Executive summary:

The EU trend towards concentration and intensification of livestock, in particular pig farming, has resulted in increased burdens related to waste management (increased water, soil and air ammonia pollution) as well as increased difficulties to adhere to EU environmental legislation. Consortium SMEs have identified a clear need to find a cost effective, carbon neutral way of eliminating inassimilable ammonia to prevent environmental pollution and reduce costs of waste disposal for the farmers. Most existing manure treatment processes do not eliminate ammonia from the waste. The proposed PLASMANURE technology transform excess ammonia found in pig waste into an environmentally neutral product in a simple, on-site, cost-efficient manner, without intervention of sensitive biological methods. The technology further enhances existing treatments by facilitating the oxidation of ammonia coming from pig manure into nitrogen gas and water vapour that can be released into the atmosphere, causing no negative environmental impact. The commercial objecive was to develop a cost-effective optimized plasma-catalyst reactor for manure wastes that will result in direct economic benefits and improve the competitiveness of consortium partners by reducing costs associated with ammonia fixing and separation strategies (pH control, stripping-scrubbing sequences, etc.) needed in manure treatment. By optimizing steps in waste processing, Plasmanure also results in savings on processing equipment and time. Plasmanure technology also significantly reduces the costs associated with regeneration of regions affected by acid rain and eutrophication and, combined with existing treatment systems, results in new market opportunities, and competitive product differentiation.

Project Context and Objectives:

The project context and the main objectives were:

- to significantly reduce the cost of manure,
- to create a new market for consortium members by developing an innovative technology that will enable the extraction of value from livestock waste in the form of reusable waste,
- to provide considerable savings in transport expenses which will be achieved since the disposal of pig manure into less critical regions will no longer be required,
- be expected to be applied primarily for livestock farmers but will also find applications in food waste disposal and general biomass disposal in food processing and commercial kitchens.

TECHNOLOGICAL OBJECTIVES

- Improve the NH_3 conversion rate of selective catalytic oxidation from 30% to 70% by means of the proposed enhancements in the catalyst composition and properties.
- To determine the best reproducible method of synthesis to produce the catalyst for use in the final industrial application.
- To design at laboratory scale a plasma system able to improve this conversion up to values greater than 95%, by means of its synergic effects in the SCO of the NH_3.
- The construction of a cost-effective plasma-catalyst reactor with a nominal consumption (below 100W) to generate minimum of 50W of plasma power. (WP3)
- This reactor will be able to operate continuously converting a flow rate of NH_3 gas of 50l/h (atmospheric conditions).
- In parallel to the validation of the technology in the partner facilities, establish theoretical parameters for potential use of the technology in pig housings and barns air cleaning systems.

SCIENTIFIC OBJECTIVES

- The study of the selective catalytic oxidation (SCO) of the NH_3 using chromium (III) -oxide as the main catalyst component.
- The understanding and determination of parameters (temperature, pressure, catalyst properties, etc) affecting the selectivity of such reaction in favour of N_2 formation, avoiding the generation of harmful nitrogen oxides (NO_x).
- The investigation of the synergic effects in the application of plasma energy to the selective conversion of the NH_3: decomposition of NO_x and the possible pig manure volatile compounds (VOC, organic acids, etc.) due to the formation of reactive species (ozone, atomic oxygen, hydroxyl radical) and to the required increase of the temperature to 300-500 °C.
- The study of conditions in which the plasma have to be generated in terms of power source, pressures and oxygen concentration to favour the stability and homogeneity of the plasma discharge for this specific application.
- To ensure a cost-effective operation optimized by energy balance of the proposed system.
- To set the optimal catalyst composition and properties (specific surface, particle size, shape) to improve the catalytic properties observed in pure chromium oxide for NH_3 conversion into N_2 and water.

TRAINING, DISSEMINATION AND EXPLOITATION OBJECTIVES

- The manufacturing cost of the whole pilot plant will be kept around 20k EUROS.
- The development of training activities addressed to the consortium SME members, first in pre-validation stage in order to ensure the understanding of the technology operation before the partners initiate the validation tasks.
- Technology transfer will be carried out to present the project results.
- To develop a sound dissemination plan to deliver 4 workshops, presenting the results of the project in at least 2 conferences, 3 specialised magazines and launch mailings to at least 500 SMEs.

Project Results:

A questionnaire has been prepared and sent out in order to collect more precise information of the market needs. The survey was carried out in two stage, one between 1 March and 31 August 2010, and a second one between 10 July and 31 August 2011. 178 answers were collected in the first one, and 338 additionally in the second one. The 516 answers were treated together. The market need was estimated upon the answers arrived. The critical points specification as well as the steps of implementation has been agreed upon the discussion of Consortium members including the needs of SME partners and knowledge of RTD performers.

The questionnaire was translated sent out to partners of the members of the consortum. Also companies around Europe were asked to fill in the forms. Due to the slow response time, the answers were evaluated at the M6 project meeting. The results are summarized in Deliverable 1.1.

The following general consequences were taken from the first Market search:
1. There are two types of business that treats pig manure: a. The framers, who holds the animals treats themselves the pig manure. In this case, the number of employees in the company is relatively high: usually between 25 and 50 or 50 and 250; The number of pigs are also high, e.g. more than 100, or 1000.

These companies use the pig manure as fertilizer after adding chemicals to it, they do not always monitor the quality. They do not willing to invest more than 10 €/t for a treatment of pig manure including all steps. b. In the other types of companies there activity is focused on a business other than animal breeding. They usually get the pig manure because the treating activity is outsourced from the farmer. These companies have low number of employees on site (less than 10) and must face to massive legislation rules. They would like to pay more, i.e. 20-50 €/t for the treatment if the method is environmental friendly and has low power consumption.

2. The legislation is usually an important pressure on the market. The maximum ammonia concentration, which can be released to the nature is 15 ppm per weight in most of the countries.
3. Using the manure as a fertilizer, after adequate pre-treatment, is a usual approach.
4. Direct financial support is usually not available, but the technology could be financed indirectly, if the economical and environmental benefits are justified.

The 178 answers received in the market survey were not found to be enough by the reviewer of the project in the assessment report. The consortium members decided to carried out further investigation with the same questionnaire. 338 additional responses were collected out of about 1000 companies targeted. The total number of answers was 178+338=516.

