INCO-CT-2004-509093

ADU-RES

Co-ordination Action for Autonomous Desalination Units Based on Renewable Energy Systems

Instrument: Co-ordination Action

Thematic priority: B.1.3 – Advanced water treatment, re-use and energy implications

Final activity report

Period covered: 01 April 2004 - 30 September 2006 *Date of preparation*: October 2006

Start date of project: 01 April 2004 *Duration*: 30 months

Coordinator:
Michael Papapetrou
Dr Christian Epp
WIP – Renewable Energies
Sylvensteinstrasse 2, 81369 Munich, Germany

Table of Contents

Introduction

This activity report covers the whole period of the project ADU-RES, i.e. from 01.04.2004 to 30.09.2006. ADU-RES is co-funded by the European Commission in the framework of the 6th Framework Programme (Contract No. INCO-CT- 2004-509093).

The activity report provides an overview of the activities carried out by the consortium, a description of progress toward the objectives, milestones and deliverables of the project, the identification of any problems encountered and corrective action taken. The text of this final report is based on the equivalent test of the respective periodic activity reports.

This report is prepared according to the guidelines provided in the following document: *"Project reporting in FP6 - Guidance notes for Integrated Projects, Networks of Excellence, Specific Targeted Research or Innovation Projects, Coordination Actions, Specific Support Actions, Co-operative Research Projects and Collective Research Projects"* of October 2004[1]

[1] available under http://www.cordis.lu/fp6/find-doc-management.htm#reporting

Publishable executive summary

Co-ordination Action for Autonomous Desalination Units based on Renewable Energy Systems - ADU-RES

1. INTRODUCTION

Many arid regions in Mediterranean countries have a great potential to cover part of their pressing water needs by renewable energy based desalination. However, the wide-scale implementation of this technology faces numerous technical, economic and policy barriers.

These barriers are studied and strategies to overcome them are developed and implemented within the ADU-RES project. The consortium involves partners from 7 Mediterranean Partner Countries (MPC) as well as institutes and SMEs from 5 EU countries specialised in desalination and renewable energy systems. In table 1 all consortium members are presented.

The project started on the 01 of April 2004 and was successfully completed on the 30th of September 2006.

Table 1: *ADU-RES consortium members*

AUA, Agricultural University of Athens, Greece	**FM21**, Fondation Marrakech 21, Morocco
CDER, Centre de Développement des Energies Renouvelables, Algeria	**IAV**, Institut Agronomique et Vétérinaire Hassan II, Morocco
CRES, Centre for Renewable Energy Sources, Greece	**INRGREF**, Institut National de Recherche en Génie Rural, Eaux et Forets, Tunisia
CREST, Centre for Renewable Energy Systems Technology, Loughborough University, UK	**ISE**, Fraunhofer Institute for Solar Energy Systems, Germany
E.C. DG-JRC, Institute for Environment and Sustainability, Renewable Energies Unit, EU	**ITC**, Instituto Tecnológico de Canarias, Spain
ELARD, Earth Link and Advanced Resources Development, Lebanon	**PHG**, Palestinian Hydrology Group, Palestinian Authority
ETA–Renewable Energies, Italy	**RSS**, Royal Scientific Society, Environment Monitoring & Research Central Unit (EMARCU), Jordan
EWE, Egyptian Association for Water and Energy, Egypt	**WIP**–Renewable Energies, Germany

2. PROJECT OBJECTIVES

ADU-RES aims to push forward all necessary technical and policy developments to boost the implementation of renewable energy based desalination units in the Mediterranean region. There are two central objectives. The first is to analyse of the current status and develop recommendations for improvements on the technical and socioeconomic side, for mature and cost efficient renewable energy based desalination systems. Secondly there is a focus on political strategies for boosting ADU-RES implementation within the existing policy and legislative frameworks.

3. WORK PERFORMED AND RESULTS ACHIEVED

Various research exchange activities between relevant stakeholders took place. One tool that has been developed for this purpose is the **"research matrix"**. This is an Excel based, easy to use database with recent publications related to autonomous desalination. Furthermore the research matrix provides links to institutes and companies active in the field. It is available for downloading on the project website and the user can update it with the most recent publications.

During the period of the project, three major **events** were organised, one in Morocco, one in Tunisia and one in Jordan. All attracted a diverse and interesting mix of people and contributed to the awareness of targeted stakeholders. On the project website are available the relevant proceedings and presentations.

Major literature review and on-site research was performed in order to achieve a good overview of the technology status. A **comprehensive report** has been produced covering the following fields:

- Description of the available combinations of renewable energy systems with desalination technologies introducing the main technological features of each one.
- General guidelines for selecting the appropriate technology combination depending on the framework conditions and requirements of each case
- An overview of selected plants worldwide focusing on the technological and financial performance of the units and the lessons learnt from their operation
- A survey on the relevant software simulation tools
- A review of research projects on the field

A **computer model** has been developed for use by project planners and decision makers on a local level. This programme is integrated into existing software called MEDWATER model. The model allows the user to get also information on the water management options of the wider area. Thus, the decentralised solutions, like autonomous desalination units, are put into a general perspective and an assessment is given of their potential role in the integrated water resources management of the region. The software requires some climatic and water data as input and gives information on the general features of the main technologies for desalination based on renewable energy. Additionally, quantified results are given for the production capacity of each technology and the required size of the energy components.

Information has been collected **on potential consumers** of the fresh water produced from autonomous desalination units. On-site research has been carried out in the five target countries, Morocco, Algeria, Tunisia, Egypt and Palestine. Twenty consumer groups have been analysed, four from each country. The consumers were selected based on specific predefined characteristics, mainly scarcity of fresh water and access to salty water and renewable energy resources. All results were compiled in one report.

A **study of the financing mechanisms** that could be used in small desalination projects was also performed. The study includes a description and comparison of the various financing schemes, evaluation of these mechanisms for financing autonomous desalination projects and case studies of renewable energy powered desalination practices, with special focus on Mediterranean Partner Countries. Conclusions and recommendations concerning ADU-RES financing strategies and mechanisms are drawn. Because of the similarity these projects have with the usual renewable energy projects, the research builds on the experiences acquired from the financing of small scale renewable energy projects in the target countries.

The potential for **reducing the capital and running costs** of installing and running small desalination plants powered by renewable energy has been studied. Two parallel actions took place, first the various components of the desalination unit have been analysed theoretically and then the process has been simulated in a computer programme. The results of both actions were documented in a report while specific recommendations were summarised in a separate document.

The possible **environmental and social impacts** of small desalination units were analysed based on a desk-based study and on-site research in four South-Mediterranean countries. The outcomes of the research were collected in a report while in a separate short document concrete recommendations for project developers were given. These will assist future projects to better integrate their systems in the environment and the society, minimising their negative impacts and further developing the image of the technology.

A simulation tool was developed and the **energy performance** of existing units was analysed. This allowed developing concrete recommendations regarding the potential for improving the designs in this respect. The results and the conclusions have been presented in a comprehensive report.

A review of issues requiring special attention in autonomous desalination was performed, recommendations were developed and "blue boxes" prepared, which give the reader a short overview. All results were put together in the **"Design Guidelines"**. These guidelines are targeted to scientists who are involved in the research topic, therefore they address the aspects that should be considered while planning installation in order to avoid mistakes and achieve a good system performance.

The **legislative and institutional** framework conditions in relation to autonomous desalination applications were analysed in Spain, Greece, Morocco, Tunisia, Algeria and Jordan as well as on the EU level. Based on these results an "Action Plan" was developed, suggesting actions that will facilitate the wide-spread deployment of the technology in question.

Finally, based on the outcomes of the whole project and the contributions of the industry in the ADU-RES events, an **exploitation plan** was developed. This has been also formatted for publication and will be widely disseminated to encourage the further development and follow-up of the project results.

All major reports produced within ADU-RES are available for downloading through the project website (www.adu-res.org)

4. OUTCOMES

1) Knowledge of relevant R&D actions was scattered between institutes and companies in EU and the Mediterranean.

→ ADU-RES compiled relevant data in comprehensive documents and Internet portals.

2) Basic technical requirements, like drastic cost reduction and improved reliability, have to be fulfilled before the commercial implementation of the technique is possible.

→ ADU–RES developed concrete recommendations that contribute in the progress towards this objective.

3) Issues related to the environmental and social impacts of any activity are usually neglected causing harm to the environment and opposition of local populations

→ ADU-RES focused its research on potential environmental, gender, health and social aspects of decentralised desalination and provided recommendations how to deal effectively with these issues

4) The awareness of the technical options and the socio-economic barriers of RES based desalination units is rather limited between stakeholders in utilities, industry and policy

→ ADU-RES enhanced the awareness for the desalination based on renewable energy sources, through several dissemination activities and its seminars

5) Practical implementation is hindered by the lack of adequate financial resources

→ ADU-RES analysed and define appropriate financial options and raised awareness among investors and financial institutions

6) There are not many commercially operated plants that would raise the trust in the maturity and efficiency of decentralised desalination units.

→ ADU-RES developed the exploitation plan that paths the way for planning of commercial size desalination units based on renewable energies in the Mediterranean.

ACKNOWLEDGEMENT

ADU-RES is supported by the European Commission under contract number INCO-CT-2004-509093. However, the views expressed herein are those of the authors and can therefore in no way be taken to reflect the official opinion of the EC.

