HigHVILLE – Annex Demonstration sites ABRUZZO

Draft specification
ABRUZZO in HigHVILLE

Draft – Annex
December 15, 2003

Anne Marit Hansen,
Hydro HigHville team

HigHVILLE – Annex Demonstration sites ABRUZZO

B.1 Description of Abruzzo demonstration community

The river basin, given its geographical configuration starting in the mountains and ending in the sea, offers various sources of renewable energy; wind energy on the mountaintops and plains, biomass (in the mountains and hills), hydro (mostly in the mountains), photovoltaic in the plains near the sea, geothermal (all areas). The general use of energy in an Italian river basin is divided amongst agriculture, tourist, small industrial, transport and residential use. The territory of a river basin in Italy represents a homogeneous and defined area and is managed and administrated by a juridical institution established by law (Legge 183/89). In Italy alone over 29 national and interregional basins are identified under this law. As a well managed confined area, a river basin community could be used as an ideal entity to demonstrate the integration of existing and potential renewable energy sources. This integration could be replicated by other basins, as they are managed in the same way by regional, interregional and national organisations.

1.1 B.1.1 Area, boundaries and other general information

The Treste River Valley has a space of 162 000 scm and a population of 20 000 people. The population in the rural areas are declining and there is a need for new activities.

Main commercial activities are tourism and farming.

B.2 R&D effort in realtion to demonstration activities

Guidance:

Explain how the research/innovation effort of the project is comprised of a number of different components (major elements or blocks of work). Describe each of the components, identify who will carry out each. Show the relevance and contribution of each to the research work elements of the project on which these demonstration activities are fully or partly based. Show contingency planning for unexpected outcomes of the research work.

B.2.a Project title

Biogas from waste, polygeneration with small CHPs and experimentation on new engines

B.2.a.1 Project details from the University of L'Aquila (UNIAQ)

The studies will have two main macroactivities: the first oriented at the defining the CHP plant more suitable for locl applications, the other referred to the biogas from landfill treatments. For these two areas of interest the following considerations apply.

A) CHP PLANTS

The study will deal with the processes for producing biogas from landfill, treating it and utilising it in internal combustion engines (ICE) for combined heat and power (CHP)

applications. This research topic allows for two main aims: the effective management of a waste source and its use as a renewable source [1].
The estimated production of biogas in the landfill of Cupello is about 1.7 MNm^3 per year. This biogas will be first treated with suitable processes (chemistry, Chemical Engineering and Material Department of the University of L'Aquila), in order to yield a fuel mixture suitable to be used in an internal combustion engine for power generation. Composition of the treated biogas would be variable in according to treatment processes: methane content could reach 80-90% on a volume basis. The power plant capacity for using all the treated biogas should in the range of 250-350kW; it will operate cogenerating mechanical and thermal power. A remarkable influence on engine operation and performance is exerted by the fuel gas composition [2].
To build a demonstrative cogeneration power plant, using treated biogas as a fuel, it is necessary to produce a R&D effort devoted to physical modelling processes of the whole system, in order to optimise layout and operation of the integrated plant, and to an experimental phase carried out on a prototype plant, in order to characterise its behaviour at various operation conditions.

B) BIOGAS DEPURATION

Biogas from anaerobic digestion and landfills has significant potential as an alternative energy source. Biogas is a combination of methane, carbon dioxide, hydrogen sulphide , hydrogen, nitrogen and other trace gaseous compounds.
The potential benefits of biogas as an alternative energy source have been the subject of research over the latter part of this century [1]. In the European Community, biogas has been taken into account as an alternative energy source [2].
There are three primary compounds that must be removed to improve the combustibility of biogas: water, carbon dioxide and hydrogen sulphide. Water vapor in biogas is problematic for compressibility and should be removed prior to storage. CO_2 decreases the caloric value of biogas and H_2S is toxic and exhibits corrosive effects on process equipment.
Physicochemical methods such as physical adsorption, physical absorption or chemical absorption are commonly used to treat biogas. The removal of water vapour and H_2S can be accomplished by physical adsorption onto a solid commonly silica gel or activated carbon. Alternatively, physical absorption into a liquid will remove water vapor and H_2S, as well as CO_2. Typically, water scrubbing will remove CO_2 and H_2S, while ethylene glycols are required to remove water vapor.
Chemical solids absorbents, such as quicklime, are also capable of removing all three compounds, while liquid absorbents, such as ethanolamines, will remove only CO_2 and H_2S.
However, physicochemical processing of biogas generated additional waste and unwanted end-products. As an alternative to physicochemical processes it has been proposed that a microbial oxidation process can be employed to remove H_2S from biogas, Cork et al. first proposed the use of photosynthetic bacteria with saturating light intensity to remove H_2S from biogas [3].

ACTIVITIES

In the first area of interest, the following subactivities have been planned.

HigHVILLE – Annex Demonstration sites ABRUZZO

1.1.a Comparative analysis of cogeneration technology (Activity a)

The study will be focused biogas-fuelled power plants of medium-small size: any component must be integrated in a wider plant structured according to a cogeneration logic. The plant must satisfy two users: the electrical power generation and the heat production. Both of them require the definition of the electric power, the heat and the temperature demand of the user.
The choices related with the cycle property and plant design will be executed considering several cogeneration top layout (Internal Combustion Engine, Gas Turbine) and comparing the typical specification of he plant (pressure ratio and temperatures in GT, regime and cooling system in ICE, heat exchangers specification), in order to obtain admissible thermal and electrical efficiencies also in off-design conditions. A comparative analysis will deal with the gas small/micro-turbine plants: the effort must be devoted to the definition of thermodynamic regenerative cycle optimised to the design specification with a particular care for plant's efficiency improvement. The efforts of this analysis will be directed to enriched the know-how on the ICE plant fuelled by biogas, employing the relevant experience that the Department of Energetic has on this item.

1.1.b Modeling of engine and integrated CHP system (Activity b)

Internal combustion engines fuelled with treated biogas need optimisation of otto or diesel cycle for stationary power generation.
A particular care will be devoted to the modeling, control design and validation through experimental phase on dedicated fuelling system. The effort can be oriented to the optimisation of the combustion process related to the fuelling control (mixing of fuel with air in gaseous phase in spark ignited, the mixing with diesel combination of *combustion kinetics*, pollutants formation, regulation of the gas mass flow rate and Air-fuel ratio control).
The cogeneration heat demand can be fulfilled by the thermal exchange with the engine cooling water (90°C) with the lubricating oil (90-95°C), with the exhaust gases (300-500 °C). Inside the plant a peculiar problematic is the analysis of heat exchange dynamic, such problematic will be studied through the elaboration of unsteady models, afterwards validated experimentally.

