

HP-ACS Report Summary

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Final Report Summary - HP-ACS (Metal Hydride Heat Pump for Waste Heat Recovery in Vans Refrigeration Systems)

Executive Summary:

Following the analysis and the estimation for the refrigerated road transport market at global level, the market would reach a 17.95 % growth over the period 2014-2019, at Compound Annual Growth Rate, by increasing awareness about food safety, consumer spending on high value perishable goods and replacement of refrigerated vehicles are driving the growth in refrigerated transportation market. In the same time, the growing trend of the international transportation and handling of perishable products from producers to end-users in distant market would also contribute to such natural evolvement of this market and the increasing demand of the frozen food, which is a main drive of this market. Currently, Approximately 650.000 refrigerated road vehicles are currently in use within the EU only.

The increase of fuel price is becoming a crucial aspect for cold transport companies, since the continuous growth of oil price is leading to a drastic increase of operative costs.

Refrigerated vans and trucks spend 10.000-100.000 liter of fuel/year and 8% about of this amount is due to refrigeration, today performed by energy-consuming compressor-driven Air Conditioning Systems (ACS) fed by the electricity generated by an alternator.

The HP-ACS project deals with the development of an innovative Sorption Heat Pump, based on the adsorption/desorption of a gas stream (hydrogen) on solid beds and able to produce cold exploiting the waste heat generated by the thermal engine and thus saving 800 - 8.000 fuel liter/years for each van/truck.

The sorption heat pump to develop is a Metal Hydride Cooling System (MHCS) based on hydrogen adsorption/desorption on solid beds. Such a technology allow reaching the highest compactness and Specific Cooling Power (SCP, i.e. the ratio between cooling power and system total weight) comparing the other heat-driven heat pump units, up to 50 W/kg versus 25 W/kg of silica-gel technology.

The main S&T objectives of the HP-ACS are:

1. Developing, testing and characterizing of suitable materials for cold van (operating temperature = 4°C).
2. Designing and engineering a retrofit HP-ACS system, to be easily assembled in cold van and with the scope to minimize system weight.
3. Implementation and testing of HP-ACS prototype on a refrigerated van, in conformity to the CEI EN regulation, to be benchmarked with presently van ACS systems.

Project Context and Objectives:

HP-ACS project was aimed to demonstrate the feasibility of waste heat driven heat pump technology, based on the adsorption/desorption of hydrogen on properly designed solid beds. To reach this objective, the HP-ACS Consortium established a set of strategic objectives, of quantitative targets and of operative goals to be achieved with the new heat pump technology. In particular:

STRATEGIC OBJECTIVES

S.O.1. To develop a cold production heat pump totally driven by vans engine heat, so that cold is produced without consuming energy but simply exploiting the available waste heat.

S.O.2. To properly design the heat pump in order to install it in existing refrigerated small size van, respecting the volumes and weights thresholds, making easier the integration.

S.O.3. To promote the technology concept among the key audience and primary stakeholders, disseminating the key message that producing cold without consuming fuel is possible.

QUANTITATIVE TARGETS

(considering a 750 W_{cold} unit to be installed on a small cold van)

Q.T.1. Operative condition for sorption materials pair: the materials should work in a range of pressures of about 0.1 - 30 atm and a range of temperature 0 - 100 °C.

Q.T.2. Maximum system weight that can be accepted in a commercial system: M_{tot} < 100 kg.

Q.T.3. Price: the final market price of system should be around 1800 € (the evaluation of cost is referred to the market price of the product when industrialized on a large scale).

- Q.T.4. Life cycle of adsorption materials: 10.000 cycles approximately (corresponding to about 3 years of operation).
Q.T.5. Specific cooling power: SCPACS >15 W/kg
Q.T.6. Specific volume cooling power: SVCPACS > 7,5 W/l

OPERATIVE OBJECTIVES

- O.O.1. To select the sorption materials constituting the hot and cold beds of the heat pump. The alloys pair has to be selected after a deep experimental characterization of the operative behavior.
O.O.2. To define the system functioning strategy, based on the material performance.
O.O.3. To design the HP-ACS heat pump for a 750 W retrofit unit.
O.O.4. To fabricate and test a 750 W prototype, in order to demonstrate the feasibility and to assess the "on field" performance.
O.O.5. To evaluate the technology industrialization potentialities and to plan the market exploitation.

