



LIFE Project Number
LIFE08 ENV/GR/576

Progress Report
Covering the project activities from 01/08/2010 to 31/12/2010

Reporting Date
<17/02/2011>

LIFE+ PROJECT NAME or Acronym
SMART-CHP

Data Project

Project location	Thessaloniki – Ptolemaida – Amyntaion
Project start date:	01/05/2010
Project end date:	31/12/2012
Total budget	919,557€
EC contribution:	450,143€
(%) of eligible costs	50

Data Beneficiary

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2. List of key-words and abbreviations (when appropriate).

1. SMART-CHP: Demonstration of a Small scale Mobile Agricultural Residue gasification unit for decentralized Combined Heat and Power production
2. AUTH: Aristotle University of Thessaloniki
3. LAT: Laboratory of Applied Thermodynamics
4. UACA: Union of Agricultural Coop of Amyntaion
5. DHCP: District Heating Municipal Company of Ptolemaida
6. PPC: Public Power Corporation
7. ICE: Internal Combustion Engine
8. CHP: Combined Heat and Power
9. LPG: Liquefied Petroleum Gas
10. AUA: Agricultural University of Athens

3. Executive summary

3.1. *General progress*

The progress of the project so far can be characterised as satisfactory and on schedule. Action 1 has been concluded at the end of 2010. Actions 2 and 5 are running smoothly so far. The general management of the project (Action 6) is running normally. Action 3 will commence in January 2011 as scheduled. The main objectives of the consortium during the time between the inception report and the first progress report are experimental testing of the technology and the equipment comprising the SMART-CHP unit and the dissemination of the results achieved so far.

3.2. *Assessment as to whether the project objectives and work plan are still viable*

Based on the information provided below, the consortium is confident that the project objectives and the work plan are still viable. There is only one barrier which has caused a delay in the Action 2 timetable. It is estimated that Action 2 will not be finalised until the month of April, 2011. Since the first demonstration operation is not scheduled to take place before May, 2011, it is almost certain that the project's progress is not compromised.

3.3. *Problems encountered*

There is one main problem which causes a delay in Action 2 as mentioned above. When the unit's base was transported at AUTH from the manufacturer, it was placed temporarily at the yard of the university. It was decided that no further work would be done on the unit's base until it was re-located to a safer location within the university since the danger of vandalism actions within the university (which is considered an asylum) was possible. The consortium decided to move the unit within the subway construction site adjacent to LAT/AUTH. As a result, a formal letter was written and sent to the company responsible for the subway construction (Attiko Metro S.A.). The authorisation has been obtained orally but a formal written response is not necessary as stated by Attiko Metro S.A.. It is estimated that within the month of January the unit's base will be officially moved at the construction site which is protected from the public. Nevertheless, all side-actions

regarding the unit's development are being implemented as originally scheduled so as to be finalised when the unit's base is transported.