1.1.c Experimentation of biogas-fuelled engine (Activity c)

The main field of interest is the definition of the Air/Fuel (A/F) ratio in the operating field, that is to be compared with dynamical filling models. The regulation of A/F ratio has to be optimised in respect with the emissions, the efficiency, and the engine load. The activity will be oriented to the finality of the engine plant. Advanced combustion methods are needed to achieve the target of low CO HC and NOx emission and high efficiency levels and optimised in the chosen regime field, through a correct valve timing . Advanced Sensors and Controls will be needed as part of a next-generation system for engine controls to meet the aggressive emissions and efficiency targets. Exhaust emission sensors for NOx, CO, HC in-cylinder pressure measurement, dynamic torque sensors, advanced engine diagnostic strategies may be some components oriented to such purpose.
Exhaust After-treatment is a key element of achieving the low emission targets. The study of specific catalysts for these engines will be one of the most significant topic.

1.1.d Experimentation of the integrated CHP system (engine-based) (Activity d)

A dedicated experimental activity will be devoted to the CHP arrangements to be integrated with the engine. Particular care will be devoted to the optimisation of the engine cooling system and of the waste heat recovery. This will be carried out with the aim to fit different values of mechanical-to-thermal energy production, in relation to the energy user requirements.

In the area related to the biogas cleaning the following subactivities have been planned.

1.1.e State-of the art of gas cleaning. State of the art of physical and biological gas cleaning systems.

1.1.f Selection of gas cleaning process. Selection of simple and reliable processes suited for small/medium installations. The eligible processes should be low-cost, reliable, easy to run, with low environmental impact .

1.1g System simulation, optimization and design. Simulation and design of the process. Heat and material balance of the process, evaluation of environmental impact. The simulation tools will also supply input data for an accurate estimate of investment and operation costs with reference to the application of the integrated power generation system in different economic and market scenarios, so that this experience could also be exported in other areas of the Abruzzo region.

1.1.h Building and start-up of the full scale plant. Commissioning and start-up of the full scale plant .

1.1.i Full scale plant tests. Testing and operation of full scale plant. Evaluation of performances in comparison. On site evaluation of process environmental impact.

<u>Performance indicators</u>

Indicators

- Electric power production per year
- Availability of models for the optimisation of individual components and for this global system
- Availability of experimental data for a ICE set on a test-bed:
- Mechanical power conversion efficiency
- Pollutants reduction through biogas utilisation
- Energy consumption of depuration process
- Environmental impact of the depuration process
- Characteristics of the depurated gas

B.2.b. <u>Project title</u>

PV and energy efficiency applications in eco-buildings

<u>B.2.b.1</u> ***<u>Project details from the University of L'Aquila (UNIAQ)</u>***

The restructuring utility industry, along with new or developing technologies in response of urgent problems of rational use of energy and eco-sustainable technologies, is creating a market demand for energy-efficient systems that reduce peak operating costs, increase system-wide reliability, and give customers wider choices. The result is a growing demand for smaller, flexible energy systems that are installed close to the point of use. The use of

"distributed" energy systems, in contrast to central generation, can provide benefits to both consumers and utilities alike.
Distributed energy resources (also called distributed generation) are typically small, modular, decentralized, grid-connected or off-grid energy systems located in or near the place where energy is used. They are integrated systems that can include effective means of power generation, energy storage, and delivery.
The researchers of the Electrical Engineering Department of L'Aquila University have worked for many years on the fields of the energy distribution, network automation and efficient use of energy [2], [3], [4], [8], [11]. Actually, the same researchers, have implemented a number of models and simulation tools concerning design and verification of methodologies and architectures for an efficient distribution and use of energy [1], [6], [7], [10], [14]. Many of these previous experiences have pointed out that in most of practical applications, energy efficiency and rational use of energy always involve a general approach to be followed in the design of the electrical distribution system. This wide-range procedure often include analyses in the fields of reliability and quality of supply [5], [9], [12], [13].
With reference to the HYVALLEY Project, a study able to manage the distribution system for distributed generation will be provided as well as a study aimed at building a remote control of the different sources of electrical energy. The activity will produce also some contributions related to the tariff system definition: this activity will be also referred to the demo project n. 5.

ACTIVITIES

1) Analysis of the electrical loads installed in the demonstration plant and definition of both the duty cycles and electric load diagrams. In these preliminary studies, appropriate software codes of bottom-up kind will be used.
2) Suggestions for a correct design of technological plants of the eco-buildings involved in the project. The work will carry out by using eco-sustainable technologies characterized by high-energy efficiency.
3) Implementation of a simulation model able to optimize, according to specified rules, the management of such distributed sources;
4) Reliability analysis of the electrical system.
5) Tests and verifications of the effectiveness of the proposed management rules;
6) Implementation of a remote control system of the distributed system.

Performance indicators

The technological provisions involving retrofitting interventions in the existing buildings are expected to provide on average 20% of the total demand of the buildings as a saving potential with pay-back-time less than 6 years. Typically only optimizing the running time of the equipment without any investment could save 10 to 15% of the total demand.
In addition both availability and reliability of the whole distribution system is expected to be significantly improved with respect to a conventional one, since the project provides the full redundancy of the energy sources (public grid and renewable resource).
Finally the full working on of the management software will be provided

HigHVILLE – Annex Demonstration sites
ABRUZZO

B.2.b.2 Project details from the University of Pescara (UNIPE1)

The Faculty of Economics, University "G. d'Annunzio", Pescara will contribute by:

1. assessing the overall environmental impact of power distributed generation by installing and operating PV panels in a specific beach resort, as compared to the conventional grid power supply. The assessment will be carried out through the implementation of the LCA and/or other life-cycle-based tools (testing of innovative streamlined and simplified tools more suitable for application in SMEs).
2. carrying out a Life-Cycle Assessment of the service typically delivered by local beach resorts in order to quantify the relative contribution of PV power generation and use to the overall service life-cycle and identify improvement options. The results may be considered as a first step for the local beach resort industry in any subsequent implementation of eco-labelling schemes (such as type-III eco-labels).
3. analysing the market and economic issues concerning the delivering of the surplus generated power to the local power distributor(s).

B.2.b.3 Project details from the University of Pescara (UNIPE2)

The objectives of the project are to demonstrate and advance sustainable building practices, energy saving technologies and more sustainable living practices.
The project design will be managed and implemented by considering the technical aspects of building construction and space performance, indoor environment and materials used. The implemented project demonstrates effective energy saving techniques, ranging from to maximizing heat storage through choices of appropriate natural materials and energy PV production.

The eco-building design concept will be developed on the following priority goals:

1. *Select materials which are environmentally sound while not prohibitive in cost.*
   Building materials selection criteria including: health effects; reduction in the use of toxic adhesives and finishes, energy required for transportation to site, use of toxic materials, finishes to help minimize indoor air pollutions.
2. *Use of local materials.*
   The use of low maintenance materials is a further requirement of the community members, however, cost and availability were ultimately the determining factors in whether they were used or not. Other environmental impacts including the resulting from product manufacture or demolition, energy storage, building envelope insulation.
3. *Directives for street and common spaces use.*
   Car-free commons design on human scale to encompass small gardens, benches and play areas for children with all other common spaces. Interior and exterior yardspace will be designed by the residents. The commons landscape design is determined by collaborative design workshops. Open spaces and traffic conditions will be improved by means of negotiated agreement, landowners have given up some of their property for common areas and paths. The primary objective will be to establish ecologically sound open space areas within the block itself and to rebuild one public space like a quiet street zone where people can interact with one another. The street has been altered by traffic calming features and planting new trees, with places for sitting, bikes, activities and a recharge point for electric cars.
4. *Passive solar heating and PV systems use*

Use of indoor combustion sources to help to reduce indoor air pollution and to reduction the overall CO production. Solar panel use integrated with PV panels and strips for electrical power production, for housing, recreational activities, and common/public spaces.

