



## Working Paper Series

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THE NEED OF STANDARDIZATION  
AND THE POTENTIAL ROLE OF  
VOLUNTARY APPROACHES: ISSUES  
AND TRENDS IN ITALIAN GCHP  
MARKET

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## Introduction

On 23 January 2008 the European Commission put forward a far-reaching package of proposals that will deliver on the European Union's ambitious commitments to fight climate change and promote renewable energy up to 2020 and beyond. In December 2008 the European Parliament and Council reached an agreement on the package that will help transform Europe into a low-carbon economy and increase its energy security (European Parliament, 2008).

This agreement will have a huge impact on the whole energy sector. It is in this framework that, as it is clear from the position of the European Parliament on the promotion of the use of energy from renewable sources (RES) - adopted at first reading on 17 December 2008 -, both technical and managerial opportunities have been set also for the Geothermal Heating and Cooling (GHC) market. Hereby, direct entrepreneurial opportunities are mainly offered by:

1. that impact on the demand-side that emerges from the possibility to consider as renewable energy that part of the energy provided by Ground Coupled Heat Pumps (GCHP) exceeding the primary energy needed;
2. that impact on the supply-side that emerges from the request for the Member States to introduce certification schemes (or equivalent qualification schemes) by 31 December 2012 for installers of shallow geothermal systems and heat pumps.

Beside these, also indirect opportunities are available and mainly connected to:

3. the impacts on regulatory bodies and administrative procedures at national level (e.g. permitting requirements, monitoring plants, etc.);
4. the impacts on investment strategies and energy policies (including the provision of incentives);
5. the side-effects on the overall entrepreneurial behavior.

These entrepreneurial opportunities do not refer to “stand-alone” categories since both the technical and the managerial dimensions are interdependent along the entire GHC industrial chain. As an example, the expansion of GHC market due to the modulation of RES targets could induce changes in the way entrepreneurs place their products and brands on the market as well as the introduction of certification schemes could impact the way installers relate with designers and technology providers. For these reasons, an integrated management of these dimensions is worthwhile indeed. Increasingly the broader frames and boundaries conditions of energy policy are elaborated internationally, but the practical policy implementation remains much a national or local task (Lund, 2006). This paper, analyzing the demand-side of policies and relating tools, seeks to explore the way entrepreneurs intend to compete in the GCHP market in Italy.

At first, some highlights on the GCHP market are provided so as to draw the technical and managerial framework for future developments. After introducing the main standardization approaches as alternatives to regulation, a discussion on the entrepreneurial attitude of GCHP actors is presented through an entrepreneurial segmentation, the drafting of a matrix of interests and the synthesis of the design options. Once the different scenarios for the introduction of certification schemes are designed, a SWOT analysis is performed for defining the “best compromise” between technically, managerially and economically driven expectations. Both in-field observations and direct interviews serve the scope of providing adequate interdisciplinary descriptors and inputs.

Finally, the results are discussed against the background of theoretical considerations. As final outcome of our work, a potential configuration of a certification scheme is provided, along with a review of some “consensus statements” gathered during public conferences and sectoral meetings.

## GCHP market in Italy: background and problem definition

### *Energy in the building sector: opportunities and constraints*

In Italy, the energy consumption framework is rapidly changing. Moving from a substantial equilibrium between industrial, transport and building sectors at the end of last century, at present the most critical (due to the potential shares) and unpredictable (due to annual and seasonal variations) changes are expected in the building sector.

In last years, while industry decreased its energy consumption, due to the terziarization of the Italian economy and the high costs of energy supply that encouraged investments in greener processes, household-heating and -cooling energy consumption was still a quite undervalued issue in customers' agenda.