The main result of the survey taken in the second period was the same as the first one. The following differences can be noticed:
- The companies asked in the second period less favour recycling , 84% yes in the first 178 answers and 66% in total

- Approximately the same percent has a pig manure treatment facility, but more companies have experience in solid-liquid separation (43% vs 33%).
- Price became even a more important issue than previously

Beside the questionnaire survey, personal and telephone survey was carried out. OTSI mainly investigated Spanish partners using pig manure treatment methods. RIVA contacted their clienteles in Romania, BIOFOR and VDB approached pig farms in the EU but mainly in Greece and Spain (since the activities of VDB is also located in Spain). The aim of the survey was to learn about intentions of possible partners and learn about the possible business possibilities. About 30 different companies were contacted by this manner. No separate question list was prepared, the conversation strategy was selected by the partners, basically the topics of the questionnaire used in the survey were discussed.

The summary of the results of these conversations:

Spain

- The Spanish sample selected by OTSI typically has farm with interval 1000 to 5000.

This is the most economical size for big farmers in Spain.

- In Spain there is no legal pressure for lowering the ammonia gaseous emission. There is not any control in the farms for gaseous ammonia emission. There is a strict limitation in the effluent water (15 ppm)
- As a consequence of the legal requirements, the detection limit of ammonia in effluent water shall be some ppm but for the untreated manure hundred or thousand pmm is enough
- According to the experiences of OTSI, the costumers do not know how to calculate the cost of pig manure treatment, because the main income in Spanish plants is electricity produced and the cost of the treatment remains hidden by the profit.
- The OTSI sample corresponds to big farmers or manure processors, they can afford more than 50000 EUROS for the installation. For these companies, not the price of the device, but the return of investment is the main question.

Romania

In Romania Mechanical separation is the most commonly used technology for pig manure processing. The size of farms covers a wide range from about 50 up to 5000. The problem is different at different size. There is no regulation for gaseous ammonia release, but the so called environmental load tax must be paid for the effluent water. Despite thi fact the farmers do not care at all about the liquid phase, and hoping to escape from the taxpaying, however it is more and more difficult due to the sever control. The solid phase of pig manure do not cause any problem, and usually used as fertilizer or additive to composting, or biogas production process. The need in Romania is driven by more and more sever control and the increasing environmental load taxes. The market is very price sensitive and due to the different sizes scalability is a very important issue.

Greece

In Greece, in particular in Crete pig farms are relatively small with maximum few 100 pigs. No real attention is paid to pig manure treatment and most of the case it is deposited on the land without any treatment. The liquid content is decreased by evaporation of water. Similar to other countries, there is no regulation for gaseous ammonia, and it cannot be controlled. According to the experiences, the effort taken for the elimination of ammonia correlates with the possible controls and penalties. In those regions, where the ammonia concentration in effluent water is strictly measured, the manure treatment is more commonly dispersed.

The catalyst composition, particle size and surface area were measured and the sample was examined in the oxidation of ammonia. The laboratory test reactor system has been successfully implemented. The reaction temperature, effect of catalyst amount and the effect of oxygen flow has been examined. The introduction of air was necessary to obtain high conversion of ammonia. It has been proved that the temperature is the key factor in ammonia oxidizing process. The optimum temperature was found 300°C, where 98.7% of ammonia was oxidized without detection of any nitrite and nitrate ions. Other catalyst compositions were evaluated by mixing chromium oxide catalyst with different trivalent oxides (iron oxide and aluminium oxide). This change in composition was demonstrated to be useless since no increase on percentage of ammonia conversion was achieved. The effect of volatile organic compounds (VOC) was studied on ammonia oxidation over Cr_2O_3 catalyst. Presence of VOCs did not affect the catalytic activity of chromium oxide catalyst in ammonia oxidation. Ageing of chromium oxide catalyst was also evaluated from different points of view. Consecutive distillations of low ammonia flow (8 mg/h) over previously used catalyst produced the same conversion of ammonia (98.7%, at 300°C). Also higher ammonia flows were examined over the same amount of catalyst. At 1.5g, 75.9% of ammonia was converted when working with an ammonia flow of 210 mg/h, without any detection of neither nitrite nor nitrate ions. Higher ammonia flows (460 and 1210 mg/h) resulted in formation of NO_x species. Chromium oxide catalyst aged at room temperature for ten months showed no significant loss of activity since a 97.5% of ammonia was selectively converted to N_2. Accelerated aging of catalyst in the oven at 55°C presented a minimum loss of activity of 3.3% since a 95.4% of ammonia conversion was achieved.

An alternative synthetic route to produce chromium oxide catalyst has been developed by precipitation of chromium hydroxide and post6thermal treatment, and compared with thermal decomposition method used earlier, from different criteria point of view: synthesis method difficulty, effectiveness on ammonia conversion and cost evaluation of raw materials. From all aspects thermal decomposition procedure was superior to precipitation and it was established as the optimal synthesis method. Moreover activity of commercial chromium oxide has been evaluated in comparison to thermal and precipitation catalyst activity. It has been proved that effectiveness of commercial chromium oxide catalyst is much lower than both synthesized catalysts. Repeatability of catalyst synthesis by thermal decomposition has been proved by producing three batches of chromium oxide with high yield with similar characteristics.

For the pilot scale catalyst production a stainless steel reactor was designed. The catalyst prepared by this equipment was put in the the pilot plan constructed in Task 4.3, the performance was reported in Deliverable D4.3. The target described by Milestone number 2 was successfully reached: a reproducible catalyst synthesis method was developed, and a value of 98.7% ammonia conversion was achieve, compared to the targeted value of minimum 70%.The system specification of the plasma reactor was determined. The pressure range of the plasma reactor was defined as 0.1 barless thanpless than1 bar, preferably around p=0.25 bar, and temperature range as 100°Cless thanTless than250°C, preferably around T=150°C. The glow discharge method was selected for plasma generation using a tubular design, developed by Plasmaclean Ltd. The power supply for the PLASMANURE system was designed to be tunable between 30 and 150 W. The mechanical and electrical design of the plasma reactor was presented. The optimization and characterization of the effect of tube sizing and plasma power was presented in details. It was found that the most reliable design is the usage of tubes with 28 mm diameter with 120 mm electrode length. At this setup the ammonia conversion can be tuned by the plasma power. This size is the optimal for the prototype system and combination with the catalytic reactor, since both the ammonia conversion and the amount of NOx can be varied at large scale. The effect of possible contaminants, VOCs abd solid particles were studied. The presence of VOCs did not result in pronounced effect, but the presence of solid may reduce the efficiency of the plasma power.