5. *Specification of the relationships among energetic production systems coming from renewable sources and safeguarding of the natural and appropriate technologies systems*

Activities description

The work program refers to the application of a logical process that delineates a design approach founded upon the evaluation of compatibility between places and activities, beginning from the knowledge of the environmental conditions of the context.
The whole of the acquired knowledge will provide the informative system of reference for the individualization and classification of the more recurrent situations. In comparison to the typological repertoire, it will be individualized some of the most interesting cases, for which to develop the ideation and realisation criterions for the experimentation of the PV technologies, with reference either to existing buildings or to new concepts of product.
For what concerns the existing "beach buildings", they will be activated some evaluation procedures aiming to "measure" the possibilities of their rehabilitation and their "transformability", considering the principal demands of the study subjects, delineated in this research ambit. Besides, as regard to the new realizations one will proceed to the integration of the PV technologies, for an enhanced echo-efficiency of the building interventions, evaluating the environmental effects of the solutions individualized about the following terms:

- Appropriate building operations
- use and management flexibility
- autonomic and energetic efficiency
- organic adaptability and reversibility of the constructive processes.

B.2.c. Project title

Test systems for storage, use and polygeneration from renewable power and support vehicle equipped with FC power generator

B.2.c.1 Project details from the University of Bari and Ferrara (UNIBA and UNIFE)

Low maintenance energetic system for the production of hydrogen and heat from RES (solar) suitable for small industry, farm and rural communities. This project will be integrated in the existing photovoltaic power plant in Cupello.
A PV system with concentrator (surface 40 m^2– 5 kW) will be used to supply an inverter in order to obtain AC electrical energy. Electrical energy will feed the public grid, the eco-building and a horticultural greenhouse.
Electrical energy will be used to feed an electrolyser for the hydrogen production. A hydrogen storage system and a fuel cell will be used to "store" the electrical energy, that will be used in relation with the demand from the public grid, the greenhouse and the eco-building.

HigHVILLE – Annex Demonstration sites ABRUZZO

The lack of economical convenience of photovoltaic energy is mainly caused by the high cost of the silicon employed in the realization of flat photovoltaic panels. Such an expensive material is inherently unsuitable, from the economical point of view, for a profitable exploitation of a low intensity energy source like solar energy. A possible alternative can be to concentrate, with large surfaces of cheap mirrors, the light on a small amount of highly efficient solar cells. Photovoltaic concentration can, therefore, offer a convenient alternative to flat panels photovoltaic because large powers can be produced with relatively small amount of photovoltaic cells.
A modular kW scale system is proposed based on a properly shaped reflective surface, produced in composite materials, mounted on a sun tracking frame.
A single module system is being tested at the University of Ferrara and is composed, in its simplest form, by a 2.54 m^2 resin mirrors (composite mirror) shaped to attain, at 1 meter in front of the mirror, an uniform illuminated area of 13x13 cm where the energy flux exceeds 100 times that of the sun.
This radiation is collected by a properly designed photovoltaic receiver employing high efficiency silicon cells specifically designed to handle concentrated solar radiation. Cell efficiencies, under concentrated radiation, can exceed 18% employing a relatively low cost design and can be pushed at 24% resorting to extremely sophisticated cells layouts. Currently the 18% efficiency solution is employed. Due to the high energy flux a large amount of heat is also generated at the receiver and is drained by a water cooled cold plate. Since the cooling water is in a temperature range useful for civil applications it is then feed to a boiler/distribution system resulting in a solar cogeneration system (heat + electricity).
The concentrating mirror and photovoltaic receiver are mounted, through a lightweight metallic frame, on two axis electrical movement system. The motors are in turn controlled by an autonomous sun tracking system maintaining the dish optical axis continuously pointed to the sun. This is a necessary requirement for solar concentration but it also allows for a better exploitation of solar energy resulting in energy productions that, with the same peak system power, can overcame flat panels of up to 30% on a yearly basis.
Each composite mirror has a nominal rating of 300 W of electrical power at the AC side and 1.2 kW of thermal power in the form of water between 50 and 60 C°. Four mirrors can be mounted on a single tracking system resulting in a 10 m^2 collector producing 1.2 kW electrical and almost 5 kW thermal. The complete system proposed for this demonstration site includes 4 of there systems for a total nominal power of 4.8 kW electrical and 20 kW thermal.
This project section is designed to demonstrate the possibility of economical small scale production of solar based hydrogen and to illustrate the advantages, both in terms of energy production and of heat cogeneration, of concentrator solar systems with respect to similarly positioned flat panels.
These kind of comparison is currently lacking in a southern Europe scenario and the evaluations are based on simulated data and on real experiments carried out in the different climate of California.
Since a simplified version of the concentrator system is already under test at the University of Ferrara and to the fact that the electrolyser to be employed is a commercial system, the risk of unexpected outcomes of the research work is minimal. Moreover, since this subsection is largely independent from any other, risks associated with non-conformities in other sections are minimal as well.

HigHVILLE – Annex Demonstration sites ABRUZZO

The following have been identified in case some problematic situation may arise in connection with different project sections.
In particular in the case of non utilization of the produced hydrogen in fuel cells (for any reason) such a gas can be mixed with common gaseous fuels and easily burned, with proper burner modifications, to provide extra heat to both the eco-building or the greenhouse.
In the case of elimination (for any reason) of the subsection relative to the electrolyser the electrical energy produced by the concentrators can be directly feed to any other user or directly to the grid.
If, on the other side, the photovoltaic system will demonstrate insufficient power rating for the electrolyser an integration from the nearby PV plant can be easily employed.
If no use can be found for the hot water produced by the concentrator system a water to air heat exchanger can be provided to cool the water or different systems can be designed based on passive open sky cooling of the hot water.

B.2.c.2 ***Project details from the University of L'Aquila (UNIAQ)***

The fuel cell system naturally produces electricity and heat at medium low temperature (70-80 °C in a PEM fuel cell). The tracking of the heat-to-power ratio of a small size plant requires the development of a specific steady and unsteady modeling and experimental analysis, in order to achieve an effective regulation.
Many peculiarities lead the choice to a Fuel Cell cogeneration plants, also of small size (10-15 kW) are expressed hereafter: the use of hydrogen allows for a low environmental impact, also considering that H_2 is produced from renewable sources (PV and wind plants); the conversion efficiency is not bounded by second-law limits; the efficiency remains high at low size and at partial load operation; the tracking transient response is high enough to follow fast load changes; another remarkable feature is the fact that the moving components are only owed to ancillary elements, the main conversion process is completely electrochemical. The high versatility of small size plants for mobile power unit can be suitable to a support vehicle equipped with FC module .
The versatility of a fuel cell plant can be highlighted by the two demonstrative projects regarding:
a fuel cell-based combined heat and power plant (5-10 kW), supplying electric power for a house and heat for a greenhouse;
a mobile fuel cell module placed on a vehicle able to provide electric power of 10-15 kW with an overall autonomy of seven day.
Both the demonstrative applications will require first a R&D effort devoted to physical modeling processes of the whole system, in order to optimize layout and operation of the integrated plant, and to an experimental phase carried out on a prototype plant, in order to characterize its behavior at various operation conditions.

