view to reducing their activity for direct internal reforming of natural gas, *Journal of Power Sources*, 2005
148. H. Kim, S. Park, J. Vohs, R. Gorte, *J. Electrochem. Soc.* 148(2001) A693
149. T. Takeguchi, Y. Kani, T. Yano, R. Kikuchi, K. Eguchi, K. Tsujimoto, Y. Uchida, A. Ueno, K. Omohiki, M. Aizawa, *J. Power Sources* 112(2002)588
150. O. Marina, C. Bagger, S. Primdahl, M. Moggensen, *Solid State Ionics* 123 (1999) 199
151. S. Jung, H. He, K. Ahn, R. Gorte, J. Vohs, Influence of composition and Cu impregnation method on the performance of Cu/CeO₂/YSZ SOFC anodes, *J. Power Sources*, 2005
152. M. Boaro, J. Vohs, R. Gorte, *J. Am. Ceram. Soc.* 86 (2003)395

153. R.Gorte, S.park, J.Vohs, C.Wang, *Adv.Mater.*12 (2000)1465
154. R.Gorte, J.Vohs, *J.Catal.* 216(2003)477
155. R.Gorte, J.Vohs, S.McIntosh, *Sol. St. Ionics* 175(2004)1
156. S.Park, R.Gracium, J.Vohs, R.Gorte, *J.electrochem.Soc.*146(1999) 3603
157. S.Park, R.Gorte, J.Vohs, *Appl.Catal.A Gen.* 200(2000)55
158. S.Park, R.Gorte, J.Vohs, *J.Electrochem. Soc.* 148(2001)A443
159. J.Vohs, S.Park,R.Gorte, *Nature* 404(2000)265
160. S.McIntosh, J.Vohs, R.Gorte, *Electrochim. Acta* 47 (2002) 3815
161. R. Kikuchi, N.Koashi, T.Matsui, K.Eguchi, T.Norby, Novel anode materials for multi-fuel applicable SOFC, *Journal of Alloys and Compound*, 2005
162. D.Dees, T. Claar, T.Easler, D.Fee, F.Mrazec, *J.Electrochem.Soc* 134 (1987)2141
163. R. Kikuchi, N.Koashi, T.Matsui, K.Eguchi, T.Norby, Novel anode materials for multi-fuel applicable SOFC, *Journal of Alloys and Compound*, 2005
164. R. Kikuchi, N.Koashi, T.Matsui, K.Eguchi, T.Norby, Novel anode materials for multi-fuel applicable SOFC, *Journal of Alloys and Compound*, 2005
165. Y.Jiang, A.Virkar, *J.Electrochem Soc.* 150 (2003) A942
166. H.Kim, J.Vohs, R.Gorte, *J.Chem.Soc.Chem.Commun.* (2001)2334
167. S-I Lee, J.Vohs, R.Gorte, *J.Electrochem.Soc.* 151(2004)A1319
168. Y.Jiang, A.Virkar, *J.Electrochem Soc.* 150 (2003) A942
169. C.Lu, W.Worrell, J.Vohs, R.Gorte, *J. Electrochem. Soc.* 150 (2003)A1357
170. Y.Jiang, A.Virkar, *J.Electrochem Soc.* 150 (2003) A942
171. S. Singhal, *Sol.St.Ionics* 135(2000)305
172. G.Sivasundram, J.Kilner, Solid oxide Fuel Cells, in:S.Singhal, M.Dokiya (Eds), *Proceedings*, vol.2003-07, The Electrochemical Soc.Inc., 533
173. A.Esquirol, N.Bonanos, N.Brandon, J.Kilner, M.Mogensen, Solid oxide Fuel Cells, in: in:S.Singhal, M.Dokiya (Eds), *Proceedings*, vol.2003-07, The Electrochemical Soc.Inc., 580
174. Barbucci, P.Carpanese, G. Cerisola, M.Viviani, Electrochemical investigation of mixed ionoc/electronic cathodes for SOFCs, *Sold State Ionics*. 176 (2005) 1753
175. V.Dusastre, J.Kilner, *Sol.St.Ionics* 126(1999)163
176. E. PerryMurray, S.Barney, *Sol.St.Ionics* 143(2001) 265
177. V.Dusastre, J.Kilner, *Sol.St.Ionics* 126(1999)163
178. E.Perry Murray, M.Sever, S.Barnett, *Sol.St.Ionics* 148(2002) 27
179. W.Wang, M.Mogensen, High-performance lanthanum-ferrite-based cathode for SOFC, *Solid State Ionics* 176(2005)457
180. V. Dusastre, J.Kilner, *Sol.St.Ionics* 126(1999)163