The assembly of the plasma unit was carried out in the following way: The matching box was designed to create a separate and compact unit for the plasma reactor, which can be simply integrated into the mechanical frame of Plasmanure prototype and its control software. Due to the special size and inner shape requirements a customized box were designed and fabricated. The machining was made by laser cutting, the inner holder pins was fixed by spot welding and after the fabrication the whole box was paint with grey sand paint. The inner parts of the plasma reactor unit were designed parallel with the matching box design and fabrication. The inner subparts integration was broken into two categories: mechanical fabrication of the vacuum chamber and the electronics integration. As regards the vacuum chamber, three side connectors were planned in order to connect the plasma reactor electrically, to connect a standard K-type thermocouple and to have a view port to observe the plasma discharge. The material of the tube is stainless steel which selection was important due to the flowing heavily corrosive gases that can easily oxidize other materials like steel or aluminium. The inner width of the matching box was made exactly to the same size as the length of the vacuum tube. The viewport is attached to the side of the plasma reactor unit. For the electronics integration, before the assembly of the matching box every electronic part was measured and computer modelled in order to paste it into the 3D design of the matching box. After the fabrication of the matching box and fixing the parts the connection was made according to the wiring diagram. Terminal blocks and standard cable hulls were used and fixed with screws and nuts for flexible assembly. Deliberate measurements were taken for the second issue after connecting all the steel surfaces to the protecting earth of the input filter. Nor the chamber neither the matching box charged up during the tests, as proved by measurements. After the assembly, a six hours long stability test was made in the laboratory of MFKK using air. The stability was also made in model ammonia flow: 5 w% ammonia solution was used to model the pig manure. The system was continuously running for 4 hours without any interruption at maximum power (150W). The integration of the plasma system to a matching box did not affect the plasma performance observed earlier. A "Prevention Action and Installation Guide" was prepared for safety cautions. The plasma reactor unit for PLASMANURE was designed to be adequate as much as possible for several standard compatibilities. After the plasma reactor unit was completed, it was sent to CRiC for integration into the PLASMANURE prototype. The unit arrived in Barcelona before the M18 meeting held in Barcelona on the 21st October 2011, where SME partners were trained for the operation of the PLASMANURE device. The installation guide and the prevention actions were explained and discussed.

The information gathered, and the conclusions/decisions made have been taken into consideration for the WP4 development. In order to achieve a competent and reliable pilot plant, the design of the equipment has been carried out according to the criteria of 4 different areas, without forgetting to minimize the cost as much as possible.

Thermal Design:
Energy balances, calculation of heat losses, basic sizing of the condenser...
- Hydraulic design:
Optimum flow speed, pressure drops, fluidized bed, vacuum conditions...
- Mechanical design:
Tanks under vacuum conditions.
- Material Design:
Corrosion, temperatures, chemicals, strength
Pipes, evaporation vessel, tubular electric heater, plasma reactor, catalytic reactor, condenser, cooler s, valves along with auxiliary equipments (sensors, connectors) were calculated, designed and constructed or selected from commercial sources.

For the control equipment the system architecture was defined by characterizing the system's control strategy, including control architecture, the controller software configuration, the different control loops (relation between input and output along the system) and the communication protocol.

The integrated software integrated was presented, being mainly represented by the user's interface and the possibilities which offers. The operational for Start-up and Shut-down regimes was done and the power electronics diagrams were designed.

THE PLASMANURE prototype, including the Plasma reactor, was initially modelled in CAD in order to simplify the procedure of manufacture ordering, and also provide a general overview and detail its overall dimensions.
The pilot plant was setup with the following innovations:
Piping: For obvious reasons the pipes has been modified accordingly to the new equipment and special distribution of the prototype.

Catalytic reactor: Initially was placed in a vertical position, however, the catalyst packs offering a big resistance to flow. Similar to IQS experiments, the catalytic reactor was placed in a horizontal position. Furthermore, different simulations were carried in order to acknowledge better the inner reaction. This simulations are beneath presented.

Air introduction: The new positioning of the catalyst reactor has moved the plasma reactor to a upper position, therefore the air introduction has been also displaced.

Pressure control: The vacuum pump and the solenoid valve were control by means of the pressure sensor placed at the condensate tank. This situation has led to a non-accurate control of the evaporation temperature. Now the pressure is controlled by means of the pressure sensor installed at the evaporation vessel output, achieving a more stable system.
Condenser: The condenser was designed based on a numerical estimation; however the equipment showed poor performance. For that reason, an oversized equipment has been designed and finally built.

In order to stimulate the catalyst's activity and also to avoid steam condensation, the catalytic reactor is covered with a heating blanket that allows heating up till 300°C, temperature that has been proved to be the optimum one to enhance the reaction.

The catalyst was charged manually, mixed with inert ceramic balls (supported by a drilled plate and a small piece of fibre glass) that will facilitate the steam transport through the horizontal pipe. The condenser is built by a condenser coil placed inside a pipe, and closed by two flanges welded in each end. The housing is attached to the other pipes by two others flanges that include the steam inlet and the condensate outlet.

The steam is running inside the pipe, while the tap water acts as the coolant through the internal coil. In order to enhance the condenser performance, the design considers an empty tube placed into the middle of the coil that forces the steam to flow closer to the coil and increase the contact with its cooling surface. The cooling system is equipped with a thermometer monitoring inlet water temperature, a flow-meter, and a temperature sensor monitoring the outlet temperature. With these values an energy balance of the system could be calculated indirectly. Air gases are released from the system by sucking them from one of the upper connections placed at the condensation tank. The pipe is connected to a solenoid valve, and the valve in turn is connected to the vacuum pump. The pump and the valve are programmed to start and open with a small delay, so once the valve opens, the pump is providing vacuum immediately.

Laboratory validation trials were performed to characterize the behaviour of the PLASMANURE prototype.