ACTIVITIES

Analysis of FC technology (Activity a)

The choice of the PEM and the plant layout is conditioned by the user demands and, for what concerns the module lodged in the vehicle, by dimensional bounds.

The variation of heat-to-power ratio which is not relevant on the mobile module, where the autonomy is the former target, comes the main issue in the cogeneration stationary plant.
The choice of the PEM will be aimed to fulfill the user performance specification according to a logic of high efficiency and versatility, in perspective of developing a specific control support.
Also a cost and investment analysis will be draft in order to respect budget bounds and improve the economic advantage through a right plant choice .

Modeling of FC and integrated CHP system (Activity b)

Some physical properties, which make very demanding the design and control of a small size cogeneration FC plant , deserve to be specifically modelled . Many restraints are to be respected in order to guarantee a good efficiency, availability, a sufficient autonomy towards the service, the respect of the cogeneration goals .
A difficult control problem is the tracking of the relevant changes of the heat-to-power ratio due to the small size (10 kW) of the plant. Particular care requires the regulation of the heat production and the electrical stability of the load fed by a generator described by external voltage-current polarisation line whose slope gives the equivalent marginal resistance .
The model will be oriented to investigate the optimal steady regulation and the unsteady control of dynamics during the transients operations. The model will concern many regulation channels which alter both the electrical power and the heat generation. They include the change of the following operating parameters: the reactants flow rate, the temperature, and/or the pressure, of the compression system the humidification variation of the system's electrical configuration, the shape and/or position of the polarization curve.
Heat production is strictly related to the conversion efficiency in the fuel cell and therefore it is also related to the voltage drop: matching a large heat-to power ratio could produce a remarkable reduction of the fuel cell efficiency.
In a such perspective the regulation field and the control dynamics must take advantage of a consistent model of the heat exchanger steady performance and transient dynamics.
The heat exchanger in cogeneration stationary plant is a key component for the connection between the fuel cell and the thermal user, also considering that it introduces a significant time lag in the transient behaviour. The heat exchanger lag generally influence the dynamic response of the whole cogeneration plant .
The heat exchange in mobile module has the peculiar task of dissipating the heat produced at (almost) fixed point operating it requires an analytical model in order to predict heat fluxes and temperature evolution. In the context of mobile application the model will be oriented to find out an optimum set point (in respect with energy saving) and the dissipated heat can be used for cabin air conditioning .
The results coming of the model simulation will help to define the layout of both the stationary and mobile plants.

Experimentation of the H_2-fuelled fuel cell (Activity c)

The very specific realisation of these two plants requires experimental investigation about the steady and unsteady electrical and thermodynamic characteristics of the fuel cell stacks and of the ancillary system . Such investigation can be carried out on a prototype plant
Cogeneration stationary FC plant.

The experimental results can validate the models and give essential information for the improvement of the performances (flexibility, efficiency, etc.) of both stationary plant and mobile plants. To achieve a match between the heat-to-power ratio demanded and that supplied, a CHP FC must incorporate several design features and a clever control design. Such control strategies can be analitically calculated but they require significant research and development on prototypes to introduce themselves in practice. Other technical suggestion affect arrangement of the balance of plant; such operating variations can be calculated from the analytical model, although they need an experimental analysis on a FC prototype in order to test the robustness of control strategies .

Mobile FC plant.

Also the less difficult regulation of mobile fuel cell will require an experimental work oriented to the characterisation of a prototype having significant behaviour analogies with the installed FC plant. The main objectives are the maximisation of energy autonomy and the optimisation of regulation strategies with respect to the specific demand of the dedicated user.

3.1.d Experimentation of the integrated CHP system (FC-based) (Activity d)

Cogeneration FC stationary plant.

The activity will require a specific measurement set up in order to evaluate the thermal fluxes and the time dependent temperature evolution of the heat exchanger both in steady and unsteady operative conditions.

The results of the experiments are aimed at validating the dynamic heat exchange models, at determining the plant layout and the power regulation range. The control strategies which operates through multiple input parameters will be tested on a prototype plant in order to enumerate the critic aspects, the sensitivities and the bounds affecting the control performance.

Mobile FC plant.

Temperature and heat flux measurements will be oriented to fit the regulation and to test the efficiency of the cooling or heat dissipating system in order to keep constant the operating temperature of the fuel cell and to explore the cooling system capabilities for the air conditioning.

Indicators

- H_2 production efficiency by electrolysis process
- Electric power production per year
- Availability of models for the optimisation of individual of individual components and for this global system
- Experimental data availability for a FC set on a test-bed:
- Energy conversion efficiency of FC
- Thermal power recovery (CHP)
- Model validation
- Emissions that are avoided when H_2 is used

B.2.c.3 Project details from the University of Pescara (UNIPE1)

The Faculty of Economics, University "G. d'Annunzio", Pescara will carry out an analysis and assessment of the internal and external costs and benefits related to the overall system, including power generation through the exploitation of solar radiation, energy storage in the form of hydrogen and power generation by fuel cell operation.

B.2.d. Project title

Mini wind power applications

B.2.d.1 Project details from the University of L'Aquila (UNIAQ)

SCIENTIFIC BACKGROUND

The wind energy is a renewable energy source, with a null pollutant impact.
The modern research invests many efforts to improve the technology of the wind plants, especially for the global wind system control, that must be realised in conformity with the meteorological features of the site.

Activities

H_2 production issues for mini wind power application (Activity a)

The production of hydrogen is expected when the meteorological conditions are not adequate to exchange economically electricity with the network. Therefore the main issues to face for this plants are the integration of electrolysis system with the wind plant, the regulation and the control of global system. A particular care will be devoted to the switching logic of the generated-wind power towards the electric network or the electrolyser unit, depending on the mean wind speed.

Utilisation of H_2 in a FC systems (Activity b)

The specific analysis concerning the use of H_2 in FC has been developed in the previous section.

Analisys of the problem related to distributed generation (Activity c)

The activity will deal about the aspects concerning the tariffs related to the management of a discontinuous electric source; in the meantime, the electrical aspects concerning the interactions between plants and grid will be deepened.

Indicators
Electric energy production per year
Energy conversion efficiency of the wind plants

HigHVILLE – Annex Demonstration sites ABRUZZO

B.2.d.2 Project details from the University of Pescara (UNIPE1)

The Faculty of Economics, University "G. d'Annunzio", Pescara will contribute by:

1. An economic assessment of the system costs and efficiency. Innovative life-cycle costing approaches will also be tested.
2. Analysing the market and economic issues concerning the integration with the local power distributor(s) and/or the national grid.