Coordinated by:

Michael Papapetrou, Dr Christian Epp
WIP - Renewable Energies
Sylvensteinstr.2, 81369 München, Germany,
Tel: +49-89-720 12 792, Fax: +49-89-720 12 791
e-mail: pmp@wip-munich.de

Section 1: Project objectives and major achievements

1.1 General project objectives and current relation to the state-of-the-art:

ADU-RES aims to push forward all necessary technical and policy developments to boost the implementation of renewable energy based desalination in the Mediterranean region. The project objectives can be summarised under two main targets. The first is to develop further the technical and socio-economic side for mature and cost efficient renewable energy based desalination units. The second field where the efforts of the project are focused is the formulation of political strategies for boosting ADU-RES implementation.

The project work is based on a comprehensive analysis of the current status and therefore follows a clear and efficient strategy based on the following goals:

- to create a complete survey on recent progress in R& D work
- to develop an understanding of potential user groups in the Mediterranean
- to assess the social and environmental impact of autonomous desalination units (ADUs)
- to define cost reduction strategies
- to analyse the socio-economic and policy framework conditions
- to develop recommendations for policy strategies supporting ADUs
- to broadly disseminate the opportunities and advantages of renewable energy based desalination and raise the awareness for sustainable water supply

Based on the **criteria for measuring the project success**, as expressed in the Annex I of the contract, an overview of the progress towards the stated objectives will be presented here:

→ *Today, the knowledge on relevant R&D actions is scattered between institutes and companies in EU-15 and the Mediterranean. ADU-RES will be a success if it manages to compile all relevant data in comprehensive documents and Internet portals:*

A great amount of data regarding companies, institutes and individuals active on the field has been collected and fed into a database. Information about completed and on-going research and demonstration projects and installations has been compiled in a comprehensive report. Additionally, relevant literature and websites are collected into the "Research Matrix", an Excel based tool. This work is disseminated to targeted audiences and is made available for the public through the internet.

→ *There are technical requirements that have to be fulfilled before the commercial implementation of the technique is possible, including drastic cost reduction, improved reliability, optimised environmental and social impact and advanced control and management systems. ADU –RES will be a success, if the ADU-RES design guidelines will contain solutions which will bring progress in these critical fields.*

The potential for cost reduction has been analysed and recommendations for design and construction of more cost-effective units were given in deliverables 4.1 and 4.2. The environmental and social impacts were also examined with an extensive on-site and desk based study. Finally, simulation models and real data are combined for better understanding the energy flows and efficiencies in the combination of desalination with renewable energies. These results and the review of installed units were brought together in reports that set guidelines for successful design of such systems. The targeted dissemination of the guidelines and further research will lead to more efficient units better integrated in their natural and social environments.

→ *The knowledge about potential user groups for decentralised and autonomous desalination units in the Mediterranean is very low. Particularly, their economic and water related characteristics are unknown. ADU-RES will be a success when detailed pictures of potential users will be elaborated which allow the definition of desalination plants which perfectly fit into the requirements of the selected user groups.*

More than 20 specific water consumer groups that face difficulties in obtaining the fresh water they need have been identified in five Mediterranean countries (Morocco, Algeria, Tunisia, Egypt and Palestine Authority). For each one of these groups a set of data has been collected that allows an initial assessment of their suitability for autonomous desalination solutions. Then the ten most promising consumers have been selected, two per country. These were analysed in more detail and a clear, representative view of the potential users was obtained. The results are documented in a report that is available on the website for all interested parties and the wider public.

→ *The policy framework for sustainable water supply is inefficient in many Mediterranean countries. The national water policy often favours large-scale centralised solutions instead of decentralised water supply from non-conventional resources. ADU-RES will be a success when policy recommendations will be developed for improving the framework conditions for sustainable and decentralised water supply.*

The political framework conditions were analysed on the EU level and recommendations for improvements were formulated. On the national level Spain, Greece, Morocco, Algeria, Tunisia and Jordan were analysed and recommendations were developed for policy framework conditions that will facilitate application of decentralised and environmental friendly water supply solutions.

→ *The awareness for the technical options of RES based desalination units is rather limited among stakeholders in utilities, industry and politicians. ADU-RES will be a success when the awareness for the desalination based on renewable energy sources is enhanced significantly.*

High profile events were in Tunisia and in Jordan. There, stakeholders from the industry, utilities and politicians were addressed directly and the awareness of the systems and how they can be implemented has been enhanced. The ADU-RES model allows easy and quick access to main facts about what an autonomous desalination unit has to offer depending on the hydrological conditions of each site. The internet site is another powerful tool where the relevant stakeholders and the general public can access the project results. The constant presence in conferences and international events keeps the link with the specialists.

→ *It still lacks commercially operated demonstration sites for decentralised desalination units in the Mediterranean which would raise the trust in the maturity and efficiency of decentralised desalination units. ADU-RES will be a success when the project will stimulate the detailed planning for commercial size desalination units based on renewable energies in the Mediterranean*.

Already, within the project have been identified numerous sites and consumers very suitable for application of ADU technologies. Additionally an extensive network of organisations and companies active in the field was built with emphasis on the companies that have mature technologies. Finally, information on financing schemes has been put together. All these stakeholders and information brought together in the ADU-RES workshops buid-up the critical mass for creation of consortiums that will be very effective in developing a new generation of improved and cost efficient applications of renewable energy based desalination units and for initiating commercial applications in the Mediterranean. The exploitation plan collects in few comprehensive pages the ADU-RES message that indicates the way to follow for commercial ADU applications.

1.2 Objectives, work performed, contractors involved and main achievements

ADU-RES has organised its actions into a detailed work plan operating on four levels:

1. Consortium management (WP0)
2. Research coordination work (WP 1)
3. Thematic research and study work (WP 2 – WP 7)
4. Dissemination work (WP 8)

The work-packages are related with each other as reflected in figure 1:

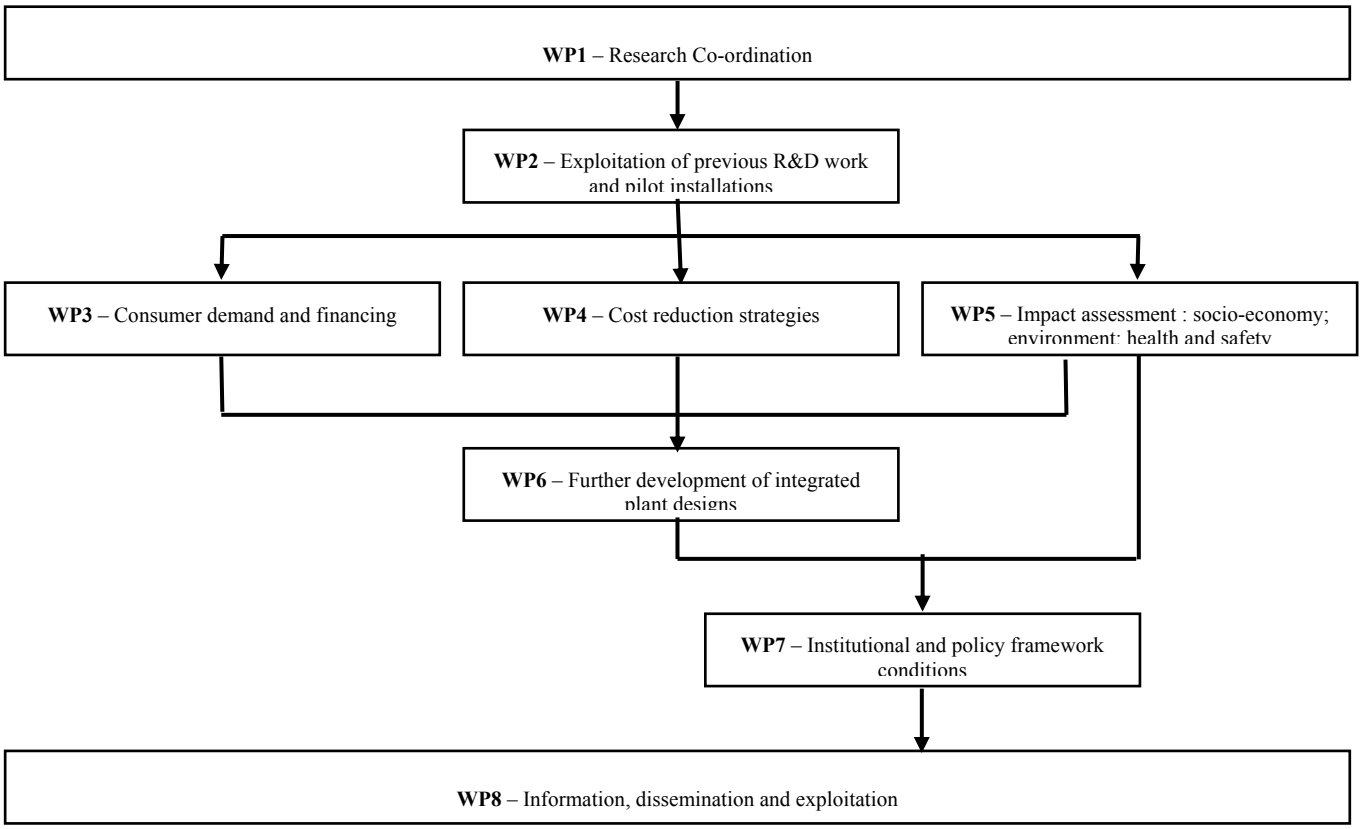

Figure 1: Graphical presentation of the work-packages

An overview of the project objectives, the work performed and main achievements will be **presented shortly in this section**, along the lines of the work-packages. **More detailed information** of the actions carried out for every work-package can be found **in section 2 of this report**.