These trials have been constructed from a bottom-up manner, testing each part separately, and assembling them together and fine tuning the final outcome. For laboratory validation consecution, a test rig was prepared to characterize equipments performance. The industrial NH_3 flow has content between 600-800 ppm, so for the preliminary trials a 1% solution was prepared, from concentrated NH_3 (30%). An 8 litres solution was diluted to 1,000 ppm and introduced to the evaporation chamber. Once the ammonia dilution is evaporated, it remains in vapour conditions and does not condensate (Boiling point at 240K), therefore it will be liberated to the atmosphere by means of the vacuum pump. Also a hypothetic formation of NO_x will be also released to the air. In order to avoid this undesirable and healthy risky compounds liberation, a 3% Boric acid solution was prepared, and the outlying gases was bubbled through. Boric acid reacts with both ammonia and nitrogen oxides, forming solubilised NH_4^+ the first, and nitrates and nitrites the later, which also keeps trap into the water. Ammonia presence was quantified in the initial solution, and once finished the test rig, in the liquid remaining into the evaporation vessel and within the condensation tank, by valorisation with Chloric acid (0.115N). Phenolphthalein indicator was used upon water and Tashiro indicator was used upon Boric acid. Comparing the ammonia presence, the reaction conversion was acknowledged. Nitrites (NO2) or nitrates (NO3) presence was also studied, employing Griess A and Griess B indicators. These indicators turn red on the presence on nitrites. In case that nitrites are not present, Zinc shall be introduced in order to turn nitrates into nitrites and also identify them by the Griess method. Catalyst size distribution is an average of 43 µm, therefore a 20 µm FRITS was placed in the inlet and outlet of the catalytic reactor in order to avoid the appearing of catalyst all around the system. A significant part of the particles could pass through the 20 µm FRIT, but softer classification will lead to huge head loss within the system. In fact, this is the counterpart; with the stainless steel filter installed vapour flow gets significantly diminished by opposition to flow that it is being created. Nevertheless, the small volumetric flow gets compensated by a considerable mass flow. Laboratory Plasmanure prototype works similar to a distillation system (completed by the plasma reactor and the catalyst reactor), so ammonia distils first and the vapour leaving the evaporator is mainly ammonia. The system was pre-heated during one hour before starts, getting the plasma reactor and the catalytic reactor at process conditions before the evaporation takes place. Following the same line, the system is maintained hot during half an hour after the end of the experiment, aiming to skip condensations inside pipes, equipments or instrumentation.

RTDs have discussed together how it would be the better approach during laboratory validation. The steps that were followed

A. Catalyst reactor testing
1. Charge only water and check that the system is vacuum tide (vacuum pump switched off)
2. Evaporate ammonia solution without catalyst with vacuum, to obtain the blank
3. Introduce ammonia solution with catalyst with vacuum, to obtain conversion rates (as well as flow rates)
4. Changing the pressure, temperature and catalyst amount

B. Plasma reactor testing
1. Trial functionality of the plasma unit after assembly
2. Without catalyst, without water vapour but with plasma in atmospheric conditions – trial of the plasma unit under atmospheric cond. and check the functionality of plasma
3. Without catalyst, without water vapour and with plasma in vacuum – trial of the plasma unit under vacuum conditions and check of the functionality
4. Without catalyst, without water vapour but with plasma with Helium, Argon and/or Oxygen – trial of the plasma unit under pressure and additional gas and check of the functionality of the plasma unit
5. Without catalyst, with water vapour and the plasma is already built up – trial of the plasma under vapor conditions

C. Plasmanure tests
1. With catalyst, with water vapour and the plasma is already built up – full system lab test
2. With catalyst, with water vapour and the plasma is already built up + Ammonia is inserted – full system chemical laboratory testing

Catalyst reactor tests

1. The system was rinsed with water, and the heater elements forced evaporation. The vacuum pump was maintained switched off in order to increase the pressure. Some leakages were identified (vapour was released) and there were fixed in order to have a vacuum tide system.
2. The Blank was studied, to know how the system interacts with ammonia without interferences (plasma & catalyst). At IQS certain amount of ammonia was released "lost", however in this case all the ammonia evaporated was finally present at the condensation tank. Therefore the blank was zero. The main reason is that working under vacuum conditions, in the hypothetic case of a leakage, only air will enter into the system; no ammonia will leave out.
3. Ammonia solution (1.000 ppm) was introduced in presence of catalyst. The reactor was completely filled with 13g of Chromium oxide catalyst. Process conditions were 75°C @ 0.25 bar. Volumetric flow was small 89,22 l/h in gas phase, while mass flow was 0,495 g/h. All the ammonia was converted, so the conversion was 100%.

Plasma reactor tests

1. Plasma unit started to produce sparks between outer and inner electrodes, providing a non-stable plasma discharge. For that reason, MFKK and CRIC teams joined together to disassemble plasma reactor, and fix the parts involved. The actions carried were mainly:
- Construct an outer Teflon electrodes cover (Teflon shows a dielectric of 50kV per centimetre)
- Rewire the inner electrodes, covering them with an isolation handling 150°C @ 35kV

After reassembling the functionality of the plasma reactor was tested, getting the initial behaviour.

2. Once the plasma reactor was operative, was integrated within the Plasmanure prototype. The first conditions to be tested were run the system without catalyst, without water vapour but with plasma in atmospheric conditions. In the experiment was introduced 1l/min of pre-heated air, in order to provide plasma with oxygen (as will be also needed in the latter catalytic reaction). The plasma engaged normally, and Ozone generation was clearly due the smell.
3. Next step was to test the plasma under vacuum conditions, and the system reacted satisfactorily with air and under vacuum conditions. It is well known that glow discharge plasma engage easily under vacuum conditions. Again, Ozone was present during the experimentation.

4. The goal of applying plasma to a water vapour was indeed difficult. The dielectric barrier for water is 500kV/cm2,1, while actual power supply offers 15kV. Therefore, in order to check the viability of plasma (we have seen that only with the catalyst, the conversion rates are very competitive) the introduction of inert gases, such as Helium, Argon, Nitrogen and Oxygen, is an effective way to change electron density in a low-pressure plasma discharge. It is also an effective technique to enhance the production of certain active species. VUV emission spectroscopy, is a useful tool to determine relative concentration of ground-state active.

Partners discussed on how to proceed, and considering their wide experience cumulated on Dielectric Barrier Discharge (DBD) plasmas and current literature on the field, they decided to work only with Argon and Helium accompanied by Oxygen, as a limiting reactant during ammonia oxidation reaction.It has to be said that in the initial experiments, plasma emitted light in the visible spectrum. However, after first hours of operation, the light emission disappeared. The system kept working (Ozone was identified), so the hypothesis is that the system is producing punctual discharges (sparks) instead of glow discharge. UV-Vis spectrometer was installed, in order to study process emission; certain peaks were identified in the range of 300-400 nm. It has to be supposed that these peaks correspond to NOx generation.

5. The experience with water vapour was not satisfactory. Once the water vapour started to flow within the plasma reactor, Ozone presence starts to disappear. Bigger flow rates meant less ozone up to their extinguishment. Possible causes are:

(i) water dielectric breakdown value;

(ii) tension is liberated before it reaches the glass electrodes

(iii) water corrodes some elements, so their current resistance increase;

(iv) accumulation of vapour condensation on the inner glass tubes.