B.2.d.3 Project details from the University of Pescara (UNIPE2)

Activities description

The present search is set as objective the experimentation to demonstrative purposes of the most greater versatility of systems of production of wind power energy you dictate type "not conventional". Her activity of development of the "mini wind power" they constitute, to all the effects, a local opportunity of development, finalized to the installation of fittings for the production of energy from the wind, with aspects of remarkable environmental and territorial value.
The development of fit technologies to produce wind power energy through the use of wind mills of small ransom, is back still a footstep in comparison to I strive him/it completed by the most greater world producers of the sector, assembled more and more in the production of powerful wind mills (but also more and more visual impact). Her new productions assure nominal powers of over 3,00 MWs with tall structures of support more than 130 mt. This technology foresees the use of generators of the maximum power of 20 Kws and a middle height of the supports of 18 mt instead. In comparison to the winds farm type conventional, these fittings allow a more suitable insertion the context of reference, eluding the prejudices and the hostilities proper of this type of fittings. The diffusion on vast staircase of the wind power fittings of small ransom would allow to pursue manifold objectives, assuring at the same time, the production of important quantity of energy to global level and to assure at the same time a particular attention towards the local development.
Besides such fittings can be developed both for the connection to the electric net BT (whereas the installation of wind mills of average and great ransom is not possible), both for the feeding of isolated uses. The notable versatility of the system allows a diffusive potential employment on the territory, the production of electric energy making possible in the immediate proximities to the places of use, reducing the cost of transport (and the possible losses of transfer) and improving the conditions of local provisioning.

Objective of the diffusion of the mini wind power:

- Improvement of the conditions of energetic provisioning in the rural areas;
- decentralization of the energetic production through aware local solutions;
- increase of the water abilities to thin irrigated through systems of desalination fed by renewable sources;
- production of deprived electric energy of polluting issues with favourable effect on the environment;
- increase of the local economic development through the creation of professionalism related to the construction, maintenance and management of the fittings;
- production and accumulation of hydrogen;

Advantages in comparison to wind power fittings of great ransom:

- - low environmental impact and contained levels of noisiness;
- - reduced maintenance;

- - reduction of the costs of production and elevated efficiency;

The tied up aspect to the possibility to produce and to accumulate quantity of hydrogen, opens the search toward ampler confinements. In fact wind power energy production can constitute by itself a part of the energetic production of a country, but not to replace her/it in how much, for definition, inconstant and varying. Instead the hydrogen constitutes, really for its universality and availability, an alternative possible to the combustible fossils. A based energetic system on the decentralization and self-production of hydrogen constitutes, if adequately exploited, an energetic revolution from the absolute potentialities. The hydrogen is the most abundant of the chemical elements of the universe: it constitutes the 75% of its mass and the 90% of its molecules. To succeed in effectively exploiting him/it as source of energy could mean to virtually have access to a boundless energetic resource. Today around halves the hydrogen produced in the world is drawn out from the natural gas through a process of steam reforming through a reaction in a catalytic converter. Although the steam reforming of the natural gas is revealed, to everything today, the more advantageous method economically for the industrial production of the hydrogen, the methane is a hydrocarbon and therefore the process of conversion produces issues of CO2. The production of hydrogen through electrolysis fed by electric energy produced by the wind power system, constitutes a concrete possibility for this type of technology to make convenient. Through the cells to combustible you feed to hydrogen, you/they could totally be created some mini fittings of generation self-sufficient and that to make possible "distributed generation" that it allows from a side the diffusion and energetic autonomy able to absolutely satisfy the local demands with deprived energies of carbon, from the other one of being able to relieve the load and to prevent interruptions of the service in the whole system in the moments of peak.

B.2.e. Project title

Biomass applications

B.2.e.1 Project details from the University of L'Aquila (UNIAQ)

The activities will be organized following two areas: the first aimed at defining the biomass potential of the territory of the Treste Valley including the residual production and the energetic crops which could be produced using the areas of small interests from an agricultural point of view; the second related to the biomass preparation, collection. The possible final use of this “fuel” will be also deepened considering technologies able to produce cogeneration and/or a low environmental impact.

Background

Among the renewable energy sources one of the most important, for its suitable energy density and the wide availability, are the vegetable biomass derived from energy crops or from agricultural and forestry residues. Suitable technologies allows for the direct energy conversion or for the production of derived fuels.
Particularly significant for the territory here considered is the exploitation of residues. The pre-treatment of the fuel has to be evaluated on the basis of the biomass quantity. The direct firing lead to simpler biomass management systems but to low efficiency energy conversion, mostly related to the high biomass moisture content. Biomass drying represents a possibility to increase the overall energy conversion efficiency. Energy integration between the drying

and the energy conversion processes must be evaluated on the basis of the biomass moisture content.

Activities

Geographic planning

It will be carried out a geographical analysis in the Treste valley which determines the territories of marginal interest from an agricultural point of view, eligible to energetic dedicated crops.

Municipal coordination

It will be coordinated the municipal interest in the Treste valley in order to produce a local planning of energetic crops.

Drying technologies

It will be analysed drying technologies of biomass in order to be used as a strategic fuel.

Biomass supply. To evaluate the Biomass present in the area, quantity, type, characterisation, raw material supply and useful for gasifier. Eventually the need for biomass pre-treatment. Research necessary for a better use of biomass resources in the area and the forward gasification and hot gas purification system plant requirements determination. This analysis have a secondary aspect, in fact it could be considered also an analysis about the state of the biomasses in the basin, because it could also reveal the presence of pollutants in the plants.

Biomass amount. Collect information about the Biomass sources and types present in the area, check for compatibility of “energy crops” for the environment of the area. Evaluate the quantity and collect samples.

Biomass characterisation. The Biomass characterisation will be made by means of:
Chemical analysis: proximate analysis, ultimate analysis, elementary analysis and biochemical analysis.

Biomass conversion. Evaluation of different technologies for biomass conversion for hydrogen production applicable in the.

Biomass gasification tests. Tests on bench scale gasifier (available at University of L’Aquila) in order to check the behaviour of the biomass in different gasification conditions catalytic and non-catalytic.

Evaluation of gasification products. Analysis of the products from gasification: the product gas, the tar formation and ash analysis. Evaluation of environmental impact of the conversion process.

HigHVILLE – Annex Demonstration sites ABRUZZO

Indicators
- Thermal power production per year
- Electric power production per year
- Pollutants reduction by biomass utilisation
- Improved hydrogen yield
- Reduction of environmental impact in comparison with other conversion technologies

Expected pollutant in the product gas: Particulate< 0.01 μm, Oil residual contents≤ 0.003 ppm, SOx< 5 ppbv, Tar< 400 mg/Nm$^{3.}$

B.2.e.2 Project details from the University of Pescara (UNIPE1)

The Faculty of Economics, University "G. d'Annunzio", Pescara will contribute by:

1. an assessment of the overall environmental impact of the system, also considering different scenarios (e.g.: various locations and number of collection points) in view of optimising economic and environmental issues.
2. analysing costs and benefits related to the implementation and operation of the integrated biomass system.