WP 0 - Consortium management

The main objective of this WP is to ensure smooth implementation of all project activities and administrative obligations.

A kick-off meeting in Munich and three project progress meetings, in Marrakech, Hammamet and Amman were held. The work progress was discussed and planning for the next periods was made.

The WP was a success as all administrative and contractual obligations were fulfilled without major delays and on budget. In general a good working environment has been developed with frequent and effective communication among the consortium members as well as with the EC officers.

WP 1 - Research co-ordination

The main objective in WP1 is to create close ties of research exchange and communication between all partners. Thus, all the members of the consortium will work closely together for the achievement of the project research targets, using the knowledge pools of all the involved institutions. Finally, in this WP is also aimed to create the framework for enhanced communication and cooperation between all the related researchers worldwide.

An internal communication platform (intranet) has been developed and integrated into the project website. This gave the opportunity to the consortium members to keep up to date with the research actions within all the work-packages performed by other contractors.

A user friendly tool has been developed in Excel format that enabled consortium members and the international research community to exchange up to date information for publications related to autonomous desalination and the target area. This is in effect a database of publications and is called "Research Matrix".

ADU-RES has been actively represented in the EuroMed 2004 conference "Desalination Strategies in South Mediterranean Countries" in Marrakech, Morocco. Many consortium members participated in the conference and informed the conference participants about the ADU-RES project and its activities. Informal meetings were arranged with industry representatives where extensive discussions took place on technical issues and the potential of market development for the renewable energy based desalination.

In the ADU-RES event in Hammamet, Tunisia more than 100 participants representing national and international scientists, policy-makers and entrepreneurs had the opportunity to meet, get informed about the latest technical developments and network.

In the ADU-RES event in Amman, Jordan more than 40 national and international scientists, policy-makers and entrepreneurs had the opportunity to meet, network and get informed about the project results.

WP 2 - Exploitation of R&D work and pilot installations

The main objective of this work-package is to set the foundations for the next steps of the project by collecting past research, development and demonstration activities, and identifying key research results, research actors and demonstration sites.

A great amount of relevant information has been collected that is very useful for the planning and implementation of the next work-packages. The WP has succeeded to compile all relevant information into a comprehensive report that reflects the current status of the technology offering to the consortium and to all interested stakeholders the required tool for capitalising on past actions when researching into this field.

WP 3 - Consumer demand and financing

The objective of WP3 is to study the needs and requirements of specific user groups in order to guide the technology developers into designs tailored to the needs of the end user. Additionally, as the end users are identified and studied, the required information for entities that want to enter this emerging market are collected and documented.

In order to create a clear picture of the framework conditions for all the interested stakeholders, the schemes with which projects could be financed are analysed and evaluated for their suitability to small desalination applications.

An Excel model has been developed that analyses the water supply by means of Autonomous Desalination Units powered by Renewable Energy. The ADURES model focuses on a detailed analysis of some options related to the production of "limited" quantities (< 50 m3 per day) of fresh water through RES powered desalination units.

In the field of consumer monitoring, user groups that complied with specific characteristics, mainly scarcity of fresh water and access to salty water and renewable energy resources, have been selected and analysed. The consumers were in Morocco, Algeria, Tunisia, Egypt and Palestinian Authority and the information collected is presented in a report that giving a unique in-sight into the isolated rural communities in pressing need of autonomous alternative water solutions.

A desk based research was performed in order to bring together all the relevant information for schemes that could be employed for financing this kind of projects. Everything has been compiled in a comprehensive report.

WP 4 – Cost reduction strategies

The objective of this WP is to analyse the techno-economic performance of selected technologies and highlight the items where cost reductions could be realised either in a short term or in a longer term perspective. The steps followed for realising this objective were:

4.1 Evaluation of Techno-Economic Performance of Selected ADU Technologies

4.2 Definition of Cost Reduction Potential for ADU Technologies

4.3 Collection of Results of Task 4.1 & 4.2 in a Concise Report

The results of the above work were the base of the two scheduled deliverables.

The first deliverable has two parts: Part A is the "Report on techno-economic performance and cost reduction potential". In this part of the report are described the ADU-RES components that significantly affect the produced water cost. The alternative solutions for each component are presented with their most important technical characteristics. The supply cost and operation and maintenance needs are also outlined. Furthermore information on the integration of each component to the ADU-RES are provided and estimation of the cost reduction potential. Finally, any significant environmental issues for the described components are addressed.

In the Part B of the same deliverable is presented the model used as a supporting tool to extract qualitative conclusions about the cost reduction. This description includes the different cases and sub-cases that were simulated. The theoretical results are complemented with data from practical cases. Finally, the report offers the extracted conclusions and the consequent recommendations to be taken into account in order to reduce the costs in ADU RES systems.

A separate document based on Deliverable 4.1, was also prepared with general recommendations to be taken into account on the development of new more economical integrated plant designs. This document entitled: "Recommendations for further development of integrated plant designs" comprises the second deliverable of WP4 (Deliverable 4.2).

WP 5 – Impact assessment: Gender, environment and health

The objective of this WP is to analyse the environmental, gender and health issues related to the installation and operation of autonomous desalination units.

The work has been separated in two main parts. The environmental study was based mainly on desk-based research. For the social part of the study a questionnaire has been developed and was widely distributed to local populations in the target countries. The results of these actions were processed and presented in one extensive report. The main conclusions derived from the report together with concrete recommendations for project developers have been collected in a separate document.

WP 6 – Further development of integrated plant designs

WP6 aims to integrate the results from WP2 – 5 and to compose a guideline for ADU-RES design. From the WP2 results the most promising strategies for coupling ADU with RES were summarised. The peculiarities resulting from intermittent or variable-rate operation of the RES and recommendations for dealing with them were described, as well as other important topics such as fouling, scaling, corrosion and post-treatment. The results from WP5 on environmental and social impacts were also condensed and complemented from other literature sources. For each of these topics a chapter was developed with conclusions and recommendations. All chapters were collected in a report, deliverable 6.2.

In parallel, a computer simulation of PV and wind driven RO units was developed. This has been fed with data from several real systems. The results are described in a report and give an insight in the energy performance of the units and how this could be improved.

WP7 - Institutional and policy framework conditions

This work-package addresses the institutional and policy framework aspects.

The relevant legislation and policy programmes in Greece, Spain, Tunisia, Jordan Morocco and Algeria as well as on an EU level were analysed. The results were presented in a separate report for each case.

Based on this analysis, a general action plan was developed calling the Mediterranean countries for concrete actions that will help the autonomous desalination to be established.

WP 8 - Information dissemination and exploitation

The objective of the dissemination WP is to maximise the impact of the co-ordination action and the exploitation of results produced, in terms of awareness, information availability and market initiatives.

The project website provides up to date information and has more than 750 visitors every month. ADU-RES is also present in various relevant international events creating awareness of its activities. Three newsletters have been developed, printed and distributed. Finally, an exploitation plan was developed that calls the autonomous desalination community to follow concrete steps in order to get organised and established.

1.3 Problems and corrective actions undertaken

No major problems were faced.