Plasmanure tests

1. Experimentation with catalyst, water vapour and plasma. There is no certainly plasma engagement under vapour conditions.
2. Once introduced ammonia, some considerations had to be made. The extremely good performance shown by the catalyst alone (100% conversion) does not leave space to improvement, so plasma enhancement could not be quantified (in case of exist). The first action was decrease catalyst amount, leaving the catalytic reactor partially empty, therefore water molecules could pass freely through the system, only reacting with the catalyst surface. Even under this unfavourable situation, 76% conversion (79,31 l/h gas; 1,05 g/h ammonia @ 0.3bar; 75°C) was reached on average during the experiences. In the future experiments (beneath explained) the plasma interaction was be studied. Another interesting point to mention is that non-reacted ammonia was not trapped by the Boric acid contained in the evaporation tank, so left the system through the vacuum pump. Probably vacuum pump creates bubbles in a very energetic regime, so the ammonia has no time to diffuse and react with the boric acid. As temporally solution, another boric acid solution was placed at the vacuum pump impulsion, and all the ammonia got reacted.
3. Future testing: The experimentation has to be broadened during industrial validation. In order to reach the results expected, plasma has to be assured, and compared with the catalyst combination to study the potential improvement. It will be also desirable increase the volumetric flow whenever possible.

Field test validation at OTSI:

Test I

Plasma + Catalyst: In order to avoid the compression of catalyst (deeply explained at D4.4), an small quantity of catalyst was introduced inside the catalyst reactor (10 grams). However, the conversion achieved in this test was only 6.6%, which indicates that the catalyst quantity was too small, and permitted free pass of the ammonia through the reactor. In general, ammonia and air did not got a good contact with the catalyst.

Test II

Next test relied on the search of a baseline, to characterise the plasma effect on the reaction. Therefore, a higher amount of catalyst was placed, but still leaving a free space inside the catalytic reactor. Results shown a conversion of 20%, better than in the test I, and valuable to compare in the further test with plasma. the average a flow rate was 152mL/h.

Test III
This test was performed maintaining catalyst conditions of test II but adding plasma, as it was above mentioned, aiming to acknowledge plasma improvement towards ammonia conversion.

Test IV
Something else to be tested, and comparative to IQS tests, a completely full reactor test was performed. With this configuration, the flow rate decreased until few ml/hour. Moreover, difficulty on air circulation created a high pressure before catalyst reactor, therefore a poor quantity of O_2 was introduced causing low conversion in the test (O_2 is the limiting reactant).

Tests at CRIC

Test I
These tests were performed with filled catalyst reactor and without plasma. Conversion decrease from 13% to 0% in tests. The hypothesis is that solid suspended particles and organic matter have deposited and stick on the catalyst surface. This effect was observed also during industrial validation.

Test II
After the results seen in tests I and the hypothesis that solid suspended particles and organic matter have deposited and stick on the catalyst surface, the catalyst was washed with a Hydrogen Peroxide, as had done with FRITS in OTSI facilities, in order to eliminate these particles and recover catalyst effectiveness.

Test III
In order to recover catalyst effectiveness, this one was changed for a newer and the test was repeated. In addition, the catalyst was mixed and introduced in the reactor with ceramic balls trying to increase flow rate. Temperature used in the evaporation tank was a bit lower that in test I.2 (80°C versus 83°C) and the flow rate a little higher (44ml/h versus 20ml/h). So, ceramic balls slightly increase flow rate.

Test IV
These two tests were performed with the same catalyst conditions than test III, but introducing plasma, in order to study again plasma benefits in ammonia conversion.

In WP5, further application of the PLASMANURE system in alternative sectors were reviewed.

The final technological results of the project are the following:

- An integrated pre-competitive PLASMANURE prototype
- A catalyst able to selectively oxidize ammonia to water and nitrogen
- A plasma reactor unit

Main S & T results/foregrounds

- The developed PLASMANURE technology majorly improved the NH3 conversion rate of the selective catalytic oxidation (SCO), as the selective oxidation catalyst that was developed can convert 98% of the ammonia. For the overall system, the requirement was 95% in total, and some results reached even 100 % under certain circumstances.
- The consortium developed a chromium base catalyst and designed, built a catalyst synthesis reactor for mass production the catalyst. The catalyst is more effective and cheaper than state-of-the-art one.
- RTD partners designed and built a laboratory scale plasma system which is now able to improve the ammonia conversion up to values greater than 95%. The Consortium reached over 98% in laboratory scale.
- The Consortium designed, constructed and validated a cost-effective plasma-catalyst reactor system with a nominal consumption of 150W to generate the plasma power.
- The overall system is able to operate continuously converting a flow rate of 420 l/h gas flow with NH3 (under atmospheric conditions).
- The project established the principles for further applications of the PLASMANURE technology, opening up new market possibilities for consortium SME members by developing a chromium oxide catalyst able to oxidize selectively ammonia to nitrogen and water, a technology that will not only enable the extraction of value from livestock waste in the form of agricultural reusable waste, but also opens up new market possibilities to consortium SME members, where ammonia treatment and disposal is important (like semiconductor production, biogas treatment, food processing waste management, livestock related processes etc.)
- The developed technology overall reduces the cost of liquid manure treatment and provides savings in transport expenses, as the placement of liquid manure will be less cost sensitive.

The PLASMANURE system as a whole will be a possible alternative technology for ammonia treatment in agricultural residual water, treated now with distillation and stripping. Its wide application would significantly reduce not only the cost of pig manure treatment but also its environmental impacts, further the technology is capable to convert the unpleasant odour accompanied of pig breeding.

The catalyst itself can also be a possible "stand-alone" product which can be used in the chemical industry, wherever the problem of selective oxidation of ammonia to water and nitrogen may occur. The material cost of the chromium oxide catalyst developed within the project is 86 €/kg which is much more favourable than the price of 1056€/50g of ruthenium-titanium oxide catalyst currently used for the same purposes. SME partners of the consortium are planning to commercialize the catalyst as it considerably reduces the price of ammonia oxidation. The plasma reactor, as it is, can be used for odour treatment too, especially in livestock farming.

Potential Impact:

The objective of this report is to present the discussions and agreements between the Parties, in particular the SME participants, for the dissemination and exploitation of the results. The individual interests of each SME partner in the consortium have also been taken into consideration. The SMEs are satisfied with the work carried out by the RTD performers and the generated foreground; hence the results of PLASMANURE have both technical/scientific and commercial value.