181. H. Hwang, J. Moon, S.Lee , E. Lee, Electrochemical performance of LSCF-based composite cathodes for intermediate temperature SOFCs, *Journal of Power Sources* 145(2005) 243
182. G. Corbel, S. Mestiri, P.Lacorre, Physicochemical compatibility of CGO fluorite, LSM and LSCF perovskite electrode materials with $\text{La}_2\text{Mo}_2\text{O}_9$ fast oxide-ion conductor, *Solid State Sciences*, 2005
183. K.Murata, T.Fukui, H.Abe, M.Naito, K.Nogi, Morphology control of $\text{La}(\text{Sr})\text{Fe}(\text{Co})\text{O}_{3-\delta}$ cathodes for IT-SOFCs, *Journal of Power Sources* 145(2005) 275
184. W.Wang, M.Mogensen, High-performance lanthanum-ferrite-based cathode for SOFC, *Solid State Ionics* 176(2005)457
185. B. Steele, Materials for IT-SOFC stacks 35 years R&D: the inevitability of gradualness?, *Solid State Ionics* 134 (2000) 3
186. S. Singhal, Advances in SOFC technology, *Solid State Ionics*, 135 (2000)305
187. X.Xu, C.Xia G.Xiao, D.Peng, Fabrication and performance of functionally graded cathodes for IT-SOFCs based on doped ceria electrolytes, *Solid State Ionics* 176 (2005) 1513
188. Barbucci, P.Carpanese, G. Cerisola, M.Viviani, Electrochemical investigation of mixed ionoc/electronic cathodes for SOFCs, *Sold State Ionics*, 176 (2005) 1753.
189. W.Wang, M.Mogensen, High-performance lanthanum-ferrite-based cathode for SOFC, *Solid State Ionics* 176(2005)457
190. C. C. Chen, M. N. Nasrallah and H. U. Anderson, *Proc. 3rd Int. Symp. SOFCs*, eds S. C. Singhal and H. Iwahara 4 (1993) 252
191. X.Xu, C.Xia G.Xiao, D.Peng, Fabrication and performance of functionally graded cathodes for IT-SOFCs based on doped ceria electrolytes, *Solid State Ionics* 176 (2005) 1513
192. H. Hwang, J. Moon, S.Lee , E. Lee, Electrochemical performance of LSCF-based composite cathodes for intermediate temperature SOFCs, *Journal of Power Sources* 145(2005) 243
193. Hawkes, M. Leach "Solid Oxide Fuel Cell Systems for Residential micro-Combined Heat and Power in the UK" *J. Power Souec.* 149 (2005) 72
194. S. Singhal "Advances in Solid Oxide Fuel Cell Technology" *Sol. St. Ionics* 135 (2000) 305
195. J. Bockris, A. Reddy and M. Gaboa-Aldeco in "Modern Electrochemistry" vol IIA, Kluwer Academic/Plenum Publishers, New York 2001
196. B. Conway, B. Tilak *Adv. Catal.* 38 (1992) 1
197. Appleby in "Fuel Cell Systems", L. Blomen and M. Mugerwa eds., p 179, Plenum Press, New York 1993
198. K. Kordesch and G. Cimader in "Fuel Cells and their Applications" p13, VCH, Weinheim 1996
199. W. Vielstich, A. Lamm and H. Gasteiger in „Handbook of Fuel Cells, Fundamentals Technology and Applications“, vol II, Wiley. N. York 2003
200. C. Song "Fuel processing for low-temperature and high-temperature fuel cells. Challenges, and opportunities for sustainable development in the 21st century" *Catal. Today* 77 (2002) 17-49
201. K.L. Seip, B. Thorstensen, H. Wang "Environmental impacts of energy facilities: fuel cell technology compared with coal and conventional gas technology" *J. Power Sources* 35 (1991) 37-58.
202. Douvartzides SL, Coutelieres FA, Demin AK, Tsiakaras PE. Fuel options for solid oxide fuel cells: a thermodynamic analysis. *AIChE J* 49(1) (2003) 248-57