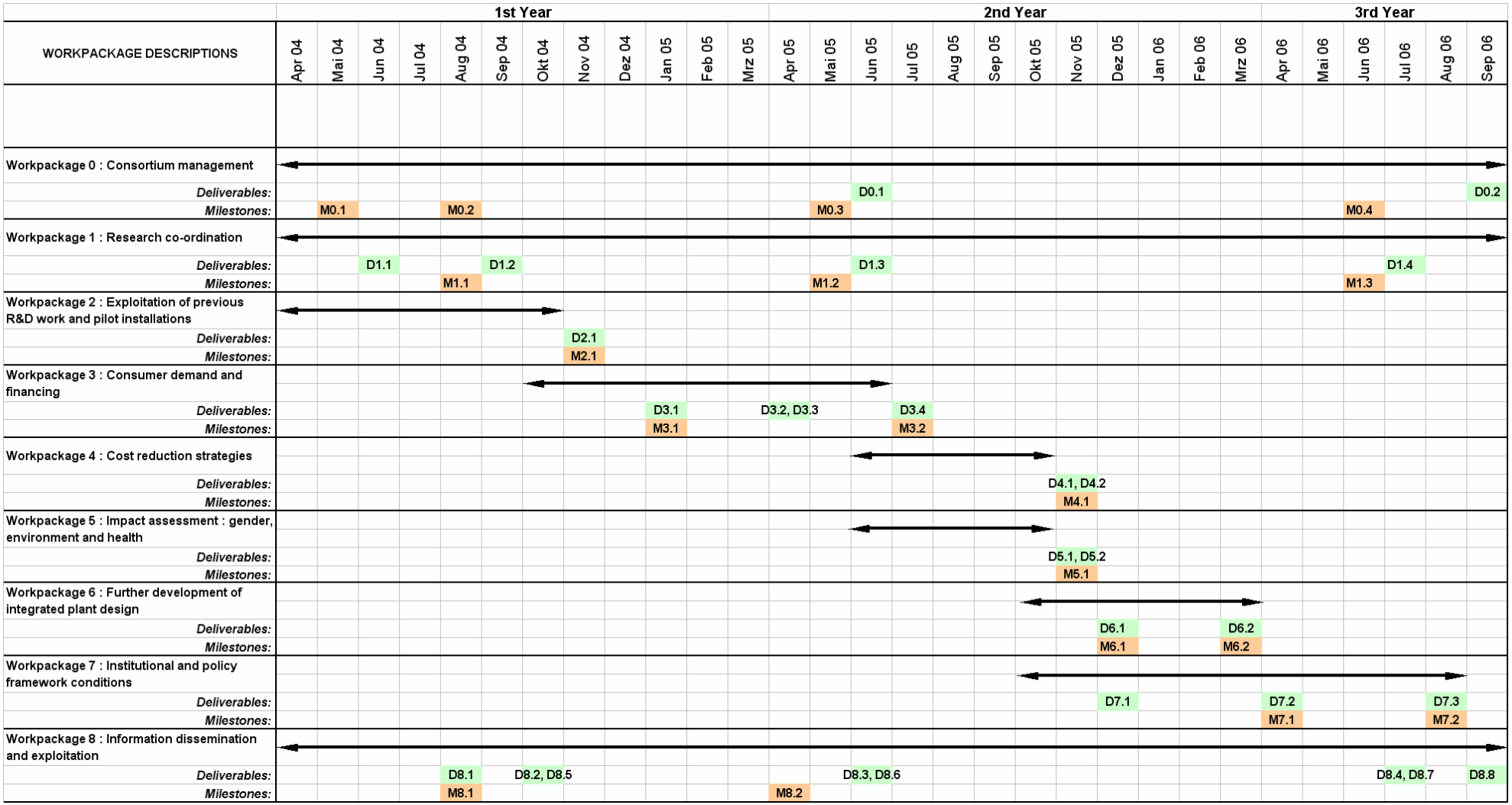

Figure 2: Timetable

Section 2: Work-package progress of the period

In this section an overview of the actions carried out in whole project period is given. For each work-package, information are presented under the following headings

- Work-package objectives
- Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, contractors involved
- Deviations from the project work programme, and corrective actions taken.

2.1 WP 1 - Research co-ordination

Work-package objectives

The "research co-ordination" work-package aims to enhance exchange of information and communication among the consortium partners as well as within the wider scientific community active in the autonomous desalination field. The work has been broken down into the following specific tasks:

Task 1.1 – Electronic intranet for research related communication.

Task 1.2 – Various research exchange activities in the MPC and the EU

Task 1.3 – Organisation of 3 ADU-RES seminars

Progress towards objectives – tasks worked on, achievements made and contractors involved:

The leader of this work-package is WIP together with ELARD. All other contractors support the implementation of this WP. The activities of WP1 are spread over the whole duration of the project, as can be seen in figure 1. Here the WP1 activities in the third reporting period and the related outcomes are described:

Task 1.1: An **intranet** tool has been developed. This electronic communication platform can be accessed over the project website and is not open to the general public. Each contractor has been given a unique "user name" and "password" in order to log in the project intranet. WIP is the administrator of the communication platform and maintains the information flow.

The intranet is organised in the lines of the project work-packages. The user can choose the WP that interests him and get informed about the contractors that take part, the objectives, the tasks and the relevant timetable. Then, all relevant information about the WP execution, either drafts, reports or other auxiliary documents can be accessed. Thus, at any moment every contractor had a clear picture of the project status, achievements and planned actions.

The intranet tool has been extensively used by the ADU-RES consortium. It has been constantly updated by WIP in order to keep the consortium informed about the latest news and results of the project.

Task 1.2: For the realisation of the objectives of the WP1, the most important tool that will have also long-term effects is the establishment of **research exchange activities** between all the relevant stakeholders. In this respect three main actions have been undertaken:

1) The **research matrix** has been elaborated by WIP and all contractors have been contributing constantly to its update. The research matrix is an excel based, easy to use database with information from publications related to autonomous desalination and links to institutes and companies active in the field.

2) As part of WP1 all partners have collected contact details from individuals, organisations and institutions active in the desalination and renewable energy field. These data have been

added to the **database** developed in WP8. The database has been used to inform stakeholders about the ADU-RES events and to disseminate the project results.

The research exchanged described above is an additional tool used complementary to the specific information exchange that takes place anyway as part of the work performed within the various work-packages. Thus, this normal information exchange and networking procedure is enhanced and the expected results of more intensive and targeted research, new networks, initiatives and pilot demonstrations is achieved quicker.

3) As a research exchange activity with long term positive effects a plan was conceived focusing on the promising new generation of researchers form the MPC and the EU. A **training course for students and young researchers** was designed that should be followed with their placements in the consortium and other institutes for short internships. Thus young researchers from MPC will have the opportunity to work for some months in EU institutes, benefiting from the know-how and the personal relationships they will develop and similarly EU students will go to MPC with the same benefits. As the ADU-RES funds cannot support such an activity additional funding has been sought. A funding proposal has been put together and submitted to the INCO-MPC/SSA-2 call on September 2004. This effort for funding has been unsuccessful. However, the consortium is determined to put this plan forward as the funds required are not very high in relation to the expected outcomes of such an action.

Task 1.3: The EuroMed 2004 conference "Desalination Strategies in South Mediterranean Countries" in Marrakech, Morocco organised by the European Desalination Society is an important event, especially relevant to the activities of the ADU-RES project. Therefore, it was planned to organise a **seminar** parallel to the conference presenting the activities of the project. However, the project start was delayed and on May 2004 no project funds were available. Therefore, the scope of the seminar was narrowed down. More specifically, it was decided instead of renting an expensive venue, similar effects could be achieved with consortium members participating actively in the conference and informing the participants about the ADU-RES project and its activities. In the framework of this approach the following actions have taken place:

- ADU-RES planned activities were presented as part of the official conference programme.
- Many members of the ADU-RES consortium participated in the conference, distributing the newsletter developed for that purpose and informing personally key stakeholders about the planned activities of ADU-RES.
- Two meetings were arranged parallel to the conference. All consortium representatives present in the conference attended both meetings. The first was with representatives from the industry, namely the membrane manufacturers Dow chemicals. Technical issues related to the use of products designed for large scale desalination plants in small autonomous units were analysed. The second meeting was with Moroccan stakeholders from the national water authority (ONEP). Extensive discussions took place on the potential of market development for the renewable energy based desalination in Morocco.

The second **ADU-RES seminar** took place in Hammamet, Tunisia on the 26th of September 2005. The seminar has attracted a large and diverse collection of actors from the desalination and renewable energy scene from Tunisia and other Mediterranean and European countries - a total of 125 participants from 15 countries. This event brought together politicians, decision makers, researchers, lectures, engineers, students, commercial companies of water desalination systems and related equipment, water suppliers, NGOs and consumers, to discuss and analyse the different issues related to development of autonomous desalination based on

renewable energies. This was an excellent platform for research exchange activities. For the preparation of the seminar and the coordination of the tasks of the local partner a meeting has been arranged with a WIP representative and took place in April in Tunisia.

The final **ADU-RES seminar** took place in Amman, Jordan on the 19th of September 2006. This event brought together politicians, decision makers, researchers and representatives from the industry to discuss and analyse the institutional and policy issues related to development of autonomous desalination based on renewable energies. This was an excellent platform for research exchange activities. The seminar was a parallel session to the "Global Conference on Renewable Energy Approaches for Desert Regions (GCREADER)" which was held in Le Royal Hotel, 18-22 September 2006 under the Royal Patronage of His Majesty King Abdullah II. For the preparation of the seminar and for the coordination of the tasks of the Jordanian partner RSS, Dr Christian Epp from WIP held meetings in Amman in autumn 2005.

Deliverables List

Del. no.	Deliverable name	WP	Date due	Actual/Forecast delivery date	Lead contractor
D1.1	Internal research exchange platform	1	Jun 2004	Oct 2004	WIP
D1.2	Proceedings of the first seminar	1	Sep 2004	Sep 2004	IAV
D1.3	Proceedings of the second seminar	1	Jun 2005	Nov 2005	INRGREF
D1.4	Proceedings of the third seminar	1	Jul 2006	Sep 2006	RSS

Milestones List

Mil. no.	Milestone name	WP	Date due	Actual/Forecast delivery date	Lead contractor
M1.1	Implementation and documentation of seminar 1	1	Aug 2004	May 2004	IAV
M1.2	Implementation and documentation of seminar 2	1	May 2005	Sep 2005	INRGREF
M1.3	Implementation and documentation of seminar 3	1	Jun 06	Sep 06	RSS

Deviations from the project work programme

No major deviations from the work programme were observed.

The first seminar scheduled to take place in Marrakech in May 2004, has been realised in a different manner than initially planned, because of the delayed start of the project, as explained in the previous section. The result was that instead of renting a venue and performing a dedicated seminar, the more cost-effective option was chosen to inform about the project activities through an official presentation of ADU-RES as part of the conference programme and informal meetings parallel to the conference.

2.2 WP 2 - Exploitation of R&D work and pilot installations

Work-package objectives

In this work-package the objective is to collect information about past research, development and demonstration activities, and identify key research results and demonstration sites in the field of desalination based on renewable energy. The outcome of this research activity was used as a basis for the next steps of the ADU-RES project.

Progress towards objectives – tasks worked on, achievements made and contractors involved:

The leader of this work-package is CRES while the following contractors offer their support: WIP, LOUGH, FM21, INRGREF, ITC, RSS and JRC. The execution of the work-package activities has started on April 2004, together with the project, and was scheduled to be completed by November 2004. Here all the activities and the related outcomes are described:

List of the RES desalination models: First, a list with all the simulation software tools that have been developed in the field of desalination based on renewable energy the recent years has been compiled. There are ten simulation models presented, with an overview of each one describing its main functions and possibilities. Additionally, for every model, there are the developers and all the available reference mentioned, allowing the reader to obtain more information if desired.