4. Administrative part

4.1. *Description of the project*

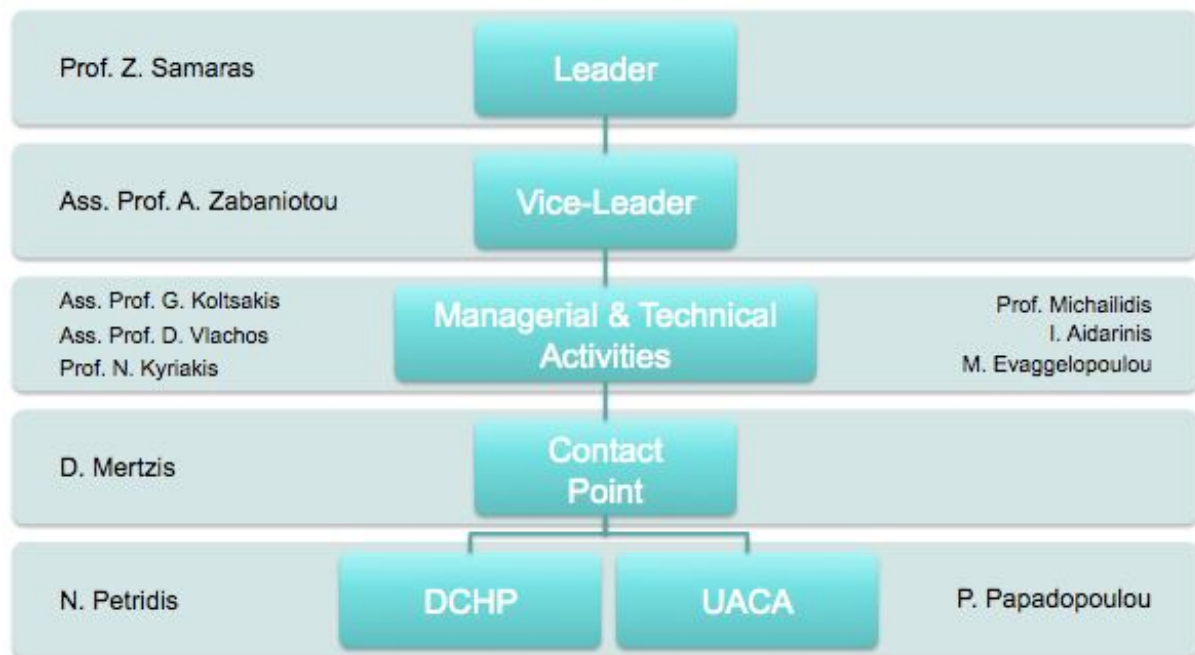
The project manager (Z. Samaras) and other representatives of the coordinating beneficiary (AUTH) play a significant role in the certain project regarding organisation, monitoring, guidance, communication between partners and increasing awareness in general. A project management committee has been formed. This committee includes representatives of all partners. As a result, several meetings of the committee have been organized at the project manager's office at Thessaloniki. Minutes of all the meetings have been recorded. The table below depicts the date of all meetings occurred, the main topic and the meeting location covering the dates from 01/08/2010 until 31/12/2010.

Table 1: Coordination meetings along with their details

Meeting Date	Meeting Topic	Attendants
01/09/2010	Action 2	LAT AUTH
20/09/2010	Overall project's progress	All partners
01/10/2010	Action 1 results	All partners
29/11/2010	Action 2 progress	LAT AUTH

4.2. *A clear informative organigramme of the project team and the project management structure*

The organigramme of the project team remains unaltered compared to the latest report submitted.



4.3. **Delivered reports**

The only delivered report so far was the inception report which covered the activities from 01/01/2010 until 30/07/2010.

5. **Technical part**

The SMART-CHP project concerns the construction, demonstration and dissemination of a 12kWth and 5kWel mobile gasification unit coupled with an ICE for energetic exploitation of agricultural residues in Greece, aiming to solve the problem of biomass logistics like biomass residues transportation over long distances, protection from weather variations, storage and general handling--The scope of the project is the demonstration of an innovative small scale mobile power production unit, for the energy utilization of agricultural residues generated in rural areas, where large amounts of biomass wastes are available. The proposed work structure is structured along the following six (6) actions.

- A1: Regional biomass availability profile
- A2: SMART-CHP unit development
- A3: Demonstration operation
- A4: Demonstration results and sustainability analysis / best practice guidelines
- A5: Dissemination of project results
- A6: Management and coordination

5.1. Actions (progress from 1/8/2010 until 31/12/2010)

5.1.1. Action 1 – Regional biomass availability profile

Action 1 was completed by the end of December in 2010. The progress from August until the end of 2010 was concentrated around concluding the A1 deliverable, which, through its contents, ensures the successful implementation of Actions 2 and 3. The biomass species dictated through A1 deliverable will be used for unit testing in Action 2 and unit operation in Action 3. Also, the operation locations selected during Action 1, will be the basic project locations regarding Action 3. For the implementation of the action's targets, additional specialties (compared to the proposal's original budget form) have been utilised. For example, a senior and junior engineer, a well as a scientific consultant, were included in Action 1. Their activities involve residual biomass recording and sampling, demonstration location search and valuation, authorizations acquisition etc. The Action 1 progress is presented in more detail in the following paragraphs.