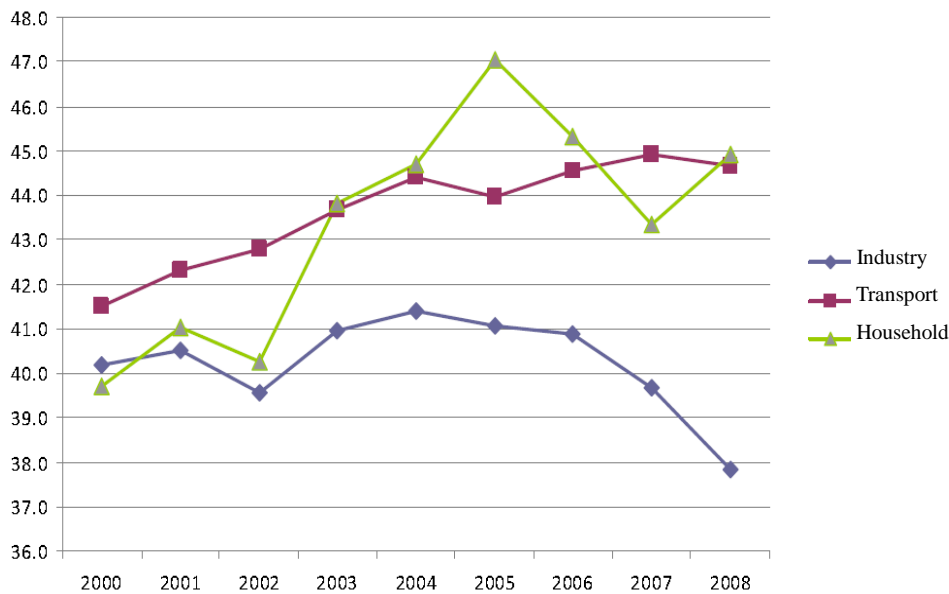


Fig. 1 Final consumption of energy (Mtep) per sector in Italy: industry, transport and household. Elaboration: ENEA; Data: Ministry of Economic Development

Ground Coupled Heat Pumps, or Geothermal Heat Pumps, are systems combining a heat pump with a ground heat exchanger (closed loop systems), or fed by ground water from a well (usually open loop systems) (Sanner et al., 2003). They can use the earth as a heat source or as a heat sink, thanks to the invertible heating- and cooling-mode feature.

Although relevant applications rely on the presence of underground water (e.g. the University Bocconi plant utilize the underground water which is pumped so as to keep the groundwater level at the same level as in '70s, when the industrial depletion was higher than at present), the largest share of installations utilize borehole heat exchangers, where no water consumption is required. With this solution, varying the number of boreholes, the GCHP can virtually satisfy any demand of heating and cooling, everywhere (depending on the availability of spaces to avoid interferences between boreholes).

Unfortunately, there are also intrinsic factors that limit the dissemination of this technology. In particular, with the only exception of few emerging technical solutions, existing GCHP features make them suitable only for operation with low-temperature heating systems (es. fan coils and radiant floors), which are not common in older heating systems installed in Italy (largely dominant e.g. in historical municipalities and territorial districts). Hence, the preservation of GCHP performances (which decline with the increase of the supply water temperature) naturally makes their application easier in new buildings and reconstructions.

A special mention deserves the exploitation of local resources and, in detail, of medium enthalpies heat storage ( $40 < T^{\circ}\text{C} < 100$ ). This category of heat resource is quite common in Italy at suitable depths, but the relating GCHP exploitation is still under research and development phase. To this purpose, it is important to notice that, nowadays, the demand for this kind of solutions is still marginal but, in the near future, is expected to increase.

Another peculiarity of Italian GCHP market is that, even if in Europe heat pumps usually operate mainly in heating mode (Sanner et al., 2003), in Italy there is a huge demand of cooling which is driven essentially by large scale applications (e.g. commercial centers, public buildings, industrial buildings and processes, etc.).

### *Italian GCHP market: early steps and future perspectives*

Within this framework, in the most recent years, the GCHP mass market took its first steps following the initiative of some first-mover structured investors (e.g. public administrations, large retailers, large builders, etc.). Many of these successful experiences have heightened public awareness on this opportunity, just while new national and regional regulations introduced minimum requirements for the energy efficiency of all new buildings, even if economic downturn entailed short-term cost cutting strategies.