The tangible outcomes of the HP-ACS project, available to SMEs partners for exploitation are:

- Production process for sorption bed materials tested and validated according to application specifics.
- Executive design of HP-ACS unit, with a control system strategy integrated able to modulate the output power in function of environmental conditions. The HP-ACS unit has to reach the following targets: SCP = 50 W/kg (=15 W/kg including air-heat exchangers); SVCP = 130 W/l (=7.5 W/l including air-heat exchangers); easy retrofitting; 5 minutes of functioning when engine is turned off.
- A 750 Wc HP-ACS prototype, to be installed and tested in a Coibent Car vehicle.
- Technical-economical-environmental issues analysis.

Target market of HP-ACS project is the refrigerated transportation sector, which continues to grow reaching 650.000 refrigerated road vehicles currently in use within the EU, with a foreseen world market increase about 17.95% over the period 2014-2019.

The plan is to produce 30 HP-ACS units to be installed on 25 COICAR vehicles to be proposed to its customers + 5 vehicles in U.K. (READER's customers), immediately after the end of the project as HP-ACS technology soundness will be demonstrated thanks to the 750 W prototype testing on field. Then, diffusing the message thanks to the practical applications, the SMEs will start the industrial production of the sorption materials (production capacity > 20 kg/h) and of heat pump units, attaching the European market with a breakthrough technology.

Reaching a market penetration of 1% by 2020, the SMEs' turnover increase can be estimated of 50 M€/y.

The objective of HP-ACS Consortium is to implement a POST-PROJECT ACTIVITY PLAN, which describes, at a very high level, the work to be done after the end of the project to both reach more desirable results in terms of unit design and to scale the composite materials production up to 6 tons/y, based on the specific agreement among the SME's and with the support of the RTD performers, ENEA and LABOR. This plan is based on following the phases:

- A first and initial approach towards the industrial production, specifically in starting-up the composite materials production, will aim at a target of 6 tons/y and the fabrication of 30 HP-ACS units.
- The second set of activities would be focused mainly on the selling of the first HP-ACS units, meaning that the assembling and mounting of the HP-ACS system on the vans and to be proposed to READER and COIBENT customers;
- And not lastly, the definitive launch on the European market, based on the industrialization production of the final system HP-ACS, accompanied by promotional activities and trade network development.

Project Results:

During the RP1 (M1-M9) activities have been performed regarding different technical, administrative, contractual and management issues.

The technical activities were devoted to the development and selection of lab scale quantities of the best performing metal hydrides to be used as sorption beds of the HP-ACS system. The initially defined nine alloys (AB5 and V-based) were purchased, processed by High Energy Ball Milling and characterized. At the aim to address the tasks issues within the project scheduling, the thermodynamical data assessment was first carried on by a non-equilibrium pressure DSC approach.

The experimental campaign's results evidenced very different characteristics for the two groups of alloys both in terms of easiness of handling and reactivity with the hydrogen gas, indicating that there are no substantial margins for considering the applicability of the V-based alloys, mainly due to the activation issues.

Moreover, the DSC method resulted ineffective and it was necessary to perform equilibrium PCT analysis on the remaining five AB5 alloys of the set. The enthalpies and entropies resulting from PCT measurements have been used as input data for the MHDT-2011 software: the single cycle cooling system based on the use of two hypothesized alloys beds cannot be practically defined.

At this stage, a new and unedited configuration was ideated and modelled based on the introduction of a third intermediate bed and a double stage heat supply. The intermediate bed realizes the hydrogen thermo-compression thus supplying the cold bed that works at pressure values slightly higher than those initially hypothesized in the project proposal. The increase in the required pressure is minimal and the value still remains in easily manageable practical operative conditions. The heat supply requires an increase in the temperature level that approaches 120 °C. The new thermal level can be achieved by using the waste heat coming from the thermal engine without affecting its overall efficiency (exhausts gas easily reaches temperatures up to 600°C). This constitutes an efficient solution allowing to increase the previously defined requirement set at 100 °C (see D1.1). Also in this period the polymeric matrix to be used for the engineering of the final composite has been defined and optimized with the addition of conductive filler. The overall experimental results of WP2 are widely presented and discussed in the deliverables D2.1 Metal alloy processing and data assessment and D2.2 Polymeric matrix engineering.

The Consortium Agreement was drafted and the rules and procedures for the project agreed upon by all the members (payments, invoicing, roles and responsibilities, IPR issues, etc.). By means of an iterative cycle of revisions, the first draft of the Consortium Agreement, sent by ENEA to the partners, was modified and filled in by the members. A final version was finally agreed before the signature of the Grant Agreement, and the signatures were collected by the coordinator for the creation of the relative deliverable D8.1.