List of the renewable energy based desalination plants: A long list with abstract information on installations worldwide has been collated. The following restrictions were imposed for the plants that should be included in the list:

- capacity of 50 m3/day or less
- autonomous plants, the grid connected are out of the scope of the project
- Hybrid systems will be included but only if diesel generators are used as a back-up

The list includes 30 RES distillation plants, 54 RES membrane plants and 3 hybrid ones. In total there are 87 plants referred, some of which are still operating, while others have been running for some time but are currently out of use. This list is a very useful tool in itself, as it offers a unique collection of the autonomous desalination installations.

Questionnaires for different technology combinations: The next step in this work-package was the preparation of questionnaires for the collection of detailed information for some of the plants from the list. Five different questionnaires have been prepared for the following five technology combinations: PV - RO, Wind - RO, hybrid-RO, solar thermal - MED, solar thermal – MSF.

Representative plants from the list have been selected for the collection of additional information. The questionnaires have been filled in with as many information as possible. For the collection of the required information several methods have been used, including: literature review, internet research and personal communication either with the manufacturers or with the owners and operators of the various installations. In some cases, people were reluctant to offer technical information about their units, either because the technology did not perform as expected or for protecting the knowledge. By explaining the scope of our research and the publication that would be developed many agreed to give the relevant data, however there were still companies that have chosen to keep on with their pilot plants without sharing their results with the international research community.

More than twenty questionnaires have been filled-in.

Report on the status of desalination based on renewable energy: All the work performed in the research steps described above has been documented in a comprehensive report. The report is structured in the following sections:

- General introduction into autonomous desalination and the scope of the report
- Description of the available combinations of renewable energy systems with desalination technologies introducing the main technological features of each one.
- General guidelines for selecting the appropriate technology combination depending on the framework conditions and requirements of each case
- An overview of selected plants worldwide is given focusing on the technological and financial performance of the units and the lessons learnt from their operation
- A survey of the relevant software simulation tools.
- An appendix with a list including the installed plants worldwide

Apart from that, an executive summary is summarising the findings of the report in a few pages offering to the reader an overview of the status of desalination powered by renewable energy.

Deliverables List

Del. no.	Deliverable name	WP	Date due	Actual/Forecast delivery date	Lead contractor
D2.1	Report on the status of "Autonomous Desalination Units Using Renewable Energy Sources"	2	Nov 2004	Dec 2005	CRES

Milestones List

Mil. no.	Milestone name	WP	Date due	Actual/Forecast delivery date	Lead contractor
M2.1	Concise summaries of state of the art which can be used in the following WPs	2	Nov 2004	Feb 2005	CRES

Deviations from the project work programme

In general, the implementation was realised in a slightly slower pace than initially planned. The reasons for that were explained in detail in the first periodic activity report. The work-package has been completed successfully and has given deliverable 2.1, a unique report compiling a huge amount of information on the topic.

2.3 WP 3 - Consumer demand and financing

Work-package objectives

Work package 3 aims to analyse the potential end-users of the technology in five specific countries, namely Morocco, Algeria, Tunisia, Egypt and Palestine. The objective is to gather relevant information that will help the next work-packages to make recommendations for designs tailored to the needs of the end user.

Additionally, the market analysis is completed by a report on the financing schemes that are suitable for the installation of small desalination units. Finally, a computer model will assist interested stakeholders and decision makers to assess the impact of small desalination units into the overall planning for a small area.

The work to be performed in this work-package has been organised along the lines of the following four tasks:

Task 3.1 – Development of individual needs assessment methodology using questionnaires and a computer spreadsheet model, based on the MedWater Model

Task 3.2 – Assessment of water needs and consumption monitoring of four consumers from prominent user groups in the Mediterranean region in remote and rural areas.

Task 3.3 – Detailed study of the consumers of Task 3.2

Task 3.4 – Investigation of financing schemes for the selected users

Progress towards objectives – tasks worked on, achievements made and contractors involved:

The leaders of this work-package are ELARD and EWE while the following contractors support the work-package activities: WIP, CDER, ETA, IAV, INRGREF and PHG. The work-package has started on October 2004 and is scheduled to be completed by July 2005. Here, all the activities that took place in the second reporting period and the related outcomes, in each one of the tasks presented above, are described:

Task 3.1: A **computer model** has been developed for use by project planners and decision makers at a local level. This programme is integrated into existing software called MEDWATER model. This allows the user to get information on the water management options of the wider area. Thus, the decentralised solutions, like autonomous desalination units, are put into a general perspective and an assessment is given of their potential role in the integrated water resources management of the region.

The software runs in an "Excel" environment and is built on the "Visual Basic" programming language. It requires some data as an input that the user has to type in for the specific area. For some of these data, the programme can use pre-defined estimations or get data automatically from on-line databases. Still there are some fields which should be completed by the user to describe characteristics of the specific area and define his requirements.

Initially the programme requires general geographical characteristics of the area, water related data and some data related to water intensive economic activities like agriculture and tourism. Based on these, the model produces an estimation of the current and future water supply situation of the area. This prediction is visualised in two separate graphs reflecting the water deficit on a monthly basis for a one year period.

In a second step, the model focuses on a local level and the option to cover the municipal water needs by the use of an autonomous desalination unit. In that part of the model, climatic data of the site are required as well as information on the availability of brackish or sea water that can be used as feed water in a desalination unit. Then the programme gives to the user the option to get some abstract information with the general features of the main technologies for

desalination based on renewable energy. Finally, quantified results are given for the production capacity of each technology and the required size of the energy components.

Task 3.2: In this task the **on-site research has been carried out in five countries**, Morocco, Algeria, Tunisia, Egypt and Palestine. In a first step a detailed schedule for the coordination of the on-site research has been prepared including also detailed directions for the researchers, explaining the aim and objectives of this task and of task 3.3.

The main objective of task 3.2 has been defined to be the collection of information on potential consumers of the fresh water produced from autonomous desalination units. The data to be collected for each consumer covers the water demand, water supply and energy supply situation as well as some general information on the consumer group. For that purpose a questionnaire has been prepared entitled "Portraits of the consumer groups". The questionnaire is rather short, requiring only the necessary information for forming a general idea about the suitability of the selected user group for covering their fresh water needs with an autonomous desalination unit.

The target has been set to identify and analyse twenty consumer groups, four from each country. In deed, the respective partners have chosen four consumers each and have filled in the portrait questionnaires. The consumers were selected based on specific predefined characteristics, mainly scarcity of fresh water and access to salty water and renewable energy resources. The twenty completed questionnaires offer a unique insight into the specific characteristics of the potential end-users of the technology under consideration.

Task 3.3: In this task it is aimed to get **more detailed information about the most relevant consumers of task 3.2**. Therefore, the twenty portraits of the consumers have been reviewed and the two most promising users from each country have been selected for further research. A new questionnaire has been prepared to guide the detailed study of the selected user groups. This questionnaire allows the researcher more flexibility to include the information he considers more relevant to the chosen user group. The difference from the portrait questionnaires is that here more detailed information are required both, qualitative and quantitative.

The results and conclusions of tasks 3.2 and 3.3 were compiled into a comprehensive report. The report conclusions include recommendations for further development of integrated plant designs and were communicated to the following work-packages. Thus, the final report incorporates deliverables 3.2 and 3.3.

Task 3.4:

In this task a **study of the financing mechanisms** that could be used in small desalination projects was performed. All the results are documented in a comprehensive report. The report is divided into 6 main sections:

- Introduction
- Description and comparison of the various financing schemes and mechanisms for renewable energy projects.
- Description of small scale desalination practices and potential funding sources for ADU-RES projects.
- Case studies of renewable energy powered desalination practices, with special focus on Mediterranean Partner Countries.
- Conclusions and recommendations concerning ADU-RES financing strategies and mechanisms.

Because of the similarity these projects have with the usual renewable energy projects, the research builds on the experiences acquired from the financing of small scale renewable energy projects in the target countries.

Deliverables List

Del. no.	Deliverable name	WP	Date due	Actual/Forecast delivery date	Lead contractor
D3.1	Development of a planning model for ADU implementation based on the MedWater Model for Integrated Water Planning	3	Jan 2005	May 2005	ETA
D3.2	Portraits of the 4 selected consumers in respect of water demand and economic characteristics	3	Apr 2005	Sep 2005	EWE, WIP
D3.3	Formulation of recommendations for further development of integrated plant designs in WP 6	3	Apr 2005	Sep 2005	EWE
D3.4	Report on private and third party financing in respect to selected user groups	3	July 2005	Feb 2006	ELARD

Milestones List

Mil. no.	Milestone name	WP	Date due	Actual/Forecast delivery date	Lead contractor
M3.1	Method for need assessment as basis for ADU-RES planning available	3	Jan 2005	Jan 2005	ETA
M3.2	Clear understanding for the energy, water and economic peculiarities of concrete water consumers as knowledge of supply requirements for further development of integrated plant designs (WP6)	3	Jul 2005	Jul 2005	EWE, WIP

Deviations from the project work programme

No major deviations from the work programme have been reported. The work of task 3.4 was completed later than initially planned. This was because of delays in collecting all relevant material as well as because of delays from the coordinator side to give feedback to the responsible partner (ELARD). However, this had no impact to the project progress as the D3.4 was not a necessary input to the next WPs

2.4 WP 4 - Cost reduction strategies

Work-package objectives

In this work-package the aim is to identify how cost reductions in autonomous desalination technologies could be achieved. The objective is to analyse the techno-economic performance of selected technologies and highlight the items where cost reductions could be realised either in a short term or in a longer term perspective.