All the work related to the exploitation has been collected in the present document which can be split into 3 main parts:
- Plan for the Use and Dissemination of the Foreground (PUDF)
It aims at collecting the individual intentions of each partner with relation to the exploitable results of PLASMANURE and it follows the requested format set by the EC. The final Dissemination and Use Plan was presented in M24 and describes the participants' actual achievements in dissemination and their plans at that time for utilising the results.

The PUDF covers the following aspects:
- Results of the project in relation to specific potential applications.
- A record of the development of the results, and a description of the needs for further development.
- The commercial, social or scientific validity of the results and an assessment of their dissemination
- A record of the role of each partner in the dissemination and their exploitation of the results
- An assessment of the requirements for other potential collaborators.

- Joint Ownership and Exploitation Agreement (JOA)
It aims at detailing the agreements between the SMEs regarding exploitation issues and the procedure to follow. In order to identify any potential exploitation discrepancies among the partners, the basic terms of the exploitation were discussed in the first year of the project and were finalized at the end of the project.

It states that the SMEs are the joint owners of all results, information, data and know-how generated by the PLASMANURE Project, all in accordance with the rules applicable to the Project. The purpose of the JOA is to establish the terms and conditions under which the SMEs will handle the joint Foreground and detail the terms and conditions for granting licenses to third parties. The JOA regulates the exploitationrestrictions, licensing arrangements and protection of the intellectual property generated within theproject, and the procedures for disseminating results. Even though the Consortium Agreement (CA)defines the basics of the above mentioned topics and provides general procedures, the JOA fully complements and details these issues from the point of view of the exploitation.

- Business Plan (BP)
It aims at summarizing all the information collected by the partners during the project's life related to the initially envisaged business model. Before the start of the project and during the meetings organized over the course of the project, the partners analyzed the business perspective of the PLASMANURE product then further detailed the schematic business plan drawn in the DoW.

Dissemination report

The PUDF intends to make clear how the partners, both as a consortium and as individual organizations, intend to use and disseminate the results of the work. All dissemination activities have been carried out with the approval of all partners and in due observance of confidentiality obligations for project results that are protected as trade secrets.

The scope, measures and the time scale for dissemination and transfer of the technology to other organizations are included in WP6, "Facilitating the take-up of results".

The dissemination plan designed by the partners guaranteed both an effective promotion of the technology and the communication of the results to a wide audience, various key stakeholders and in general to the public and ensure its success. The partners have jointly contributed to the dissemination of the results through different events, fairs, exhibitions and publications.

1. The primary dissemination channel has been the project website (plasmanure.eu) which provides general information about the Project, a description of the partners, the major objectives and news. The website also contains a restricted section in order to facilitate exchange of information and communication between the partners. Newsletters on the website have been keeping subscribers and people interested in the project progress up-to-date.

2. PCL has had the http://www.plasmanure.com commercial website designed and is specifically targeted at reaching potential clients who would like to order the device itself. The main purpose of the website is to support sales.

3. BIOFOR has contributed to the creation of the PLASMANURE flyers that were distributed at the project related events consortium members took part in

4. RIVA has initiated the design of the poster which gave information on the project to the audience and people interested at the events

5. MFKK had an article published on the project in the Hungarian Agrárium agricultural magazine published that came out in May, 2012 in 13000 copies and an additional 5000 copies were distributed at the Hungarian Animal Raising Days held in the south of Hungary in May and at the RENEXPO International Energy Trade Fair in Budapest between the 10th and 12th of May. The latter event is Hungary's largest and most significant annual event on renewable energies and attracted exhibitors from all Central European countries.

6. Mr. Attila Uderszky and Dr. Wootsch Attila from MFKK gave an interview for the International Innovation Magazine which is one of Europe's leading portal for scientific dissemination

7. MFKK disseminated the preliminary results of PLASMANURE project at the Innovation Workshop organized by the Eötvös Lorand University in Budapest on the 23rd of February 2011.

8. Dr. Attila Wootsch from MFKK presented the scientific achievements of the project at the Hungarian National Chemistry Conference on 22-25 May 2011

9. MFKK attended the FARMER-EXPO in Debrecen, Hungary between the 18th and 21st of May, 2011 which is an annual International Exhibition of Agriculture and Food Industry which usually attracts between 25, 000 and 30, 000 visitors and is a great platform to stay updated on the latest technology related to animal raising and provides an excellent opportunity for business meetings between farmers and technology providers

10. The posters of the project were taken to the BVV Trade Fair in Brno, The Czech Republic which fair aimed at presenting the latest environmentally friendly technologies used in agriculture with a special emphasis on biogas and the animal manure treatment.

Exploitable Foreground

The Exploitation Board, consisting of representatives from each SME partner and chaired by the Exploitation Manager (PCL), was responsible for the exploitation management of the project and for drawing an exploitation strategy.

At the start of the project initial plans were made on how to exploit the results but at that time it was difficult to judge the outcome. During the project development further investigation was done to find the possible ways the results can be exploited both in terms of protection and in a business sense.

A number of options were reviewed and at the end of the project the consortium decided to file for a trade mark for the name PLASMANURE as the first step to protect the future product, the PLASMANURE system as a whole should be protected by an industrial design protection, the catalyst preparation method, the catalytic material and the PLASMANURE reactor by a trade secret and as during field test experiments it was found that the plasma reactor enhances the conversion of ammonia the partners are planning for a Demonstration project in the future that will bring two additional future results such a new Plasma reactor unit that would be innovative enough to be patented and an new integrated industrial Plasmanure prototype that would be handled as industrial design.

Protection of foreground processes

The SMEs held discussions at several project meetings regarding the protection of the innovative elements within the Plasmanure technology before any communications with third parties or pre-exploitation activities were implemented.

The SMEs are well aware that the development of a new product can be only successful if the IPR protection is secured. The IPR system plays a significant role in helping businesses gain and their competitive advantage. The IPR strategy may differ depending on the results to exploit, but effectively used innovative technologies have a better chance of successfully reaching the market. IPR plays an important role in providing access to finances and investors. It can provide a strong negotiation position when it comes to entering into business partnerships.

The protection of PLASMANURE by a patent was the first option that the consortium investigated, considering that patent protection is solid and provides a clear competitive advantage to its owners (the SMEs). At the same time, patents can only be granted for inventions which are new, imply an inventive step and are capable of industrial application. After thorough patent search the partners concluded that the partners concluded that the integrated pre-competitive PLASMANURE prototype cannot be patented, however it most probably would fit to gain industrial design protection. Nonetheless, the new plasma reactor planned to be developed within a demonstration project will definitely be granted by patent. The partners also consider filing for a patent for the Cr_2O_3 catalyst. According to the current patent search it is novel enough to be patented.