One of the basic axes of the action was biomass sampling from W. Macedonia and testing at AUTH facilities. Samples were collected at Amyntaion and Ptolemaida by UACA. The samples comprised mainly of cardoon crops, barley, wheat, buckwheat, vineyard prunings and corn residues. All samples were delivered to AUTH laboratories for analyses. In addition, a ripper has been obtained for smashing residues like prunings and kernels in the desired sizes for feeding in the unit.

Additionally, a preliminary selection of residues has been made based on quantity, availability, physicochemical characteristics and pre-treatment requirements. Three demonstration locations were finalized (Amyntaion potato factory, Amyntaion winery and DHCP yard). As a consequence, Action 1 targets are considered fulfilled. The Action's deadline was set to be the end of October, 2010. The A1 deliverable (Biomass regional availability profile report) has been completed and is provided as ANNEX 1 with this report. Its content is a summary of the work implemented during this action. After completion of the deliverable, the action continued until it was actually finalised in the end of 2010. During the last two months, the main activities concentrated around collecting the necessary quantities of selected species for the demonstration period. These activities will be continued in 2011 at the frame of demonstration preparations (Action 3).

The report was presented internally during a coordination meeting on October 1st by Dr. V. Skoulou, who was the main writer of D1. All partners were present and offered advice and additional information for a more complete report. During the meeting several decisions were made in order to successfully conclude Action 1. Specially, Th. Xatziaougoustis took under responsibility the ordering and storage of 1,5 tons of the available residues in the Region of Western Macedonia that seem proper for pilot scale gasification (energy crop residues: e.g. cynara, agro-industrial residues: like fruit stones (peach or apricot, almond or nut shells, corn, olive kernels, vineyard prunings or forest residues: pine, fir, oak, beech etc). Additionally he will find a solution concerning the pretreatment and proper sizing of residues for successful feeding in the gasifier. The cynara candulus species will be provided by P.P.C.. Furthermore, it was also decided to consider olive kernel as a feeding material for the mobile gasifier, and olive kernels will be provided by an olive kernel factory in Kozani (near Ptolemaida).

5.1.2. Action 2 – SMART-CHP unit development

A2 target is the construction and test operation of a small scale mobile gasification unit for CHP production. The unit development is divided in three directions:

- A) the unit's base construction.
- B) The gasifier operation optimisation
- C) The gasifier – generator set coupling.

A) The main issue regarding the unit's base was its placement. The base will be transported to the desired location within January. It was decided that, all actions regarding the base decoration will be made after the transportation at the safer location. Picture 1 below shows that decoration of the container (paintjob, logos etc) would be useless since probabilities of vandalism at the current location are high. The colours that will be used are white for the roof of the unit and yellow-green for the rest of the container. Three big logos will be placed at the front of the container. One representing the project logo, one for AUTH and one for LIFE+. Paintjob and logo placement will take place after the container's transportation.

B) Further experiments have been conducted in the pilot gasification unit to test the effectiveness of the producer gas cleaning and conditioning unit. The experimental operation aimed at determining certain aspects of the technology like:

- Fluidisation medium impact on tar production → Fluidization medium containing metals is capable of catalyzing tars within the reactor. This kind of catalysis is called primary catalysis. Silica sand has no catalytic effects and is used as a baseline material regarding tar production. Catalytic materials like olivine and dolomite are used to measure the effect on tar production.
- Soot filter loading profile: After each filter loading experiment, the filter is scanned at a CT-scan and the loading profile along its radial and axial directions is quantified.
- Soot filter regeneration performance: When loading profile is not measured, filter regeneration (soot burning within filter) is valued. The filter is scanned at a CT-scan to check for potential thermal fatigue of the filter.
- Soot filter effectiveness: During each experiment the filter trapping effectiveness is measured through gas sampling and particle matter measuring.
- Tar measurement set-up: A tar measurement prototype has been developed for measuring tar generation. The unit is portable and comprises of a gas cooler and a tar protocol made of gas washing bottles and active carbon traps. Water, isopropanol and other possible solvents are used as “tar holders”.
- Tar reduction performance: The trap measurement unit is used to measure the performance of tar reduction technologies applied to the gasifier like wet scrubbing.
- Gasification gas production measurement: Gas sampling and measuring at a gas chromatograph is a standard procedure to

determine gas quality. Gas quality is an indicator of process smooth operation and tar catalytic performance.