The work to be performed has been organised in three tasks:

Task 4.1 – Evaluation of techno-economic performance of selected ADU technologies

Task 4.2 – Definition of cost reduction potential for ADU technologies

Task 4.3 – Collection of results of Task 4.1 and Task 4.2 in a concise report

Progress towards objectives – tasks worked on, achievements made and contractors involved:

The leader of this work-package is AUA and ITC while WIP, FM21 and EWE support the WP activities. The activities of this work-package started on June 2005 and finally finished on April 2006.

The approach used to the execution of the work was followed the "WP4 roadmap" that has been prepared to facilitate the synergies with the work performed in WP2 and to set some guidelines and a detailed timetable for the execution for the three tasks and the production of the two deliverables. The steps followed were:

4.1 Evaluation of Techno-Economic Performance of Selected ADU Technologies

In this step firstly criteria were established for the selection of the key parts of an ADURES system affecting the overall performance, and based on those criteria was prepared a questionnaire to help collecting data concerning the variable solutions their technical characteristics and their prices in several countries. The questionnaire was prepared from AUA and ITC and was filled from all the participating partners.

The data collected were the base for the development of an optimisation model by ITC to support the evaluation of the deferent setups proposed and to prepare general guidelines for the design and sizing of future plans based on the previous experience.

4.2 Definition of Cost Reduction Potential for ADU Technologies

In parallel and based on the established criteria specified the most significant components that affect the cost of the produced water were defined. Subsequently an extensive survey of the various alternative solutions for each component was carried out and their most important technical characteristics together with their supply cost and operation and maintenance needs were described. Finally, based on information from previous installations, the international literature and the experience of the involved partners, information and recommendations were given on the integration of each component to the ADU-RES and the cost reduction potential was estimated. The above work was carried out from all the participating partners. Each partner undertook the preparation of one or more short reports concerning the specified key components of the ADURES. The short reports were based on a template prepared by AUA to promote the uniformity and allow the composition of a final report based on the short reports.

The short reports prepared were the following:

Name	Responsible
Report on pretreatment + feed water system	ITC
Report on high pressure pumps	FM21
Report on energy recovery systems	ITC
Report on energy storage	AUA
Report on solar collectors	EWE
Report on hybrid system	AUA
Report on fresh water storage	WIP

With the optimization model developed different RE- desalination cases were evaluated and the minimum cost combinations were found. The model was used as a supporting tool to extract qualitative conclusions about the cost reduction. Different cases and sub-cases were simulated and analysed. The theoretical results were complemented with data from practical cases concluding to consequent recommendations for the reduction of the costs in ADU RES systems.

4.3 Collection of Results of Task 4.1 & 4.2 in final Reports

The results of the above work were the base of the two scheduled deliverables. Based on the short reports a complete report was elaborated from AUA which consist the Part A of the first deliverable entitled: "Report on techno-economic performance and cost reduction potential".

In this part of the report are described the ADU-RES components that significantly affect the produced water cost. The alternative solutions for each component are presented with their most important technical characteristics. The supply cost and operation and maintenance needs are also outlined. Furthermore information on the integration of each component to the ADU-RES are provided and estimation of the cost reduction potential. Finally, any significant environmental issues for the described components are addressed.

In the Part B of the same deliverable, which was elaborated from ITC, is presented the model used as a supporting tool to extract qualitative conclusions about the cost reduction. This description includes the different cases and sub-cases that were simulated. The theoretical results are complemented with data from practical cases. Finally, the report offers the extracted conclusions and the consequent recommendations to be taken into account in order to reduce the costs in ADU RES systems.

Both parts comprise a complete report (Deliverable 4.1) describing the techno-economic performance and the cost reduction potential of the ADU RES units. The final report was prepared with the help of WIP after the valuable comments and corrections of all partners on the draft versions.

A separate document based on Deliverable 4.1, was also prepared form ITC with the help of AUA and WIP with general recommendations to be taken into account on the development of new more economical integrated plant designs. This document focuses mainly on the RO desalination technology and includes some recommendations for solar collectors as part of distillation systems; other ADU-RES options, less common and known as membranes distillation, have not been included. This document entitled: "Recommendations for further development of integrated plant designs" comprises the second deliverable of WP4 (Deliverable 4.2).

Deliverables List

Del. no.	Deliverable name	WP	Date due	Actual/Forecast delivery date	Lead contractor
D4.1	Report on techno-economic performance and cost reduction potential	4	Nov 2005	March 2006	ITC, AUA
D4.2	Formulation of recommendations for the further development of integrated plant designs	4	Nov 2005	March 2006	ITC, AUA

Milestones List

Mil. no.	Milestone name	WP	Date due	Actual/Forecast delivery date	Lead contractor
M4.1	Knowledge compiled on cost reduction strategies	4	Nov 2005	Dec 2005	ITC and AUA

Deviations from the project work programme

No major deviations from the work programme have been reported.

2.5 WP 5 - Impact assessment: Gender, environment and health

Work-package objectives

The objective of this work-package is to set out a comprehensive agenda for gender, environmental, public health and safety issues related to the implementation of small desalination systems. The outcome of this WP will facilitate future installations to take these issues in account when planning a project.

The work to be performed has been organised in three tasks:

Task 5.1 – Environmental impact assessment of decentralised desalination units in the framework of the current water supply crises in the Mediterranean Basin

Task 5.2 – Gender, health and social aspects of desalination installations based on renewable energy sources

Task 5.3 – Formulation of recommendations for further development of plant designs

Progress towards objectives – tasks worked on, achievements made and contractors involved:

The leader of this work-package is PHG together with CDER while INRGREF and IAV offer their support.

Task 5.1: CDER organised an extensive literature review supported by PHG. Many information regarding possible environmental impacts of desalination units were collected and analysed for their relevance and implications in the case of small units powered by renewable energy. The results have been collected in a report that will be one chapter of deliverable D5.1. The report contains also recommendations that will be part of the deliverable D5.2.

Task 5.2: For task 5.2 a questionnaire has been developed covering health, gender and other social issues. This questionnaire was translated in the local languages and was filled in by numerous potential end users, especially the ones identified in WP3. The completed questionnaires were collected by PHG and their outcomes were analysed. A total of 151 questionnaires were filled out: 4 in Morocco, 31 in Tunisia, 115 in Palestine (the West Bank and Gaza) and 1 in Algeria. In parallel a desk-based study regarding possible health effects was performed.

The outcomes of these actions were documented in a comprehensive report, which was integrated with the chapter on environmental issues to form deliverable 5.1. WIP contributed into the review, formatting and editing of the document.

Task 5.3: PHG together with WIP developed recommendations for project developers, based on the work in WP5, and included them in the deliverable 5.2.

Deliverables List

Del. no.	Deliverable name	WP	Date due	Actual/Forecast delivery date	Lead contractor
D5.1	Report on social and environmental impact of autonomous desalination units	5	Oct 2005	May 2006	CDER, PHG

D5.2	Formulation of recommendations on gender, environment, health and safety issues for the further development of integrated plant design (WP6).	5	Oct 2005	May 2006	CDER, PHG

Milestones List

Mil. no.	Milestone name	WP	Date due	Actual/Forecast delivery date	Lead contractor
M5.1	Comprehensive knowledge on social and environmental impact of ADUs in the Mediterranean	5	Oct 2005	May 2006	CDER, PHG

Deviations from the project work programme

In general, the WP has been running without deviations from the plan. However, task 5.2 and subsequently also task 5.3 have been delayed. The main reason is that the WP group has decided to go beyond the initially agreed desk-based study and perform on-site analysis. This decision was initiated by the good results of WP3 in detecting and analysing end-users in remote rural areas of the target countries. The preparation of the questionnaire, the site visits and the collection of completed questionnaires as well as the analysis of the results have taken much longer than the initially planned literature review.

However, this had no impacts in the overall planning of the project. The task 5.1 outcomes together with the interim results of the other tasks have been communicated on time to WP6 for the development of the guidelines.

WIP, as the coordinator of the project, contributed in this WP although initially not planned, to support on the challenging task and the extended scope of the work-package. WIP reviewed and edited both deliverables.

2.6 WP 6 - Further development of integrated plant designs

Work-package objectives

The objective of WP6 is to compose a guideline for ADU-RES design and to provide energy modelling and simulation tools, based on the results from WP2 – 5.

The work is organised in five tasks:
Task 6.1 – Adopting computer-based simulation tools of integrated ADU-RES designs
Task 6.2 – Designs recommendations based on the outcomes of the model
Task 6.3 – Review the effects of corrosion, fouling and scaling in ADU-RES designs, with particular in regard to intermittent and variable-rate operation.
Task 6.4 – Review environmental considerations and possible technological solutions that prevent them
Task 6.5 – Bring together the results of the tasks 6.1 to 6.4 to provide specific recommendations for future pilot ADU-RES plant construction

Progress towards objectives – tasks worked on, achievements made and contractors involved:

The work-package is led jointly by CREST (Loughborough University) and FHG-ISE; AUA, CRES, ITC and JRC contribute towards the result. WIP has offered additional support as will be explained later. LOUGH is concerned with Task 6.1 and 6.2 supported by CRES and ITC. FHG-ISE works on Tasks 6.3 and 6.4 with input from AUA, JRC and ITC. Task 6.5 is dedicated to bring together the results in a "design guidelines for future ADU-RES plants". This was split in two parts, one for tasks 6.1 and 6.2 and one for 6.3 and 6.4 and two separate documents were developed as will be explained below.