The industrial design is defined as "the appearance of the whole or a part of a product resulting from the features of, in particular, the lines, contours, colours, shape, texture and/or materials of the product itself and/or its ornamentation". It can be protected if they are novel, if no design identical or differing only in immaterial details has been made available to the public. Moreover, they have individual character that is the "informed user" would find the overall impression different from other designs which are available to the public. The would-be "integrated industrial prototype" will be filed with industrial design, too.

The third option for protecting the technical aspects of the technology (instead of or complementary to a patent) is the trade secret. According to most national legislations in the EU, trade secret protection applies for information which has a specific commercial value (and that is the case of the PLASMANURE technology and the know-how for its operation) and provided that its owner takes concrete steps for protecting the secret. In this regard, all partners of the PLASMANURE consortium are aware of the importance of treating confidential information as such; all publication and other dissemination activities have been revised by the Exploitation Board in order to ensure that key information regarding the Foreground will not be available to third parties; and the Exploitation Board is ready to provide the partners with a confidentiality agreement to be signed with any third parties (such as potential licensees or collaborators) which may have access to confidential project results.

As a first step in the IPR protection the SMEs have registered a trade mark (Plasmanure) to protect the commercial sign under which the system will be offered on the market.

Business plan

Before the start of the project and during the meetings organized over the course of the project, the partners analyzed the business perspective of the PLASMANURE product then further detailed the schematic business plan drawn in the DoW. This business plan along with additional information which was gathered by the partners is presented here.

The product

As proposed in the DoW, PLASMANURE has been a novel plasma-catalyst reactor for the total conversion of the ammonia contained in pig manure into environmental neutral products. At the end of the project a pre-competitive prototype was given to the disposal of the SMEs. This prototype aims to meet all technical and economical objectives given by the DOW. This prototype, its design and production documentation includes the information necessary for the demonstration phase. The marketable system in mass production will consist of an own-developed plasma reactor unit and a catalytic reactor unit.

The market potential
In order to survey the user acceptance and the needs of the market a brief market analysis was made in the first half of 2010, as Task 1.1 in WP 1. The results of the survey were presented in Deliverable 1.1. The results of the survey confirmed that PLASMANURE will be a real alternative in pig manure nitrogen conversion.

The partners analyzed the business potential together. Special attention has been taken to Spanish market because of the following reasons:
- Spain has approximately 20 % of all pigs in the EU
- As in many regions in Europe, eutrophication is huge problem in Spain, due to the high nitrogen level in soil.
- The consortium members has large business interest in the Spanish market: 3 Spanish members (OTSI, IQS, CRIC) and pig farms in Spain (VG)
- Pig manure treatment plants with energy co-generation operates in Spain
- Spanish market and solution may serve an example for partners from other countries, e.g. in Romania (RIVA) and Greece (BIOFORUM)

Cost-price calculation for the PLASMANURE technology
The cost of the realization of the prototype unit was carefully tracked during project. The overall cost of the prototype is calculated to be 12 966 Euro however, as the nominal flow rate of this device was 420 l/h (gas at atmospheric pressure) at the final meeting the partners agreed that this flow rate could be further increased by some construction modifications, these developments will include:
For the plasma reactor:
- Increase power: in order to increase treatment capacity with plasma.
- Electrodes design: improving electrical connection (avoiding sparkling)
- Air introduction system: distribute air within plasma reactor to improve plasma stability.

For the Catalytic Reactor:
- Fluidized bed (vertical) with very low pressure drop, increasing the contact between catalyst and ammonia,
- Or alternative a cartridges configuration to force that ammonia circulate through catalyst and increase their contact.

The estimation of the consortium is that these modifications will increase the total flow rate to approximately 10 times to ca. 5000 l/h.

On the other hand this system would be scalable to a size applicable directly in industrial scale. This scale is described in detail in D1.1. In one of the existing Netporc® plants located in Olmedo, Spain, where the field tests were carried out (D5.1), the total flow rate of the condensate is 5 t/h, containing 400 - 600 ppm of ammonia per weight. It means ca. 2.5 kg ammonia in one hour. This amount equals to 147 mol meaning ca. 3500 l gas in one hour. The prototype was tested both with distillated flow and direct connection with the OTSI device. During the distillation, at the beginning, very high ammonia concentration goes through the reactor, which is decreasing continuously during the reaction. In the industrial application the ammonia is also distillated continuously. The gas phase concentration of the ammonia is relatively high, but the vapor always contains water. After a detailed technical discussion the partners considered that for this industrial size application the scale must be further increased. For example, much larger amount of catalyst must be used for the durable, stable application. Ten times more material cost was calculated. The size of the plasma chamber was calculated as double for the safer development. The total cost of such scale up unit was estimated to be 37 360 EUROS (see "sacle-up size unit" cost).

Further, all partners agreed that serial production reduces the cost of the equipment by about a factor of two. After a very detailed discussion and estimation procedure a cost of 20 310 EUROS was estimated for the industrial size unit.

According to the suggestion the SME partners at the final meeting, the margin of 30% would be acceptable. According the original proposition, the DOW document, the production price of the final device the sales price is estimated to be 25.000 EUROS. As seen in the table above, based on the calculation described, a sales price of 26 403 EUROS can be estimated.

The consortium members are convinced that the PLASMANURE technology is a real potential alternative of the existing method used currently for the reduction of ammonia.

According to their careful estimation the following financial plan was projected by the consortium for the first 5 year of market entry:

Potential markets 2014 2015 2016 2017 2018
nr of pig farms in EU251 1 431 592 1 417 276 1 403 103 1 389 072 1 375 181
average size of stocks in EU252 90 90 90 90 90
average nr of pigs in EU25 128 843 270 127 554 838 126 279 289 125 016 496 123 766 331
pgis for slaughtering 1000t
tons3 18 941 18 751 18 564 18 378 18 194
average manure in t/day 883 879 875 040 866 290 857 627 849 051
average manure in t/y 322 615 927 319 389 768 316 195 870 313 033 912 309 903 572
average performance of a treatment plant/y4 40 000 40 000 40 000 40 000 40 000
maximum market of Plasmanure device 8 065 7 985 7 905 7 826 7 748
targeted manure treatment market share 0.002 0.01 0.02 0.03 0.05
targeted air clean in housings market share 0 0 0.01 0.02 0.03
nr of sold Plasmanure device 16 64 173 218 402
Income at 26 403 EUROS per unit 425 901 1 682 311 4 579 079 5 752 214 10 612 554
Profit @ 30% of sales 127 770 504 693 1 373 724 1 725 664 3 183 766
savings in EUROS over the treatment of 1t manure 1.747 1.747 1.747 1.747 1.747
total savings in EUROS in Europe in EUROS 1 127 220 4 452 519 12 119 306 15 224 206 28 087 917

In total the partners plan to reach the following financial results:
Nr of sold Plasmanure device 873
Income at 26 403 EUROS per unit 23 052 059
Profit @ 30% of sales in 2 305 206 EUROS

Beyond the profit to be gained by the consortium SME the European-wide impact of spreading the Plasmanure technology will be measurable in savings in total of 61M EUROS.