As a result, at present, large and small, reversible and irreversible GCHP installations are booming in every sector of the market, despite the lack of specific incentives. Unfortunately, due to the lack of shared classification rules and public registers of authorized installations, it is difficult to find reliable data for installed GCHP in Italy. According to previous considerations and to several wider expert analysis (Lund et al., 2004) (Lund et al., 2005), in 2007, Italian Geothermal Union (UGI) estimates a ten-times factor for installed capacity growth within 2020 according to business-as-usual scenario (UGI, 2007). This estimation can even be considered conservative if additional actions are undertaken.

In fact, as an example, as well the competitiveness of renewable heating and cooling varies substantially reflecting variations of technical parameters in local resources and costs of conventional heating and cooling, capacity building for improved local cost/benefit analysis of each available alternative can play an essential role in spreading awareness about GCHP economic performances (Seyboth et al., 2008). By this way, acting on consultants and designers, the wider the competencies are built, the higher the installed capacity target can be set.

In planning actions at national level, these professionals are not the only relevant target of potential integrated policies. In fact, extending the example above, an important issue that has to be taken into consideration concerns the need to create of a comprehensive national industrial chain, which claims for the creation of GCHP jobs. On this subject, the lion's share of the installations is made up of foreign technologies, being domestic companies mainly integrated dealers and project managers, but a growing number of national manufacturers are making efforts in technological improvement (e.g. in the substitution of dangerous thermal fluids). To propel these manufactures to growth represents a crossing challenge that can dramatically improve the whole sector.

### *Emerging issues and related needs of regulation*

Thanks to the early installations and the perspectives of GCHP sector, a total of 113.000 Italian web pages delivering information on geothermal heating and cooling is available online, which witnesses the positive media impact of this technology. From the regulation point of view, such positive media impact of early installations entails a growth in numbers of the authorization requests to be managed and, than, makes necessary a prompt adaptation of the regulatory framework, which appears mainly developed for geothermal-electric purposes.

In fact, Italy has a strong tradition in high enthalpy geothermal resources exploitation. This favored the development of a comprehensive and effective regulation of deep resources but, as the other

side of the coin, GCHP projects have been strongly biased towards the development of geothermal power plants. As in many other countries, for example in Japan (Niitsuma et al., 2003), this bias has suppressed – despite its primary importance – diversity in utilizing the resources and created regulatory asymmetries.

Today, the lack of an homogeneous and targeted regulation at national level (e.g. both costs and permitting procedures vary according to the region and, in some regions, to the province) is mainly reflected by a jeopardized spreading of the GCHP installations, by the presence of contradictory practices, by the lack of a reliable territorial censuses of plants and, consequently, by overall uncertain levels of environmental protection.

To set clear rules on permitting procedures and shared standards for each step of the life cycle of a GCHP installation project is an important and urgent task. As an example, against the coexistence of proper and improper practices, among experts it is common opinion that a correct design requires at least an in-situ determination of reliable ground thermal properties. In fact, the way the thermal response test is conducted can considerably affect the choice of the enhanced grounding materials, the spacing, the number and the dimensions of the boreholes, as well as the technical specifications of the heat pump and, consequently, of the delivering network. Similarly, the forecast of thermal behavior of the building, which depends on a multitude of factors (e.g. climate conditions, building systems, utilization of spaces and design comfort conditions, etc.), can considerably affect the whole “design chain”.

For this reason, public institutions are paying an increasing attention to the minimum multi-disciplinary requirements within permitting procedures. With no doubt, groundwater protection against thermal and chemical pollution, biological imbalances, interactions between aquifers during the entire life cycle of plants are increasingly becoming an important issue since the growth in the number of installations is tremendously accelerating.