Task 6.1 and Task 6.2 were undertaken by CREST, Loughborough University. Detailed information describing fifteen ADU-RES demonstration systems was collected, reviewed and collated. This information included system configuration diagrams, component details and operational conditions. Six systems were then selected for detailed energy consumption modelling. Software models of the six systems were constructed in Matlab-Simulink; each individual component (motor, pump, etc.) was modelled in detail. The completed system models allowed time-domain simulation of operation over a year on an hour-by-hour basis.

The models were used to identify and quantify energy flows and energy losses throughout the six systems. The results were presented in the form of Sankey diagrams illustrating the energy flows and losses. These diagrams were discussed in detail in the report and specific recommendations made for energy efficiency improvements, both in the selected systems and more generally applicable to all future renewable-energy RO systems. The report is deliverable 6.1 and is submitted together with this periodic activity report.

Task 6.3, a review of special effects in ADU-RES was prepared in several chapters. The first chapter 'Coupling ADUs with RESs' paid special consideration to the intermittent and variable-rate operation. A report was prepared, based on literature research and field experiences by ITC. Within the second chapter 'Topics requiring special attention in ADU-RES installations' a report about Fouling and Scaling was prepared by Fhg-ISE. JRC prepared a chapter on corrosion while AUA with WIP a chapter on post-treatment.

Task 6.4 was to respect environmental and social impact considerations based on the recommendation stemming from the work of WP5. The environmental aspect that has to be addressed is mainly the brine disposal. This was addressed by AUA and WIP. The other aspects were covered by the pre-work of WP5 and complemented by literature research at Fhg-ISE.

For the social issues, the topics of health and gender were discussed in an integrative way by FHG-ISE. The special condition of rural water supply and important steps during the

implementation were outlined, with special focus on participation. Additionally, operation models were described based on reports in the literature.

Task 6.5 all contributions from task 6.3 and 6.4 were put together in the Design Guidelines (Deliverable 6.2) by Fhg-ISE. These guidelines are targeted to scientists and project developers; therefore they address aspects that should be considered while planning the installation of autonomous desalination systems. Furthermore, the guideline was made user-friendly, including boxes with recommendations and checklists.

The report has six sections:

- Introduction – prepared by FhG-ISE
- Coupling desalination with renewable energy – prepared by ITC
- Topics requiring special attention in ADU-RES installations (i.e. Fouling, Scaling , Corrosion, Post-Treatment) – prepared by JRC, Fhg-ISE, AUA and WIP
- Environmental Impacts – prepared by AUA, WIP and Fhg-ISE
- Social Aspects – prepared by Fhg-ISE
- General conclusions - prepared by Fhg-ISE

For each section, conclusions, recommendations and literature are given. The overall coordination was done by Fhg-ISE supported by WIP.

Deliverables List

Del. no.	Deliverable name	WP	Date due	Actual/Forecast delivery date	Lead contractor
D6.1	Adoption of energy modelling, simulations and outline ADU-RES designs.	6	Dec 06	June 2006	LOUGH
D6.2	Design guidelines for future ADU-RES plants.	6	March 06	Aug 2006	Fhg-ISE

Milestones List

Mil. no.	Milestone name	WP	Date due	Actual/Forecast delivery date	Lead contractor
M6.1	Methodology for computer simulation and modelling adopted	6	Dec 05	June 2006	LOUGH
M6.2	Design guidelines for future ADU-RES actions elaborated	6	March 06	June 2006	Fhg-ISE

Deviations from the project work programme

WIP was not originally planned to support in this work-package. However, because of the central role of the guidelines in bringing together the results, WIP as coordinator has participated in the planning and implementation of D6.2. In addition, WIP has supported AUA in their role to contribute the parts on post-treatment and brine disposal. In turn AUA has supported WIP in the development of the report on Greece in task 7.2 as will be explained in the next paragraph.

2.7 WP 7 - Institutional and policy framework conditions

Work-package objectives

WP7 aims to provide expert support to policy-making and institutional capacity building measures for ADU-RES. The objective is to assess the existing institutional and policy framework conditions for ADU-RES in the EU as a whole and some target countries of the Mediterranean region and to formulate recommendations for favourable legislation and institutional environments. The work has been organised in the following three tasks:

Task 7.1 – Analysis of the relevant EU legislation and policy programmes

Task 7.2 – Selection of four representative Mediterranean regions for institutional and policy framework analysis. Key items for the research will be the local water and energy prices, administrative system of water supply and stage of privatisation and subsidies in the field of water and energy supply.

Task 7.3 – Formulation of an action plan to accomplish favourable institutional and policy framework conditions for remote and rural regions with recommendations coming from the analysis of task 7.2.

Progress towards objectives – tasks worked on, achievements made and contractors involved:

This WP is coordinated by RSS and INRGREF while its activities are supported by WIP, ITC, FM21 and CDER.

Task 7.1 an analysis of the relevant EU legislation and policy programs was performed by WIP. Information was collected and analysed and the results were documented in a report that is deliverable D7.1.

Task 7.2: WIP in cooperation with AUA analysed the water policy, legislation, regulations and administration in Greece, ITC in Spain, RSS in Jordan and INRGREF in Tunisia. Additional analysis work was performed by FM21 for Morocco and CDER for Algeria. A questionnaire was sent out to active professionals in the water sector in the respective countries. This was intended to assess existing policies and institutional framework from the viewpoint of the various stakeholders. In fulfilment of the requirements of D7.2, reports were prepared for Greece by AUA and WIP, for Jordan by RSS, for Spain by ITC, and for Tunisia by INRGREF. Additionally, reports were also made for Algeria by CDER and for Morocco by FM21.

Task 7.3: Based on the above reports, an action plan was prepared in fulfilment of the requirements of D7.3 by WIP, INRGREF and RSS. The objective of this Action Plan has been to introduce small desalination as an instrument of augmenting water supply through presenting findings on successful set-ups, cost reduction, environmental and socioeconomic aspects and integrated plant designs. An analysis of policy and institutional framework favourable settings that are vital to accelerate the adoption and implementation of ADU-RES is also presented. Country-tailored action plans were also drawn for Jordan and Tunisia and presented at the final ADU-RES workshop

Deliverables List

Del. no.	Deliverable name	WP	Date due	Actual/Forecast delivery date	Lead contractor
D7.1	Survey on the relevant EU legislative and policy framework	7	Nov 2005	June 2006	WIP
D7.2	Reports on target region research on institutional and policy framework conditions	7	Mar 2006	May 2006	RSS, INRGREF

D7.3	Action plan for accomplishing favourable institutional and policy framework conditions for ADURES in EU and MPC.	7	Jul 2006	Aug 2006	WIP, RSS, INRGREF

Milestones List

Mil. no.	Milestone name	WP	Date due	Actual/Forecast delivery date	Lead contractor
M7.1	Knowledge on the existing legislative and institutional framework conditions for small desalination in the Mediterranean	7	Mar 2006	Mar 2006	RSS
M7.2	Strategic knowledge for how to boost the implementation of ADU-RES	7	Jul 2006	Jul 2006	WIP, RSS, INRGREF

Deviations from the project work programme

No major deviations from the work programme have been observed. Task 7.1 was slightly delayed as explained in the previous periodic report but still ready on-time for being presented in the final workshop in Jordan.

WIP was supported from AUA in the preparation of the D7.2 report on Greece because of the contacts and knowledge AUA has on the Greek situation. In turn, WIP has supported AUA in WP6 as explained in the previous paragraph.

Finally, WIP has worked in task 7.3 and contributed significantly in the development of the action plan, although initially not planned. This was because WIP as coordinator had the overview of the project and brought into the action plan the viewpoints of all WPs.

2.8 WP 8 - Information dissemination and exploitation

Work-package objectives

The last work-package intends to maximise the impact of the ADU-RES project and the exploitation of results produced, in terms of awareness, information availability and market initiatives. The objective is to ensure a widespread circulation of reports, papers, methodology and guidelines developed within the project amongst the research and industry communities.

For the achievement of these objectives the following tasks are planned:

Task 8.1 – Elaboration of a database of decision makers for decentralised desalination units in the Mediterranean.

Task 8.2 – Compilation and dissemination of three newsletters

Task 8.3 – Permanent dissemination of the project findings on the internet infrastructure. Furthermore, presence on the Desalination Conference in Morocco in May 2004 and other relevant events

Task 8.4 – Organisation of public lectures in parallel to the seminar 2 in Tunisia and seminar 3 in Jordan.

Task 8.5 – Creating on the ADU-RES seminars the basis for dialogue between industry, policy and research community. Adapt the wishes of commercial stakeholders present at ADU-RES events. Compile the results in a specific exploitation plan.

Progress towards objectives – tasks worked on, achievements made and contractors involved:

This WP is led by ETA and RSS while many activities are carried out by WIP.

Task 8.1: A **database of stakeholders** in the Mediterranean active in the autonomous desalination field is a powerful tool for the targeted dissemination of the project results. For that reason one simple template in Excel format has been prepared. The excel format and the simple template have been chosen to enable all consortium members to contribute as much as possible in the compilation of a complete database. This has been achieved in deed, as the database has more than 200 entries. The collection of the data to enter to the database was performed within the framework of work-package 1 where all partners take part. The up-dating of the database has continued for the whole duration of the project.