- Fuel feeding performance: Fuel feeding performance is measured through flow measurement of the solid biomass. Different fuel characteristics lead to variable flow rates of solid fuel within the reactor.
- Mass balances: Carbon mass balance has been calculated for certain experiments using the following measured masses: raw fuel fed to the reactor, unreacted carbon within the gsifier after the end of the experiment, carbon dust collected by the cyclone and the filter, gas sample and tar content.
- Soot characterisation: Soot samples from the reactor, the cyclone and the filter are collected and stored. They will be examined using microscopes.
- Simulation tools are used as support in order to minimise experiment costs: The AVL Boost is used to simulate the gas engine. The axi-suite software is used to simulate the soot filter. ANSYS Fluent is used to simulate the gasification process.



Picture 1: The SMART-CHP unit base



Picture 2: Similar actions on adjacent containers



Picture 3: The modified ICE air inlet



Picture 4: Complete gen-set experimental set-up

C) Calculations were made regarding the simulation of the ICE to work in dual fuel mode (LPG + producer gas). As a result, a modeling tool has been developed which will aid reduce experiment costs. After the completion of the calculations, modulations have been designed for the generation set in order to achieve dual fuel operation. These modulations refer to the development of an innovative gas mixer, which will be capable of handling two fuel gases while maintaining stable air to fuel ratio. In order to successfully calculate the size of the mixer, certain measurements were made to the ICE. The measured quantities were air and LPG fuel flow to the engine. Modifications are made to the ICE so as to acquire accurate measurements. These modifications include alteration of the engine's air intake system in order to measure accurately the intake air flow. A temporary buffer tank and a hotwire flow-meter are utilised for the measurements. The fuel consumption was calculated via the LPG tank weight loss during operation. A non-operational exhaust measuring device has been repaired and used solely to measure the ICE exhaust gases and calculate the air-fuel ratio on-line. The air to fuel ratio is necessary for maintaining a stable operation. The exhaust measuring device indicates the air to fuel ratio and if it is wrong, then the user re-calibrates the engine's parameters to correct it. During the experimental operation so far, air/fuel flow and engine performance have been measured accurately in the engine's speed range.

5.1.3. Action 5 – Dissemination of project results

During the past five months there was a major mobility regarding dissemination (internal and external) and promotion of the project by AUTH, DHCP and UACA coefficients. The

actions so far include the organisation of a public event, press interviews and articles, development of dissemination material and intense internet activity.

The event was the 1st project workshop. It was held at UACA offices on Wednesday the 8th of December, 2010. The workshop's title was "Biomass gasification for decentralised combined heat and power production". Workshop invitations were designed, printed and sent to target groups. In addition, workshop posters were placed at "key" locations in Amyntaion, Ptolemaida and Thessaloniki prior to the event. The detailed programme of the workshop is listed below.

- 17.20 – 17.40, Greetings by P. Papadopoulou, UACA Director
- 17.20 – 17.40, Greetings by I. Antoniadis, Vice-prefect of Florina
- 17.20 – 17.40, Greetings by K. Theodoridis, Mayor of Amyntaion
- 17.40 – 18.00, SMART-CHP project presentation by Prof. Zisis Samaras, Project leader
- 18.00 – 18.20, Possibilities for energy valorization of biomass in the W. Macedonia district, by Dr. V. Skoulou and Ass. Prof. A. Zabaniotou, AUTH
- 18.20 – 18.40, Small gasification units at producer-community level, by Em. Prof S. Kiritsis, AUA
- 18.40 – 19.00, Agro-residue utilization for heat and electricity production, by N. Philippopoulos, Philippopoulos Energy Technical S.A President
- 19.00 – 19.20, Plant evaluation for bioenergy production, by Prof. Z. Koukoura, Faculty of Forestry and Natural Environment
- 19.20 – 20.00, Q&A, Discussion