B.3 Description of the demonstration action (scope, scale, objectives, validation and success criteria)

Guidance:
Present a comprehensive description of the proposed demonstration action, including its scope, scale, objectives, validation methodology and success criteria.

B.3.1 Integration challenge

The background for the Abruzzo project is an aim to develop a decentralised energy supply system for rural communities. Lack of acceptance for more renewable power, e.g. wind-power, have created a demand for products and services where the community can benefit from wind-power parks and other major installations. Several measures are being planned such as more small-scale distributed power and energy systems. Use of local micro wind-mill for distributed systems in rural areas. Production and development of hydrogen for niches in the transport market, e.g. Italian two-wheelers.

The current situation is that the distribution of power, even generated by renewable energy sources, is done through the national grid system (GRTN) and then locally by local distributors as in our instance ENEL Distribuzione. Target of the project is to utilize the necessary amount of produced power from RES within the valley with dedicated power lines also with the use, at a sustainable cost, of hydrogen as a vector. Local lines within Hyvalley can be installed immediately for biomass, biogas, use of hydrogen and for low impact fuels.

HigHVILLE – Annex Demonstration sites ABRUZZO

In order to meet this challenge, Abruzzo will demonstrate technologies within … main areas:

- Polygeneration – based on biogas from waste, small-scale CHP, biomass supplied medium-scale CHP
    - Increased integration of surplus energy (e.g. landfill biogas, biomass)
- Integrate renewable power in local energy supply
    - Test systems for storage of renewable power
    - Further development of local existing micro wind turbine industry
    - Acceptance of renewable power by local benefits
    - Development of scooter engines powered by natural gas
- Eco-buildings: system solutions for eco-buildings that can be replicated and exported

B.3.1.1 Biogas from waste, polygeneration with small CHPs and experimentation on new engines

Partners: ARAEN/RA, CIVETA (consortium of litter removal), Comune di Cupello, APRILIA, ARTA, Università dell'Aquila, CISI.

Budget: € 922.140,00

Actions: Convey biogas, purification of biogas with production of natural gas, CHP plant from waste in order to heat and supply electricity to the grid to decrease peaks and alternatively to power local buildings. In addition, Aprilia will study and develop a high efficiency and low emission natural gas engines for scooters. Moreover, Aprilia will study the production of fuel cell technology in scooters.

B.3.1.2 PV and energy efficiency applications in eco-buildings

Partners: ARAEN/RA, Università dell'Aquila, Università di Pescara (Architecture and Economy), ENEL, GRTN, Comune di Vasto e San Salvo, Western & Co, ESCO, CISI, Final Consumer.

Budget: €1.806.130,00

Actions: a. Experimental PV bio-architectural integration with installation on various beach resort of PV panels for the production of energy that will be utilized by the resort during the summer (4 months) and conveyed to the valley grid during the rest of the year (8 months). Due to project design differences, in order to study the efficiency and repeatability of this application, various types (designs) of beach resorts will be considered.
b. Creation of an ESCO that will initiate its activities by analysing the use of energy efficiency measures to decrease the municipal energy bill of the towns

of Vasto and San Salvo. Assessment of the energy consumption in the municipalities within the project and adoption of energy efficiency measures to reduce their consumption.

B 3.1.3 Test systems for storage, use and polygeneration from renewable power and support vehicle equipped with FC power generator

Experimental plant for the PV concentrator in Cupello PV plant

Partners: Air Liquide, ARAEN/RA, COSIV, Univ. Ferrara, Univ. Bari, Univ. L'Aquila, Univ.Pescara (Economy), Western & Co.;

Budget: €1.462.780,00

Actions: This demonstration project will be developed in the Cupello 1MW PV plant. The target is to produce hydrogen from solar energy and to utilize it locally in a small fuel cell that will power, in tri-generation, the eco-building located in the site. The production of hydrogen is done through an electrolyser. The electrolyser will be powered in part by the existing PV panels and in part by the installation of a PV concentrator. The hot water produced by the PV concentrator, by the fuel cell and by the solar thermal panels, will be conveyed towards the needs of a local greenhouse and to satisfy the thermal needs of the local eco-building. Creation of a new energy (hydrogen) information and dissemination info point.
The project also provides for the production of a natural gas engine powered support vehicle equipped with a module for the generation of power from a fuel cell. This vehicle will be based and re-charged in the Cupello PV plant. The intended use of this vehicle is that of a mobile power unit to be deployed in case of secondary support after major emergencies, major sport events, public events etc…The fuel cell module installed on the vehicle has also as secondary application: the backup power system of the eco-building that would temporarily substitute an eventual main power loss. It is clear that this vehicle has a very high demonstrative impact and would be an integral part of the new energy (hydrogen) dissemination and info point on site. This experimental project is thought for a pollution free exhaust and noise application.

B 3.1.4 Mini wind power applications

Partners: ARAEN/RA, ENEL, GRTN, WE.CO. S.r.l., Univ. L'Aquila, Univ. Pescara (Architecture and Economy).

Budget: €420.740,00

Actions: The project provides for the manufacturing, installation and monitoring of nr.3 mini wind mills with a nominal power each of 20kW. These applications are innovative from a project point of view and in addition are considered to be highly efficient. The total (3 wind mills) yearly production of energy will be of 111.690 kWh. The action will also include the development of a system with electrolyser for the production of hydrogen to be activated when the wind conditions are not economically profitable. The main target is to overcome the contractual and technical obstacles within the eventual connection of these mini wind power applications to the national grid.

B 3.1.5 Biomass applications

Partners: ARAEN/RA, all municipalities, ESCO, CISI, comunità montane, Industrial Association of the Chieti Province, Univ. L'Aquila, Univ. Pescara (Economy).

Budget: €801.150,00

Actions: The project provides for the creation of a biomass integrated system within the Treste valley. Part one of the project will be performed based on optimising the valley resources. For instance, the mountainous part of the valley will supply mainly raw wood, the hilly part of the valley will supply agricultural scrap or dedicated high energy crop, while the coastal part of the valley would supply agricultural scrap and industrial wood scrap. In view of this vision, the municipalities would create each a storage point (12 sites). The local population/companies of each municipality would therefore have a storage point near their premises. Each point would be served by a mobile chipper that would transform the raw material into a transportable good. The pre-treated biomass would then be dispatched to a centralized storage point for the drying treatment, transformation into pellets and packaging. The consequent utilization in a centralized CHP station of approximately 1MW will be studied.

Activities

1. Develop and prove decentralised renewable energy supply systems for end-users in rural areas based on local supply of mini wind-turbines (20 kW) and efficient storage of energy;
2. Develop utilization of landfill biogas with CHP and production of methane or other gas blends;
3. Test out engines on hydrogen, biogas and natural gas;
4. Install and test a PV concentrator for heat and power supply to a greenhouse and eco-building;
5. Biomass system to energy;
6. Solar Thermal;
7. Eco-building applications on tourist infrastructures
8. Energy efficiency applications in public buildings;
9. System, modeling and technology study of possible routes to hydrogen;
10. Computer integrated monitoring system on production, consumption and storage of energy (prototype of a distributed power computerized management system).