Task 8.2: In order to achieve the widest and most cost-effective dissemination of the first **newsletter** it was decided to prepare the issue already before the event that took place in Marrakech. Thus, the newsletter has been distributed to many individuals active in the scene of small desalination systems and in the water provision in the Mediterranean region. This first newsletter included an introduction to the topic, presented the activities of the project and introduced the consortium members.

The second ADU-RES **newsletter** has been prepared mainly with contributions of speakers from the ADU-RES seminar in Tunisia. It is an 8 page document covering a wide range of issues relevant to the desalination powered by renewable energy. The 1000 copies have been distributed in relevant events.

For the **third newsletter** two separate actions have been carried out. Firstly, the proceedings of the ADU-RES seminar in Tunisia were printed in a user friendly A5 booklet. The one side of the newsletter has the proceedings in English and the other one in French. This was distributed in the Jordan seminar and to targeted stakeholders.

Secondly, the exploitation plan (see below D8.8) has been also formatted similar to the previous newsletters. This is intended to be the main dissemination material after the completion of the project as it calls for follow-up action.

Task 8.3: An ADU-RES logo has been created and is being used on every document relevant to the project. The **project website** has been designed and can be viewed under www.adu-res.org. The website is being continuously up-dated and gives to the visitor an overview of the project objectives and activities as well as access to the latest results. The website is being continuously up-dated and gives to the visitor an overview of the project objectives and activities as well as access to documentation related to the ADU-RES events.

ADU-RES is represented in all relevant international events creating awareness of its activities to the scientific community. There is a long list with all events where ADU-RES was present and even after the completion of the project the consortium will present the results where relevant.

Task 8.4: The second **ADU-RES seminar** took place in September 2005 in Tunisia as described in part 2.1. The participation was free of charge and all sections were either presented in French or in English with French interpretation. This way, ideal conditions were created for the local stakeholders and public to attend the event and get informed about the latest developments in the field and the opportunities it offers for their decentralised water supply. After 15:00, were concentrated all research related presentations so the not specialists had the option to leave.

The third **ADU-RES seminar** took place in September 2006 in Jordan as described in part 2.1. Although the seminar was integrated in an international conference, a special agreement was reached with the conference organisers so that members of the public who wanted to attend the conference only on the day of the ADU-RES seminar could enter the hotel at a very low fee. Also the fact that the seminar took place in the centre of Amman and was widely advertised on the local level, allowed the general public to access the ADU-RES event.

Task 8.5 – The results of the ADU-RES work and the wishes of the stakeholders as expressed in the ADU-RES seminars and other relevant events have been collected and processed. The outcomes have been summarised in the exploitation plan, a document that is intended to motivate the stakeholders of the autonomous desalination community to sustain the efforts of the ADU-RES project. This report is deliverable 8.8 and is submitted together with this periodic activity report.

Deliverables List

Del. no.	Deliverable name	WP	Date due	Actual/Forecast delivery date	Lead contractor
D8.1	Database on relevant stakeholders	8	Jul 2004	Jul 2004	WIP
D8.2	ADU-RES newsletter for the first seminar	8	Sep 2004	May 2004	ETA
D8.3	ADU-RES newsletter for the second seminar	8	Jun 2005	Feb 2006	ETA
D8.4	ADU-RES newsletter for the third seminar	8	Jul 2006	Sep 2006	ETA
D8.5	Presentation of ADU-RES in the Internet and on international conferences	8	Sep 2004	Sep 2004	WIP
D8.6	Public lectures in parallel to the second seminar	8	Jun 2005	Sep 2005	INRGREF

D8.7	Public lectures in parallel to the third seminar	8	Jul 2006	Sep 2006	RSS
D8.8	Exploitation plan based on D6.2 and D7.3	8	Sep 2006	Sep 2006	WIP

Milestones List

Mil. no.	Milestone name	WP	Date due	Actual/Forecast delivery date	Lead contractor
M8.1	Consortium Internet portal expanded for ADU-RES features	8	Aug 2004	Aug 2004	WIP
M8.2	ADU-RES known to the research community	8	Apr 2005	Apr 2005	WIP

Deviations from the project work programme

During the third reporting period, no deviations from the work programme have occurred.

Section 3 – Consortium management

3.1 WP 0 – Consortium Management

Consortium management objectives

The objective of the work-package 0 is to guide and manage the activities of the consortium. This includes the control of the progress towards the achievement of the pre-defined milestones and the production of high-quality deliverables. For that, it is necessary to facilitate the effective and efficient informational flows amongst consortium members

Progress towards objectives – tasks worked on, achievements made and contractors involved:

The management of the consortium is carried out mainly by WIP, the project coordinator. In the challenging task of managing an intercultural consortium with 16 members WIP is assisted by FM21, CDER, ELARD, EWE, IAV, INRGREF and PHG.

The project management succeeded in ensuring a smooth workflow and the efficient exchange of experiences, know-how, information and project results between all partners during the last reporting period. All scheduled project activities and contractual obligations have been implemented without problems. The cooperation within the project work packages and the frequent communication in the meetings and over telephone, e-mail and the internal communication platform (intranet) have created close ties among the consortium members and a good working environment.

The **kick-off meeting** has been organised in the premises of WIP in Munich, Germany, on 29 and 30 of April 2004. In this two-day intensive meeting all work-packages were discussed in detail and specific actions have been agreed. Additionally, issues related with the management of the consortium and the administrative obligations of each partner have been analysed. The meeting resulted in a good understanding among the partners for the contribution each one is expected to have in the scheduled actions of the project. Strong ties between the individuals working in the project have been created, setting the foundations for a good cooperation. The EC has been represented by its scientific officer for the ADU-RES project, Mr Enrique Playán. This allowed his interaction with the ADU-RES consortium and the participation of the EC into the concrete planning of the project actions.

The first administrative **project meeting** took place in Marrakech, Morocco. It has been hosted by FM21 in their offices on 30 May 2004. The discussion was based on the minutes of the kick-off meeting and the work that had been performed in the meantime. The decisions and activities of the kick-off meeting have been scrutinised and more detailed plans have been set up for the first work-packages. The ADU-RES activities in the EuroMed 2004 conference have also been organised in the framework of the project meeting.

The second **project meeting** took place in Hammamet, Tunisia. It has been hosted by INRGREF in the Savana hotel on 27 September 2005, the day after the ADU-RES workshop. The discussion was focused on the work that performed since the previous meeting and the next steps towards completion of the scheduled deliverables.

The third **project meeting** took place in Amman, Jordan. It has been hosted by RSS in their offices on 20 September 2006, the day after the ADU-RES workshop. The discussion was focused on the work performed since the previous meeting and the next administrative steps towards completion of the project.

Finally, information has been collected and put together in order to develop the **activity and management report** for each reporting period. In addition to the three periodic reports a complementary management report was prepared and submitted 6 months after the completion of the first period.

In general, the management of the consortium ensured that all **obligations deriving from the contract** and the consortium agreement are being fulfilled in time by all contractors.

Deliverables List

Del. no.	Deliverable name	WP	Date due	Actual/Forecast delivery date	Lead contractor
D0.1	First activity and management report	0	May 2005	May 2005	WIP
D0.2	Second activity and management report	0	May 2006	May 2006	WIP
D0.3	Final report	0	Oct 2006	Nov 2006	WIP

Milestones List

Mil. no.	Milestone name	WP	Date due	Actual/Forecast delivery date	Lead contractor
M0.1	Kick-Off meeting	0	May 2004	Apr 2004	WIP
M0.2	First administrative project meeting	0	Aug 2004	Jun 2004	WIP, FM21
M0.3	Second administrative project meeting	0	May 2005	Sep 2005	WIP, INRGREF
M0.4	Third administrative project meeting	0	Jun 2006	Sep 2006	WIP, RSS

Deviations from the project work programme

The management of the consortium ran smoothly without deviations from the planned tasks and the foreseen objectives. Because of the complications with the unforeseen complementary management report and the high-workload to manage a diverse and large consortium the personnel resources for the coordinator were higher than initially planned. This is explained in detail in the accompanying management report.

3.2 Changes in responsibilities and in project timetable

Most of the project activities have been carried out with contributions from the various partners as initially planned and indicated in the annex I of the contract (technical annex).

The only change in responsibility occurred in WP2 where CRES undertook the part of work that ISE would carry out, which corresponds to one person-month. In WP6, ISE contributed this additional person month instead of CRES. With this solution each one of the two consortium members focuses its personnel resources on the topic where they are more experienced.

As already mentioned in section 2 of this report, WIP has worked in addition to the scheduled tasks also for WP5 and WP6 contributing in the planning of the activities, the preparation of the deliverables and the final formatting and editing of the documents. In addition, WIP has also worked within WP7 more than initially planned, playing a central role in task 7.3, the

planning and preparation of the action plan. Finally, in WP0 the coordinator (WIP) has allocated some more personnel resources than initially planned in order to meet as good as possible the challenging objective of managing and coordinating the consortium activities and fulfilling the contractual obligation on budget and on time.

The project timetable as initially planned can be seen in figure 1. There have been some changes in the timing of the activities as explained in detail in the part "Deviations from the project work programme" at the end of each WP description above. All these amendments of the timing do not affect the overall planning and objectives of ADU-RES. The project has been completed in-time and on-budget without any need for corrective actions.