Regarding the collection and analysis of the technical requirements to be achieved for the development of the HP-ACS system, a well-assessed methodology was adopted founded on strong theoretical basis and best practices. A format table was shared with the consortium defining and organizing both the functional and normative requirements. After a deep analysis of regulatory framework and market scenario and after a long series of meetings among the SMEs and RTDPs, the Heat Pump requirements have been defined and detailed in the relative deliverable D1.1.

One of the first dissemination actions was the implementation of a public website with the main scope of diffusing preliminary information related to the project to an external audience that will be identified and clarified in the first version of the Interim Plan for Use and Dissemination of Foreground Deliverable. The domain of the HP-ACS website has been registered at: www.hp-acs-project.eu and the contents are online since June 2013. A document reporting on the preparation and structure of the website has been prepared by the coordinator and finalized in the correspondent deliverable D7.1.

In the first period, the dissemination strategy has been planned and first actions performed, preliminary indications of the exploitation strategy have been included in Consortium Agreement, the exploitation foreground table, the exploitation strategy and the forecast of patentable results reported in the DoW have been confirmed and detailed in the deliverable 7.2 - "Interim Plan for Use and Dissemination of the Foreground".

As reported in the Interim Progress Report and in the section above, the activities performed in the RP1 (M1-M9) concerned different technical, administrative, contractual and management aspects of the project. This has continued in the second period of the project, and herein such progress is reported and described relatively to the respective WPs. During the RP2 (M10-M24) activities regarding WP2, WP3, WP4, WP5, WP6, WP7 and WP8 have been performed. The specific objectives of each Work Package and the expected deliveries for the period are summarized below:

Under the WP2 lab-scale materials development under the technical activities of ENEA it has been planned to acquire, process, test and characterize the sorption materials pairs with the scope to identify the best ones to be implemented in the MHCS unit. This work package is concluded with the submission of the deliverables D2.1 Metal alloys processing and experimental assessment and D2.2 Polymeric Matrix Engineering (submitted in RP1) and the D2.3 Metal alloys Engineering (submitted in RP2).

The WP3 has been entirely dedicated to the materials scale-up, of the selected sorption materials, which were acquired and processed (in amounts suitable for the final prototype). As per work-plan, two deliverables were submitted, D3.1 Polymeric matrix and metal alloys processing scale-up (submitted on the 10/06/2014) and D3.2 Composite metal alloys processing scale-up and production, (submitted on 06/08/2014).

The WP4 included technical activities to have the executive design of the MHCS unit completed, starting from the basics to detail engineering, accompanied by the automation and control system. At month 16 of project, the two following deliverables were due, comprehensive of the activities performed and the results achieved, D4.1 Solid beds Design, (submitted on 11/08/2014) and D4.2 Control System, (submitted on the 15/09/2014). The last deliverable D4.3 MHCS Unit Executive Designs (submitted on 28/11/2014), included the designs of all the components of the final system.

The activities of the WP5 and WP6 have regarded the fabrication and integration of the MHCS prototype on the van, and also the testing protocols and its relative report, with the concrete results. The correspondent deliverables were D5.1 MHCS Prototype Fabrication and Integration (submitted on 08/05/2015) and D6.1 MHCS Prototype Testing Report submitted at the end of the project.

In regards of the WP7 Exploitation, dissemination and training, fruitful activities performed during the second period of the project, have been collected and reported in the D7.3 Final PUDF (submitted on 08/04/2015). The D7.3 also describes the strategy for the exploitation of the results, from the SME's side and a further action plan, to be put into practice, with the active support of ENEA and LABOR for industrial production of the HP-ACS units.

The Consortium Management WP8 had the main aim of carrying out the supervision of all the project activities, through specific tasks such as work planning, progress monitoring and re-scheduling in case of deviations, organization of general and technical meetings and communication with the REA. These activities were carried on by the coordinator ENEA since the beginning of the project and has been constantly carried also during the second period verifying and ensuring that deliverables and official documents foreseen by contract were submitted with suitable quality.