HigHVILLE – Annex Demonstration sites ABRUZZO

B 3.2 Targets and expected results

B 3.2.1 Targets

Targets of the project are the following:

- Activate local SME in order to develop economy;
- Reduction of the total energy consumption;
- Minimize loss of produced renewable energy;
- Optimisation of the power and transportation distribution network to reduce losses and regulate the energy peaks. Initiate the organization of the “distributed generation” system;
- Generate an “energy-consciousness” within the valley population and local planners;
- Standardize the system in order to permit a repeatability in other realities;
- Organize those energy activities needed by the valley in order to optimise the use of the power network.

B 3.2.2 Expected results

Expected increase in production from RES during the project period:

- wind: 3 small 20 kW plants (total yearly production 111.690 kWh) to be used in the industrial area
- biomass: production of energy (as fuel) with the manufacturing of pellets within the valley (1000 tons/year = to 4.900.000 kWh)
- in addition to the 1 MW Cupello PV plant, 5 kW PV (PV Concentrator) and 100 kW solar thermal will be added
- eco-building: 100 kW added on local beach resorts
- biogas from land fill: 330.000 Nm^3/year.

Expected RUE energy efficiency mechanisms:

- Valley energy consumption reduction of at least 10% which corresponds to a value of 50.000.000 kWh. This value also includes optimisation actions on the power distribution network.

- Job creation: Service companies of approximately 15 employees. Creation of a local ESCO with 4 employees. Increase of collateral of approximately 1,3%.

- Air quality: reduction of CO_2 emissions of 2%.

- Ecobuilding: Municipal regulations modification and best practice with indication of actions to reduce thermal dispersal

Plan	Action	Responsibility	Timing
Production of PV energy from beach resorts on the coast of Vasto and San Salvo	Experimental installation on various beach resort of PV panels for the production of energy that will be utilized by the resort during the summer (4 months) and conveyed to the valley grid during the rest of the year (8 months).	ARAEN/RA, GRTN, ENEL, MUN, UNIPE1, UNIPE2	22 months
Energy efficiency measures to decrease the municipal energy bill	Assessment of the energy consumption in the municipalities within the project and adoption of energy efficiency measures to reduce consumption .	Municipalities, ARAEN/RA, ESCO, UNIPE2	20 months

B.4 Training/Dissemination

Describe the training and dissemination activities in the Abruzzo project.

The training and dissemination activities are a focal point of the HigHville project: guided school tours in the major valley sites, the use of young soon-to-be graduated university students and stage workers that will have a direct contact with Demonstration Projects, the creation of a dedicated hydrogen center (H2 HigHville center) and the organization of several work activities between private and public partners (meetings, workshop, etc…). Their objective will be to sensitise the local population to the use of RES of to facilitate the HigHValley system.

The training and dissemination activities are directly connected to the all the projects involved in this HigHValley system and therefore will follow approximately the same timetable. Due to this, the work has been divided in single times and not as a schedule.

The visible and attractive training space easy accessible for citizens and tourists (APT, ARAEN/RA, H2IT), identified in the Cupello Eco-Building, will need additional work in order to make the space fully operational; 20 months;
Prepare information for the general public on the applications of hydrogen and fuel cells in combination with renewable energy (H2IT/Highville team); 6 months to make descriptions of all Highville projects, from there ongoing update and presentation in the H2 Highville Center; organise one annual event/fair to communicate the developments in the Highville project;
Prepare dedicated seminars to present specific market opportunities for small and medium sized companies in Abruzzo (ARAEN/RA, H2IT); 18 months to prepare material and organize first event, from there regular updates and events (Aperitivo H2 for local professionals in the sector);
Collect, maintain and make a database of local regulations regarding renewable, hydrogen and fuel cell installations available and communicate solutions of other national and international projects (H2IT/Highville team); 12 months to collect latest data, from there ongoing updates on local sites;
Collect, maintain and make available a database of national and European funding opportunities (ARAEN/RA, H2IT); 6 months to collect current programmes from there ongoing updates on local websites;
Create a database of successful hydrogen and fuel cell school projects and adapt material to local schools (H2IT, ARAEN/RA): 24 months to collect material for different grade levels, adoption to local schools and training of first teachers;
Set up a local Technical Training structure involving, local Universities, local technical schools and private companies to teach how to handle hydrogen and basic fuel cell maintenance; 18 months to prepare course material and identify locations;

HigHVILLE – Annex Demonstration sites ABRUZZO

B.5 Legislative status

B 5.1 Level of planning activities

The regional plan to increase the use of renewable power and energy. Futhermore there is a need to develop activity in order to prevent the decline in population. The region has long experience in solar power, wind power and development of Eco-buildings that can be utilized in a HigHville consortium.

The regional planning instruments are:

- Regional plan relating to the use of renewable energies approved with DGR (regional decision) dated 05 December 2001 in which the actions highlighted in HyValley are provided;

- The 2004 Abruzzo region financial and economical plan. The HyValley project is in accordance with the plan and provides for the necessary sums in order to co-finance the project and furthermore provides for job creation development;

- Regional plan for the protection and care of air quality. Actions to reduce CO_2 emissions are provided for, in accordance with the Kyoto protocol, within polluting sources: industry, agriculture, commerce, civil, mobility;

- Agreement with APT-Abruzzo Tourism Bureau for the diffusion of information and sensitising on energetic matters in the region. In the river basin area there are 4 territorial offices.

The national planning instruments are:

- Ongoing agreement between the central government-region-municipalities for the conversion of automobiles from petrol to natural gas or BTL and for the purchase of new natural gas fuelled automobiles. In the Hyvalley area, there are 2 municipalities that adhere to the program: Vasto and San Salvo.

- National economical program committee (CIPE) that has included in its economical program, the EU directive nr.93/389/CEE modified with directive 99/296/CE and communication nr.COM/2000/88 dated 8 March 2000 that provides for the actions planned in the Hyvalley project.

- National agreement (in itinere) with the Italian Ministry of Environment relating to the energetic valorisation of biomass.

HigHVILLE – Annex Demonstration sites ABRUZZO

B.6 Local partners

The project was born based on an idea of ARAEN, the Abruzzo regional energy agency, in collaboration with the University of Bari and Fuel cell Europe (Italy). The idea was later developed together with local Universities and SME's.

The local project co-ordinator is ARAEN the Regional Energy Agency. The project owner is the regional community of Abruzzo. The Ministry for Energy, Environment, Tourism and Territory of the Abruzzo Region – Minister: dr. Massimo Desiati made a strong support statement for the project initative in Abruzzo.

The region of Abruzzo and the 12 involved municipalities are supporting the project. The Ministry for Energy, Environment, Tourism and Territory of the Abruzzo Region – Minister: dr. Massimo Desiati promotes the project.