Photos from the workshop as well as the speakers' presentations are available for download at the project's website (<http://smartchp.eng.auth.gr/news/?id=17>). Before the workshop, Auth visitors were given a tour by the UACA's staff at the two locations in Amyntaion which are favorites for the unit's demonstration.

Additional dissemination actions involve the presentation of the project and its results so far at the 4th Energy Week organized by the Institute of Energy for South East Europe. A slideshow was presented on 23/11 during the 15th National Energy Conference "Energy &

Development 2010”. The slideshow is available at the SMART-CHP website (<http://smartchp.eng.auth.gr/news/?id=18>).

Additional dissemination actions involve:

- An interview for www.agronews.gr, the most popular portal oriented at agricultural activities in Greece. In addition, a 900 words article has been included at the newspaper “Agrenda” which is published and distributed throughout the country every Saturday.
- The workshop was publicized and presented in a large number of local and national radio, television and news sites, such as:
 - <http://www.ert3.gr/news/et3newsbody.asp?ID=531768>
 - <http://www.naftemporiki.gr/news/pstory.asp?id=1909773>
 - http://www.florinapress.gr/eblog/periballon/aeriopoiesebiomazasgia_tenapokentromenesumparagogethermotetaskaiielektrismou.html
 - http://www.eordaia.org/index.php?option=com_content&view=article&id=905:2010-12-01-21-04-27&catid=67:1
 - <http://www.e-amyntaio.gr/el//1121.html>
 - <http://www.radio-lehovo.gr/nea/345-hmerida-eas-aeriopihsh-biomazas>
 - http://true-channel.blogspot.com/2010/12/blog-post_20.html
- Presentation of the project in the Biomass Group of Seville University (Seville, Spain 26-30/09/10)
- Meeting with ANKA (Development Company for energy in Karditsa (9-10 October) for a future collaboration concerning the energetic valorization of local biomass with the concept of SMART CHP project and organization of a workshop on the issue.
- Presentation of the lecture: ‘Small Mobile gasification units for energy and green business – the project SMART CHP in the workshop entitled: ‘ Technologies for biomass energetic exploitation”, Karditsa 21/11/10.
- An info leaflet has been designed, printed and distributed along with posters.

Until December 27, the statistics of the project’s website are:

Table 2: The statistics of the project’s website based on site server

Website statistics	2010
Unique visitors	367

Number of visits	851
Hits	78,749

In addition a Facebook fan page under the name “[Project SMART-CHP](#)” and a group under the name “SMART CHP – Biomass Energy” have been created. The fan page includes 5 main categories, 1) “Wall” where posts by the consortium and fans can be posted, “Info” where several information regarding the project are presented, “Photos” which includes project-related photos divided in categories per action, “Discussions” where topics concerning project-related issues can be commented and “Events” where demonstration and dissemination activities can be publicized. The graph below shows the active fan page users for the reporting period.



Picture 5: Graph depicting the active Facebook fan page users for the reporting period

The Demographic fan page statistics for the reporting period are listed below:

Greece	67
Cyprus	3
France	1
Spain	1
Netherlands	1
Italy	1

5.2. *Envisaged progress until next report*

The next progress report (mid-term report) will be submitted by the end of June, 2011. Until then, several milestones and deliverables will have been completed, more specifically the following:

- D2: SMART-CHP unit (deadline 30/04/2011). The progress of this deliverable will be greatly determined by the end of January. It is roughly estimated that the month of April will also be included in the development of the unit. As a result, Action 2 will probably be extended by one month.