203. Kim H, Park S, Vohs JM, Gorte RJ. Direct oxidation of liquid fuels in a solid oxide fuel cell. *J Electrochem Soc* 148(7) (2001) 693
204. R. Sidwell, W. Grover Coors "Large limits of electrical efficiency in hydrocarbon fuelled SOFCs" *J. Power Sourc.* 143 (2005) 166
205. S. Douvartzides, F. Koutelieras, K. Demin, P. Tsiakaras *AIChE J.* 49 (2003) 248
206. L. Brown *Int. J. Hydrogen Energy* 26 (2001) 381
207. S. Baron, N. Branton, A. Atkinson, B. Steele and R. Rudkin "The impact of wood derived gasification gases on Ni-CGO anodes in intermediate temperatures SOFCs" *J. Power Sources* 126 (2004) 58
208. G. Maggio, S. Freni, S. Cavallaro *J. Power Sources* 74 (1998) 17
209. K. Kordesch and G. Cimader in "Fuel Cells and their Applications" p13, VCH, Weinheim 1996
210. J. Collins and U. Stimming in "Catalysis and Electrocatalysis in Nanoparticles". A. Wieckowski, E. Savinova and C. Vayenas eds, p. 531, Marcel Decker Inc., N.York 2003
211. L. de Haart, K. Mayer, U. Stimming and I. Vinke *J. Power Sources*, 71 (1998) 302
212. Y. Yi, A. Rao, J. Brouwer, G. Samuelsen "Fuel Flexibility Study of an Integrated 25 kW SOFC Reformer System" *J. Power Sources* 144 (2005) 67
213. M. Ferrari, A. Traverso, L. Magistri, A. Massardo "Influence of the anodic recirculation transient behaviour on the SOFC hybrid system Performance" *J. Power Sources* 149 (2005) 22
214. Y. Inui, T. Matsumae, H. Koga, K. Nishiura « High Performance SOFC/GT Combined Power Generation System with CO₂ Recovery by Oxygen Combustion Method » *Energy Conversion and Management* 46 (2005) 1837
215. DOE, Fuel Cell Handbook, 5th Ed. U.S. Department of Energy (2000) 352
216. S. Baron "Biofuels and their Use in Fuel Cells" *Fuel Cell Today* 7 April 2004 (www.fuelcelltoday.com)
217. D. Mc Ilveen-Wright, D. Guiney "Wood Fired Fuel Cells in an Isolated Community" *J. Power Sources* 106 (2002) 93
218. D. Mc Ilveen-Wright, J. Mc Mullan, D. Guiney "Wood Fired Fuel Cells in Selected Buildings" *J. Power Sources* 118 (2003) 393

Appendix-Consortium Collaboration Agreements



CONSORTIUM COLLABORATION AGREEMENT

The below undersigning legal representatives of the participating entities in the proposal MSW-ATREUS for the ENV.2008 program (deadline for submitting the proposal : 25th of February, 2008):


1. *agree to participate in the proposal,*
2. *agree that the UNIVERSITY of PELOPONNESE (Tripolis-Arcadia-GREECE) will act as coordinator of the project and will nominate the person who acts as coordinator of the project,*
3. *will undertake and carry out the tasks allocated to us, if the proposal gets funding from EC,*
4. *will cooperate for mutual benefit and for the benefit of the project as a whole,*
5. *agree that all information received during the course of developing the proposal will be treated as confidential, and used only for developing the proposal, and implementing the project, if the proposal is approved.*
6. *in case of disagreement, will try to solve any difference peacefully with or without the coordinator's intervention, and*
7. *will report the coordinator timely any problem arisen.*

Partner number and name of institution	Name and Signature of legal representative and seal of institution	Date (day / month / year)
Website: www.uop.gr	e-mail: icalambo@uop.gr	
Partner No: 1 University of Peloponnese 22100 Tripoli Greece	Constantine Demopoulos   Rector of the University of Peloponnese	21 /02 /2008



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7. will report the coordinator timely any problem arisen.

Partner number and name of institution	Name and Signature of legal representative and seal of institution	Date (day / month / year)
URL:www.uowm.gr	Email: rc@uowm.gr	
Partner Number 2 University of Western Macedonia Parko Aghiou Dimitriou, GR 50 100, Kozani GREECE	Christos B. Massalas  Rector of University of Western Macedonia	22/02/2008



The below undersigning legal representatives of the participating entities in the proposal MSW-ATREUS for the ENV.2008 program (deadline for submitting the proposal : 25th of February, 2008):

6. agree to participate in the proposal,
7. agree that UNIVERSITY of PELOPONNESE (Tripolis-Arcadia-GREECE) will act as coordinator of the project and will nominate the person who acts as coordinator of the project,
8. will undertake and carry out the tasks allocated to us, if the proposal gets funding from EC,
9. will cooperate for mutual benefit and for the benefit of the project as a whole,
10. agree that all information received during the course of developing the proposal will be treated as confidential, and used only for developing the proposal, and implementing the project, if the proposal is approved.
6. in case of disagreement, will try to solve any difference peacefully with or without the coordinator's intervention, and
7. will report the coordinator timely any problem arisen.