B.6.1 Local Partners

Nr.	Acronym	Project partner legend
1	AICH	Chieti Province Industrial Association
2	AIRL	Air Liquide
3	APR	Aprilia
4	APT	Abruzzo Tourist Bureau
5	ARAEN/RA	Regione Abruzzo-Regional Energy Agency
6	ARTA	Regional Environment Agency
7	CF	Final Consumer
8	CISI	Local (Abruzzo) consortium of mechanical companies
9	CIV	Waste Disposal Company (CIVETA)
10	CM	Mountain Communities
11	COS	Cupello 1MW PV Plant Management Company (COSIV)
12	ENEL	Power Distributor
13	ESCO	Energy Service Company
14	GRTN	National Grid
15	H2IT	Italian Hydrogen Association
16	MUN	Municipalities
17	UNIAQ	University of L'Aquila
18	UNIBA	University of Bari
19	UNIFE	University of Ferrara
20	UNIPE1	University of Pescara - Economy
21	UNIPE2	University of Pescara - Architecture
22	WECO	Mini Wind Mill Company
23	WES	PV and Solar Thermal Company

HigHVILLE – Annex Demonstration sites ABRUZZO

B.7 Quantitative performance

Propose a set of performance indicators against which the technical/economic/operational performance and ultimate success of the project can be judged. Indicator metrics (e.g. capacity increases, safety improvements, efficiency increases, cost reduction, returns on investment, running costs, payback times, environmental impacts, and other quantifiable impacts and benefits) should be given in sufficient detail to permit them to be checked by the proposal evaluators.

Example: One of the performance measures that will be adopted will be the calculation of the quantity of power saved in comparison with previous years thanks to the installations and implementations done throughout the valley. Specifically we will gather all the data and organize fixed comparison charts that can be easily read.

Action	Performance indicator	Proportion %
Demonstration Projects		55
B.3.1.1	Electric power production per year, pollutants reduction through biogas utilization	
B.3.1.2	Electric power production per year, CO_2 reduction through energy efficiency means	
B.3.1.3	H2 production efficiency through electrolysis process, thermal power recovery (CHP)	
B.3.1.4	Electric power production per year, energy conversion efficiency	
B.3.1.5	Quantity of biomass converted into fuel	
Training and dissemination	Quantity of training hours and quantity of material produced	5
Tourism development	Abruzzo tourism bureau figures	15
Environmental impact	CO_2 reduction per year	10
Job creation	Number of persons that directly or indirectly are involved	5
Social impact	Number of web accesses to the Hyvalley site	10

B.8 Qualitative performance

The demonstration should include a quantified assessment of performance, as well as a qualitative assessment in terms of viability and user acceptability. Include, where appropriate, technical details or anticipated performance targets.

The Hyvalley project, being an energy integration experimentation, can bring quality in the life of the valley population and to its economy as a whole.

Two macro quality indicators will be:

- Power distribution efficiency, given by a better peak management, with consequent decrease of black-outs and micro black-outs;
- Thanks to the increase in RES, better energy management and efficiency and population energy consciousness the valley energy bill will decrease.

HigHVILLE – Annex Demonstration sites ABRUZZO

B.9 Measurement and monitoring of performance

Describe the measurement and monitoring systems, which will be used to verify the performance of the system and the fulfillment of the project objectives. A common monitoring methodology will be developed for all demonstration sites.

(Monitoring should be performed in accordance with international standards or recognised practices and, preferably, should form part of a management system, which will ensure continuous performance optimisation on a long term basis)

B.9.1 Energy consumption and supply statistics and prognoses

We underline that, as of today, in the Treste Valley approximately 500.000.000 kWh are consumed each year. The RES production plants, wind and PV, present in the area produce approximately 85% of the valley energy needs.

Abruzzo has installed a PV plant of 1 MW in Cupello and a wind power plant of 112 MW in Castiglione Messer Marino. In addition an Ecobuilding is being finalized at the PV plant in Cupello.

The wind and photovoltaic plants are already operational. The Eco building project in the community of Cupello is well under way and funded in collaboration with other entities.

The community has activities on energy savings, combined heat and power systems and innovative technology.

On energy saving the community activities in the industry and the building sector. In particular construction technics and materials that allows less energy consumption has been emphasized.

The community has a program on renewable energy systems with a special focus on technologies and systems for small-scale distributed systems as this is expected to improve the acceptance for renewable energy and contribute to commercial activity locally.

There are also activities on distributed combined heat and power and on the use of cleaner energy sources in the transport sector e.g. natural gas, LPG and electrical drive in the Community.

HigHVILLE – Annex Demonstration sites ABRUZZO

Current statistics:

Municipalities	agriculture		domestic		industry		commercial		Sub-TOTAL	
	n. ut	KWh	n. ut	KWh	n. ut.	KWh	n. ut.	KWh	n. ut.	KWh
Carunchio	3	874	471	605.819	19	454.603	52	446.762	545	1.508.058
Castiglione M. Marino	3	803	1.162	1.597.732	45	152.293	123	1.444.414	1.333	3.195.242
Cupello	34	221.272	1.807	3.739.145	104	3.698.579	215	3.879.911	2.160	11.529.907
Fraine	1	957	397	360.364	6	5.878	29	154.709	433	521.908
Furci	11	5.725	638	988.593	28	126.815	60	466.832	737	1.587.965
Lentella	10	30.642	387	623.709	17	5.117.106	51	292.122	465	6.063.579
Liscia	1	83	415	585.548	13	69.010	70	316.602	499	971.243
Palmoli	8	12.687	763	907.882	25	105.169	92	529.452	888	1.555.190
Roccaspinalveti	5	4.471	758	1.300.410	38	300.421	76	512.108	877	2.117.410
San Buono	9	701.018	699	861.083	25	912.045	72	493.354	805	2.967.500
San Salvo	43	393.276	9.932	15.188.543	309	82.019.486	1.013	248.163.080	11.297	345.764.385
Vasto	112	288.714	17.983	34.201.499	489	26.634.820	2.627	39.953.514	21.211	101.078.547

Source: ENEL Distribuzione

B.10 Bugdet and financing

Hyvalley Abruzzo - Italy	EU Support	Private funds	National funds
	Euro	Euro	Euro
Total demonstration 1	325.614	462.750	133.776
Total demonstration 2	684.613	877.105	244.413
Total demonstration 3	544.078	252.600	666.102
Total demonstration 4	160.874	187.225	72.641
Total demonstration 5	34.000	72.150	695.000
Total Demo:	**1.749.179**	**1.851.830**	**1.811.932**
Training & Dissemination	332.684	324.800	406.356
Management activities	274.014	0	212.126
Accompanying studies	50.000	0	50.000
TOTAL (ALL ACTIVITIES)	**2.405.877**	**2.176.630**	**2.480.414**
	34%	31%	35%

B.11 Time-schedule and milestones

See Work Packages in Part B.

B.12 Integration with other HigHVILLE communities

Results and concepts for Eco-building can be exported to Ærø and other Communities. Experiences with lagre scale PV and micro wind-turbines can be exported. Experiences with small hydrogen vehicles like scooters and other two wheelers.

Planning and financing structure can be imported from Ærø.