Plans for future implementation
The Consortium decided to look for further and alternative ways of usage of the equipment. All the SMEs, the owners of the project results are involved in the exploitation. However, the commercial phase will not start earlier than 2015 with regards to the fact that the present prototype cannot be used as a reliable system as it stands. After considering the project results, the members agreed in following the policy below:
- By using supports from different resources (private and public), the system is planned to be improved
- SME partners also accepted to prepare an application for demonstration call of FP7 this autumn
- According to this decision of the SME partners, the present prototype will be transported to OTSI for further test.

Private funding: Several possibilities does exist from family money, business angels till venture capitals. However, at this stage, and considering the results achieved, look for European funding seems the most convenient choice.

Public funding: Like in the private world, there are plenty of public funding schemes. Local and national funding shall be studied by each project partner individually, as it will significantly change from country to country, from site to site. As it is a trans-national consortium, the European funding shall appear as the easier way to architecture a fruitful proposal. The possibilities initially envisaged are:

EUREKA/EUROSTARS
This programme currently counts 39 members including European Communities. Several European countries participate in EUREKA cooperation through a network of National Information Points.

EUREKA individual project is market-oriented R&D project labelled by EUREKA based on its bottom-up approach and involving partners from at least two EUREKA member countries, often SME-led. Through a EUREKA individual project its consortium develops new project, technology and/or service for which they agree the Intellectual property rights and build partnerships to penetrate new markets.

The Eurostars Programme is a European innovation programme managed by EUREKA. Its purpose is to provide funding for market-oriented research and development specifically with the active participation of R&D-performing small and medium-sized enterprises.

The main features of such projects:
- Eurostars/EUREKA targets research-performing SMEs and allows them to aim higher in their research efforts
- Eurostars/EUREKA projects are collaborative, meaning they must involve at least two participants (legal entities) from two different Eurostars/EUREKA participating countries.
- With its bottom-up, flexible approach, the results of Eurostars/EUREKA projects will reach the market faster
- Fast application procedures
- Fast time to market
- Other project participants – SME, large company, research institute, university are eligible

- Conditions and call procedures unbureaucratic (on-line submission, around 20pages application, Independent Evaluation Panel to evaluate (Basic assessment, Technology and innovation, Market and competitiveness) and rank project proposals). ...
- Any technological area with civilian purpose, aimed at the development of a new product, process or service
- Must involve at least two participants from two different Eurostars/EUREKA member countries
- The main participant must be an R&D-performing SME in Eurostasrs
- At least 50% of the total project costs shall be carried out by the participating R&D performing SMEs
- Market-driven projects with a maximum duration of three years
- The consortium should be well balanced, which means that no participant or country will be required to invest more than 75% of the total project costs.
- The project must have a maximum duration of three years, and within two years of project completion, the product of the research should be ready for launch onto the market.

The main difference between an Eurostars project and an EUREKA project was also investigated to ease the decision between the two programs:
- The Eurostars project must be led by a research-performing SME from a Eurostars member country.
- Slightly different funding rates – differing countries

EUREKA's Eurostars Programme is open for funding applications on a continuous basis, with an average of two application submission deadlines each year.

More info can be found at http://www.eurekanetwork.org/in-your-country

Demonstration action in FP7

Supporting SMEs for demonstration activities: the 2010 work programme launched a new test action, aimed at funding demonstration projects. SMEs often need to follow up research projects with work linked to "demonstration" or production of prototypes before actually commercialising goods and services but funding for this kind of activity is not readily available. The inclusion of demonstration activities in the research projects themselves is encouraged and analysis shows that for the 'Research for SMEs' scheme up to 8% of costs on average do relate to demonstration.

It is obvious that the demonstration element as part of future SME-specific R&D-projects should gain importance. The test action should also contribute additional insights on how this could be achieved most effectively. The aim is to guarantee that the benefits of supporting demonstration activities will go directly to the SMEs involved which are ready to fully exploit the results of such project.

Technical content/scope:

Projects must be centred on the needs of the SMEs to carry out demonstration activities
before being able to enter the market. Activities can include testing of product-like prototypes, scale-up studies, performance verification and implementation of new technical and non-technical solutions. This phase could also include detailed market studies/business plans or market strategies.

Topics:
The Demonstration action is a bottom-up scheme: the projects may address any research topic across the entire field of science and technology.

Participants:
The consortium must consist of a minimum of 3 SMEs from at least 3 different Member States or Associated Countries. These three SMEs must be/have been participants together in a 'Cooperative research' project funded under the last FP6 call (FP6-2004-SME-COOP) or in a 'Research for SMEs' project. SMEs which were members together of the 'SME core group' in the FP6-2004-SME-COLL call or which are members together of the 'other enterprises or end-users' in a 'Research for SME Associations' project in FP7 may also participate.

The SMEs should have a predominant role in the consortium: at least 75% of the declared costs shall be carried out by the SMEs and the coordinator of the project must be one of the SME participants. The participation of other actors, like SME associations, large companies and/or RTD performers is possible.

Applicants are encouraged to form small consortia fit for the purpose of the proposed project.

Type of activities:
Demonstration activities are designed to prove the viability of new technologies that offer a potential economic advantage, but which cannot be commercialised directly (e.g. testing of product-like prototypes).

Management activities over and above the technical management of individual work packages provide an appropriate framework bringing together all project components and maintaining regular communications with the Commission. It is expected that the management, training and other costs should not exceed 10% of the total cost of the project. Sub-contracting should be limited to specialised tasks (such as market studies, support to IPR and use of external testing facilities) and duly justified.

The overall budget of a project should typically be between 0.5 to 3 million EUROS.

The duration of a project is in the range of 18 to 24 months.
The call is expected to be open: July 2012 and close in November 2012.

List of Websites:
http://www.plasmanure.eu