Partner number and name of institution	Name and Signature of legal representative and seal of institution	Date (day / month / year)
URL:www.noa.gr	Email: zerefos@geol.uoa.gr	
Partner Number 3 National Observatory of Athens, Lofos Nimfon, Thisio GR 11810, Athens	 Prof. GS Zerefos President of NOA	21/02/2008



The below undersigning legal representatives of the participating entities in the proposal MSW-ATREUS for the ENV.2008 program (deadline for submitting the proposal : 25th of February, 2008):

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Partner number and name of institution	Name and Signature of legal representative and seal of institution	Date (day / month / year)
Website → www.bgu.ac.il	e-mail → resco@bgu.ac.il	
Partner No. 4 Ben-Gurion University of the Negev P.O.box 653, Beer-Sheva 84105 Israel	 Ms. Sharona Rittberg Director, Office of Sponsored Research Research & Development Authority	21/2/2008 Research & Development Authority Office of Sponsored Research Ben-Gurion University of the Negev P.O.B. 653, Beer-Sheva 84105, Israel

MSW-ATREUS 2008 / Consortium agreement files



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Partner number and name of institution	Name and Signature of legal representative and seal of institution	Date (day / month / year)
Website : www.eig.ch	e-mail: jean-marie.duret@etat.ge.ch	
Partner No Ecole d'ingénieurs de Genève (EIG) / Geneva Institute of Technology Rue de la Prairie, 4 CH-1202 Genève, Switzerland e i g Ecole d'ingénieurs de Genève	 Jean-Marie DURET, Director 	22/02/2008

Seventh Research Framework Programme (FP7) Important Legal Notice






Project MSW – ATREUS
Collective Proposal for FP7 – ENV.2008.3.1.3.2
MSW – ATREUS main → Municipal Solid Waste
 Advanced Technology in Recovery of Energy and Useful Sub-
 products

CONSORTIUM COLLABORATION AGREEMENT
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Partner number and name of institution	Name and Signature of legal representative and seal of institution	Date (day / month / year)
Website → www.perasgroup.com	e-mail → info@perasgroup.com	20 Febr. 2008
Partner No  Peras Group AG Roesstrasse 23 Wollerau, Switzerland 8832 Tel: 00 41 43 810 2643	 Steven M. Peras President	PERAS GROUP OF COMPANIES AG ROESSTR. 23 8832 WOLLERAU TEL: 0041 (0) 43 810 26 43



The below undersigning legal representatives of the participating entities in the proposal MSW-ATREUS for the ENV.2008 program (deadline for submitting the proposal : 25th of February, 2008):

11. agree to participate in the proposal,
12. agree that UNIVERSITY of PELOPONNESE (Tripolis-Arcadia-GREECE) will act as coordinator of the project and will nominate the person who acts as coordinator of the project,
13. will undertake and carry out the tasks allocated to us, if the proposal gets funding from EC,
14. will cooperate for mutual benefit and for the benefit of the project as a whole,
15. agree that all information received during the course of developing the proposal will be treated as confidential, and used only for developing the proposal, and implementing the project, if the proposal is approved.
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7. will report the coordinator timely any problem arisen.

Partner number and name of institution	Name and Signature of legal representative and seal of institution	Date (day / month / year)
URL:www.afc-tri.gr	Email: info@afc-tri.gr	
Partner Number 7 Arcadian Financial Consultants, 8 Ethnomartiron Str., GR 22100, Tripolis GREECE	Mr. George MALIFOUKAS  	19/02/2008



The below undersigning legal representatives of the participating entities in the proposal MSW-ATREUS for the ENV.2008 program (deadline for submitting the proposal : 25th of February, 2008):

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Partner number and name of institution	Name and Signature of legal representative and seal of institution	Date (day / month / year)
Website →	g.sigalas@americanoutlets.ro	
Partner No  Kallisti Extract & Energy Production (MSW) SRL *** 36, Londra Str, Sector 1, Bucharest - Romania	Mr. George SIGALAS 	20 Febr. 2008