From the point of view of the Management activities, the following actions have been performed:

1. The preparation of the First and Second Periodic Report and of the related financial statements;
2. The preparation of an agreed version of the Consortium Agreement, submitted in its definitive, signed version;
3. The creation of a Final Report showing all the developments carried out within the project framework;
4. The submission of all the planned Deliverables for the period, and the supervision on their technical contents, on the base of what was originally planned as from the DoW;
5. The planning and organization of general Project Meetings with all the partners, and the verification of the technical developments obtained by the RTDs in accordance to what is foreseen from the funding scheme, with an internal review procedure by the SMEs partners;
6. The management and coordination of internal technical meetings at WP level in order to monitor the status of the activities and to validate the results achieved;
7. The application of a contingency plan aiming at reaching the project goals and at recovering delays induced in the activities by unexpected technical difficulties with the prototype.
8. The preparation of official documents for the Amendment request for extending the project duration;

As illustrated in the figure below, the project activities can be thought as structured in 3 main phases:

- a) Phase 1: Requirements definition and the development of the lab scale materials - identification of requirements and specifications for the HP-ACS system; the assessing of the thermodynamical data for the initially selected set of metal hydrides, the processing and the development of the materials to be used as heat pump sorption beds and the selection of the best performing materials to be used as heat pump sorption beds. - Activities performed in Period 1;
- b) Phase 2: Process design and engineering / Demonstration and assessment - the material process scaling up to obtain a very high permeable material towards hydrogen, exhibiting a constant composition during the treatment stages and the realization of the MHCS executive design, the heat exchangers design and the optimization of the volume and weight of the same unit, assembling of the unit and implementation on the COICAR vehicle. Not lastly, the demonstration tests have been completed and technological validation - Activities performed in Period 2;
- c) Phase 3: Industrial Perspectives - exploitation, dissemination and training, definition of the exploitation strategy and business plan, benchmarking the technology with respect to competitors in different application scenarios and delineating a business plan for the most promising. Technology transfer and training; dissemination of results in events - Activities performed in Period 2;

The main results of each WP can be summarized as follows:

- 1 Identification of the requirements for the sorption heat pump application on cold transport vehicles and the selection of the project specifications.
- 2 The processing of the 9-alloys defined set, the characterization of the alloys in terms of purity, morphological and microstructural parameters and the recovery of the Van't Hoff plots of the materials by using a dynamic not-equilibrium method based on the pressure DSC technique. The characterization of the final selected materials by PCT measurements and lab scale batches production of such materials. The selection of the best performing filler loaded polymeric matrix and its lab scale production. The development of a metal/matrix composite able to embed the hydrating particles.
- 3 The processing scaling up of the materials to obtain a material with high permeable properties towards hydrogen, compactness properties and constant composition during the whole treatment stages and high reproducibility in terms of dependent concentration profile during the production of the entire batch. Finally, the production of the final batches constituting the three beds of the MHCS system.
- 4 The definition of the MHCS executive design and the definition of the functioning strategies of the unit. The design of the heat exchangers and the optimization of the volume and weight of the unit, nonetheless the development of the executive project for the prototype fabrication and assembling in a COICAR vehicle for final tests and technological validation.
- 5 The execution of the components and pilot designs, designed in the previous work package. The procurement of the prototype components, the fabrication and integration of the MHCS unit (the heat pump prototype).
- 6 The testing and validating of the final prototype under real load conditions, specifically on a COICAR vehicle, which is a FIAT Doblò, the mounting of the MHCS unit, the testing of parameters, such as the van temperature, the sorption bed temperature and pressures, the flue gas output temperature and the assessment of such values.
- 7 According to the SMEs' specific interests and businesses, a comprehensive study of the market has been performed with the final aim of defining a strategy for the future exploitation route, an ownership agreement, IP protection strategy of the foreground generated during the project lifetime, the realization and implementation of the dissemination plan for promoting the project results.
- 8 Management activities were successfully carried out to support the project development and prosecution; these will be further detailed in a specific section of this report.

We can state that:

- a) The metal alloys pairs selection has been properly carried out by ENEA and the results on the polymer matrix alloys selection and their engineering were fully details in the D 2.1, D2.2 and D2.3 - MS1 achieved in the Second Period, with a delay of 2 months;
- b) The composite metal alloys were designed and polymeric matrix engineered by ENEA design, meaning the achievement of the MS2 in the P2 at M13;
- c) The sorption bed materials was produced by ENEA: MS3 achieved in P2 (M13 instead M12);
- d) The MHCS executive design was realized, including the solid beds designs and auxiliaries: MS4 achieved in P2;
- e) The prototype was made ready: MS5 achieved in P2;
- f) Testing and technology validation report available: MS6 achieved in P2;

The Consortium Management has been carried out by ENEA during the whole project, and support on the management tasks in the moderation of technical discussions and the preparation of dedicated progress meetings came from the Technical Manager UTV and from the other performers.