To this end, the LCA methodology (Life Cycle Assessment) of the technology system, combined with economic cost analysis, offers a privileged integrated eco-efficiency score. By its nature, however, while addressing global challenges (e.g. through global eco-efficiency indicators), it is important to remark that LCA focuses on a static analysis of micro-level technology relations that are relevant for the specific functional unit. As a consequence, since the sustainability at macro-level depends on the overall changing consumption behaviors, policies and economics, procedures for combining LCA in a knowledge-fed scenario analysis (Huppes et al., 2008) can be useful for enabling to assess long-term total value creation and total environmental impacts at macro-level.

In terms of performance requirements, however, nowadays (especially the demand-side of) the market is mainly asking for high Coefficients of Performance (COP), measured by the ratio of “useful energy” and electricity consumption, which is only a facet of the environmental performance of GCHP technologies. This is the reason why, as mentioned above, the importance of a more general and holistic concept of “environmental performance” is rapidly increasing and, with it, the need of shared procedures for analyzing and managing the impacts of the above experimental and emerging technologies.

### *Opportunities and threats for domestic entrepreneurs*

In this framework, both the potential role of Italian companies in improving environmental performances and of the scientific community can be an interesting lever on which to base the development of an integrated GCHP regulation.

Regulation under development is a typical “additional factor” that is able to determine both instability and windows of opportunity (Sartorius, 2006). According to this, besides the institution of few coordination boards between regional authorities, proactive entrepreneurs have intensified participation in sectoral regulatory and lobbying initiatives. Among these initiatives, a great number of workshops and conferences has been organized (e.g.: the ones in Larderello, Firenze, Siena, Ferrara, Bolzano, Rimini, etc.) and an attempt to establish national standards has been promoted and

coordinated by Italian Organization for Standardization (UNI) and Italian Therm-technical committee (CTI) in 2009.

In general terms, at macro level, market imperfections foster entrepreneurial opportunities (Cohen, 2007). From this perspective, many Italian market circumstances (e.g. rapid repositioning of firms, flawed pricing mechanisms and information asymmetries, etc.) may seem to be favorable for the creation of radical technologies and innovative business models.

Despite that, at micro level, it is important to notice that Italian GCHP SMEs, not having sufficient market shares to compete on prices or on “radical innovation”, tend to compete on only “incremental innovation”, especially for specific components. In this framework, among the others, time to authorization, as well as time to market, are valuable parameters. Moreover, the lack of specific intent to foster a national GCHP pathway through integrated policies can potentially compromise micro, and consequently, macro domestic innovations.

Sub-sectoral associations are already serving the needs of companies but, as already pointed out in other countries (Sanner, 2009), a low level of systematic integration affects the optimization in supporting the overall sector. Effective actions have been taken by different associations (mainly between heat pump installers and geologists) but a coordination in terms of GCHP association does not exist. This situation reflects a lack of interactions between companies. Thanks to the increasing awareness of the need of interaction between heterogeneous competences, this has recently become a major task both in national and European working groups (e.g. Comitato Termotecnico Italiano - CTI, Consiglio Nazionale dei Geologi - CNG, European Geothermal Energy Council – EGEC, etc.). With this matter, in the GCHP sector, the natural proneness by the key-actors to compete or to cooperate depends not only on the objective of the cooperation itself but also on their role and position in the supply chain. As an example, focusing on the trade off between the globalization of the market and the protection of local market shares, modest geographic advantages (which are the advantages offered by being part of a local economic system) are revealed for technology providers, while significant geographic advantages exist for designers. According to that, the circulation of technologies tends to differ from the circulation of consultants' and designers' know-how, which are fundamental system integrators.

Finally, as additional factor to be considered, in last years the economic downturn has influenced the entrepreneurial dynamics too. It is well known that, in such context, both an efficiency driven selection and a financial driven selection can occur with opposite impacts on the overall system competitiveness (e.g. best performers gain market shares in the first case, small and innovative companies find difficulties in obtaining a return on investment in the second case). Nowadays, supply- and demand-side actions are expected to protect and further develop the internal demand for high-quality services and products (e.g. green procurement, investment funding, etc.) and foster systematic innovation (e.g. R&D funding, cluster and virtual organization policies, reaction to casual niches, etc.) (Caviglia, 2003).