- M3: SMART-CHP unit construction. The unit's base container is constructed. The goal is to prepare the whole unit until the milestone deadline (March 31, 2011). The unit's preparation involves preliminary operation in a controlled environment utilizing residues selected for demonstration operation in Western Macedonia. Several activities have been scheduled, as soon as the unit is re-positioned to the safer location. These activities include: aesthetic improvement of the unit (paintjob, logos etc), connections (electricity, water, compressed air), additional iron works to support firmly the equipment at its position in the container and intensive testing of the unit to ensure that the demonstration operation will "run" smoothly.
- M4: Authorizations for demonstration in Ptolemaida (deadline 31/03/2011). Confirmed verbally – awaiting written authorization.

All project deliverables and milestones are listed in tables 3 and 4.

Table 3: Deliverables table

Name of the deliverable	Code of the associated action	Proposed deadline	Actual deadline
D1: Biomass availability and location selection analysis report	A1	31/07/2010	31/10/2010
D2: SMART-CHP unit	A2	31/12/2010	Ongoing
D3: Demonstration report	A3	31/12/2011	Not started
D4: Results and sustainability analysis / best practice guidelines	A4	30/09/2012	Not started

Table 4: Milestones table

Name of the milestone	Code of associated action	Deadline	Accomplishment date
M1: Selection of demonstration locations	A1	30/06/2010	30/10/2010
M2: Workshop 1 – Biomass energy potential	A5	30/11/2010	08/12/2010
M3: SMART-CHP unit	A2	31/12/2010	Not yet
M4: Authorizations for the demonstration in Ptolemaida	A3	31/03/2011	Not yet
M5: Demonstration events	A3	31/12/2011	Not yet
M6: Workshop 2- Demonstration results	A5	31/03/2012	Not yet
M7: Conference: Decentralised biomass utilisation for CHP production	A5	30/09/2012	Not yet
M8: Workshop 3: Final results	A5	31/12/2012	Not yet

5.3. *Impact:*

On the one hand, there are no measurable effects concerning the environmental impact due to the early stage of the project. On the other hand, there has been mobility and contact on behalf of the local community of Amyntaion and Ptolemaida. The workshop that was organised at Amyntaion in December 2010, brought the consortium in touch with the local authorities. Further communication and follow-up was discussed during the successful event.

6. Financial part

6.1. Costs incurred

Fill in the following table concerning the incurred project costs:

Budget breakdown categories	Total cost in €	Costs incurred from the start date to 31.12.2010 in €	% of total costs
1. Personnel	683,120	213,826.9	31.30
2. Travel and subsistence	44,535.97	6480.98	14.55
3. External assistance	5,000	0	0
4. Durable goods			
Infrastructure	0	0	0
Equipment	38,538.68	857.23	2.22
Prototype	24,000	5067.68	21.12
5. Land purchase / long-term lease	0	0	
6. Consumables	39,400.00	5907.61	14.99
7. Other Costs	26,064,69	2327.27	8.93
8. Overheads	58,897.3	11,732.24	19.92
TOTAL	919,557	246,127.90	26.76

Please fill in the following additional table:

Action number and name	Foreseen costs	Spent so far	Remaining	Projected final cost
Action 1 "Regional biomass availability profile"	92,000	99,013.19	-7,013.19	99,013.19
Action 2 "SMART CHP unit development"	185,500	82691.04	102,808.96	179, 839.04
Action 3 "Demonstrative operation"	276,160	0	276,160.00	276,160.00
Action 4 "Demonstration results and sustainability analysis / best practice guidelines"	101,000	0	101,000.00	101,000.00
Action 5 "Dissemination of project's results"	145,000	24,906.69	120,093.31	136,196.06
Action 6 "Management and coordination"	61,000	27,784.74	33,215.26	68,451.41
TOTAL	860,660	234,395.66	626,264.34	860,660

7. Annexes

7.1. Deliverables

ANNEX 1 D1: Biomass availability and location selection analysis report

7.2. Dissemination material

ANNEX 2 Website
ANNEX 3 Slides
ANNEX 4 Leaflets & posters
ANNEX 5 Press