In summary, we can state that:

- Most of the strategic and operative goals of the project have been achieved;
- The technological choices and strategic decisions for the optimal execution of the project's activities and research have been always presented and agreed to the SME's within the consortium; their involvement in the development of the project work has been precious and always encouraged;
- Delays were assessed in the course of the project that needed attention from the Management Board and the application of a contingency plan; the prompt reaction of the partners in managing the critical aspects of the research led to the fulfillment of the Consortium obligations towards the REA and to the satisfaction of the beneficiary SMEs for what concerns the expected results of the project.

Potential Impact:

The 4 tangible results expected from the project are here listed and their output described in terms of commercial potential and impact.

- **Result 1 Production process for Heat Pump Materials**

State of development: The research planned for the achievement of Result no.1 has produced all the expected outputs. The composite materials for the three solid beds, i.e. LaNi_{4.7}Al_{0.3} /ABS/ Graphite (hot bed), LaNi₅ /ABS/ Graphite (intermediate bed) and MmNi_{4.15}Fe_{0.85} /ABS/ Graphite (cold bed), have been produced and fully characterized, leading to proper performance.

The production process industrialization has been started with the production of the materials packed in the final prototype. For this reason, Result no. 1 can be considered complete and achieved.

Next steps towards commercialization

Result no. 1 will be owned by ADMATIS (100% ownership). Now, the company has to design the production process scale-up, based on the process developed by ENEA and with the aim to produce up to 6 ton/year of each sorption material.

- **Result 2 HP-ACS Design and Engineering**

State of development: The design of the heat pump was produced and validated in the final prototype. The results are good and in line with the scope of the project, even if a further effort towards the design optimization, leading to a minimization of the HP-ACS unit to be installed on-board is recommended. The control system was designed and installed, attesting a proper behavior in wide ranges of operability. Generally, according to what was planned, Result No. 2 can be also considered complete and achieved.

Next steps towards commercialization:

The design of the heat pump and the general layout of the HP-ACS unit installation on a Doblò refrigerated van represent the main outcomes of the project and the main piece of foreground that might be subject to patenting by the owner SMEs.

A further optimization and engineering work will be needed to access the refrigeration markets and to implement a commercial product (please refer to the post-project phase planning), since, at the present, HP-ACS unit is greater in volume than the conventional technologies. The design effort will be made immediately after the end of the project and before the construction of the first 30 units by Aerfrigor and Reader.

Possible obstacles to the commercialization might be represented by initial skepticism of the customers towards a novel technology and the time for the engineering activity and for the validation of the technology at an industrial scale that may bring to a decrease in the stakeholders' interest. All these aspects have been evaluated in the SWOT analysis and a plan has been provided for facing these challenges.

- **Result 3 750 Wcold prototype**

State of development: The final prototype has been delivered to the RTD performer and properly tested in a real environment. The control system necessary for driving the HP-ACS unit has been realized and installed and a user interface has been implemented using the LabView software. Result no. 3 can be considered complete and achieved.

Next steps towards commercialization: Coibent Car will use the prototype for disseminating the HP-ACS technology and will participate in the design optimization phase, jointly with Aerfrigor and Reader, aiming to make easier the HP-ACS device installation onboard. However, the prototype will be a powerful tool for launching the technology.

- **Result no. 4 Technical and Economic Evaluation**

State of development: At the moment we write, the HP-ACS prototype tests are being completed and are about to be evaluated against the initial project objectives. However, a further investigation will be necessary during the summer months (July and August) to verify the HP-ACS unit behavior in critical situations (ambient temperature > 35°C). To the project purpose, this result is considered as achieved.

Next steps towards commercialization:

Publications and articles reporting the results of the prototype tests will be possible, and might be used for marketing and dissemination purposes in the next future. An additional 6 months of tests is going to be performed after the end of the project to accomplish this optimization need.

Market objectives and expected benefits for the SMEs

As it has been mentioned in D1.1 that the refrigeration has become an inseparable part of the lives of millions of people around the globe, especially in food conservation and transport. Due to the wide range of operating conditions and constraints imposed by available space and weight, transport refrigeration equipment has lower efficiencies than stationary systems. This, together with increasing use of refrigerated transport arising from the much wider range of transported goods, home delivery and greater quality expectations are placing considerable pressures on the food industry to reduce the energy consumption of refrigerated transport. HP-ACS technology is focused on the reduction of refrigerated vans fuel consumption thanks to the recovery of the engine waste heat for cold production, thus decreasing the van total energy consumption by 8% approx.

Surely, even the first developed prototype has demonstrated the HP-ACS concept feasibility, further optimization activities will be necessary on the heat pump to make it a real product, ready to be introduced in the target market. Validation and benchmarking activities will also be needed to reach this goal.

Here below, a short list of the SMEs' market objectives is included. In the following, the expected benefits from the exploitation of the results are also reported.

COIBENT CAR:

- Develop a detailed market analysis to access the market, starting from the Italian one where the initial exploitation of the HP-ACS will be carried out;

- Enter the market by selling the first 25 refrigerated vans with HP-ACS unit integrated, exploiting the marketing push due to the innovation.
- Optimize the geometry of the heat pump unit, improving the design;
- Investigation of new applications / markets where to exploit the new technology.

READER:

- Plan the industrial production of HP-ACS units;
- Improve the heat pump design;
- Fabricate, in joint venture with Aerfrigor, the first 30 HP-ACS unit, 25 for CoibentCar product and 5 for its U.K. customers;
- Evaluate the possibility to exploit the company's established network to access other European markets;

AERFRIGOR:

- Plan the industrial production of HP-ACS units;
- Improve the heat pump design;
- Fabricate, in joint venture with READER, the first 30 HP-ACS unit and supply 25 of them to CoibentCar;
- Investigation of new applications / markets where to exploit the knowledge gained.

ADMATIS:

- Fulfil the production of 150 kg (needed for the first 30 units) of the HP-ACS sorption materials;
- Develop a pre-industrial production with a capacity of 100 kg/day, analysing the scale-up strategies and involving primary international industrial partners.

COICAR will benefit from the first mover advantage, having the chance to install the HP-ACS unit in its refrigerated vans, proposing to its customers the first zero consumption refrigeration system. Firstly COICAR will propose the new product in Italy, where it will have the exclusive right: 25 vehicles will be sold by 2016, then it is foreseen an increase of production leading to triple the vans sale by 2020 in Italy. At the same time, COICAR will try to enlarge its own market, starting from France, where the company has already important commercial contacts. By 2020, COICAR has the target, thanks to HP-ACS exploitation, to sell 150 vans across Europe, leading to a profit increase by 1.160 k€.

READER will produce, jointly with AER, 30 HP-ACS units. Five of them will be sold to U.K. customers in order to boost the dissemination activities in the North Europe. A conservative mid-term target is the production and selling of 200 HP-ACS units in Great Britain, at an average price of 5.000 €. Moreover, READER will have the exclusive right in Germany and East Europe and it will attach such markets immediately after the technology reliability demonstration.

AERFRIGOR will produce the 25 units for COICAR vehicles after the project. Then, it will be the exclusive COICAR producer. Moreover, it will have exclusive rights in France and Spain, where AERFRIGOR will enlarge its production also looking for potential partners.

ADMATIS will supply the sorption material to AERFRIGOR and READER, i.e. the material for 30 HP-ACS units in short-term and 810 units/year at least by 2020, equal to approximately 6 ton/years. Moreover, other applications for the material will be searched, and it is foreseen to reach a material production capacity of 10 ton/year at least.

List of Websites:

The implementation of a public project website has been foreseen in HP-ACS with the purpose of raising awareness of its technological content and of the innovative solution proposed in it.

The project web site is one of the most versatile dissemination tools. It will inform stakeholders (and others) about the project, findings to date, resources that have been created and upcoming events/activities related to the sector. As a dissemination vehicle, it will include any publicity that the project will generate, journal articles, other publications, and presentations at conferences led by the project partners with the intention of spreading the interest in the HP-ACS technology.

The web site is also a mechanism for making the project non confidential information available; to do this, core project documents have been posted to the web site with the authorization of the Project Consortium, which will be provided with a forum section to be used for technical discussions and will be used as a tool for exchanging suggestions and ideas on the procedures for performing the planned research activities.

The project website can be found at the following link: <http://www.hp-acs-project.eu>

The implementation of a public website has been planned in the DoW with the purpose of:

1. To raise awareness on the features of the new pasteurizing and homogenizing system into the target market (dairy and juices ones), and
2. To show the results of the project and to foster the application of new fluid foods processing technologies.

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Subjects

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