Such actions are currently under discussion and development for a wide coverage area that include also GCHP (e.g. Decree 7/4/2008 on fiscal incentives for high efficiency thermal plants; Decision EEN 17/09 on white certificates for tele-heating and cooling networks fuelled by renewable energy; Decree 11/4/2008 n.135 on inclusion of energy as a category in green public policies, etc.), but still not implemented in Italy with specific reference to GCHP sector. On the other hand, as a positive reference case that comes from an entrepreneurial environment which is close to GCHP sector, the mix of similar actions has already fostered a successful “being green” philosophy among several renewable energy companies in Italy that has generated a counter-trend (e.g. between 2006 and 2008 photovoltaic installed capacity grew from 7 to 431 GW, wind from 1908 to 3537 GW, biomasses from 1256 to 1555 GW) with respect to the period of general economic downturn (Enea, 2008).

## **Standardization and voluntary regulation: concept and alternatives**

### *Toward a dynamic integration with wider policies*

The term “voluntary regulation”, in its broader meaning, can include a large range of tools referring to process- or product-management standards. In many cases, though being voluntary, the successful implementation can be verified following an independent third-party audit which allow for self-declaration of conformance with the standards.

Usually, the choice to adopt these tools in a given policy area depends on where key performances stand (e.g. in manufacturing phases, in providing a service, in using the product, etc.), and on what stakeholders are targeted (e.g. what are the key-actors in the application of the interested policy to be targeted, and what is their potential contribution to achieve the desired environmental improvement). These tools can entail a negotiation between governments and companies (as in the case of voluntary agreements and covenants) or adopted as standards (e.g.: to be applied as reference for a third party certification). On the opposite side with respect to mandatory standards (that are adopted by a government, business contract, etc.), voluntary standards are usually adopted to prove a specific commitment to best practices or requirements.

The “voluntary approach” has been increasingly adopted in the last years by the European Commission and by Member States in the field of sustainability-related policies (such as environmental policies or renewable energies). This approach is likely to succeed in terms of number of organizations that adopt it (e.g.: involved in a certification scheme), but often tend to fail in terms of effects on the environmental performance and/or competitiveness of the same organizations (e.g. in terms of final customer satisfaction or market shares). Typical causes are, as an example, the preponderance of market strategies on real environmental commitment in the first case, the lack of customer awareness in the second.

The Italian building sector provides interesting lessons (both positive and negative) to be learned about these dynamics. For instance, since traceability (including producer responsibility) of building materials has become a dominant issue in the sectoral regulation, many leading companies switched priority from time-to-market strategies to effective quality-oriented supply chain management strategies. As a consequence, relevant improvements in product performances occurred at low economic and administrative costs (Finco, ENEA, 2004). On the opposite, since the certification of voluntary quality management systems (e.g. ISO 9001) has become a standard request in public and private contracts, a huge number of companies achieved the certification implying a forced growth in numbers of the certifications (Accredia, 2009). Looking at worldwide level, sometimes a similar forced growth is reported as a threat that can cause a lack of supervision of the systems by the accreditation bodies (Tobon, 2003). This fact witnesses that a huge number of companies achieved certification, but many of them are not able to guarantee an actual continuous improvement of their product- or service-related quality and performance, as it would be requested. A related threat might be also due to the excessive spreading of the certification, which is often pursued thanks to non-accredited certifiers and which is preventing accreditation bodies to supervise the reliability of the accredited ones.

Similar failures can be acknowledged also abroad. As an example, in UK, where no adequate demand-side actions have been undertaken, SMEs operating in the building industry are still not convinced of the potential “win-win” outcome of voluntary environmental management schemes and are not adopting them (Revell, 2003).

In general terms, as widely demonstrated in national case studies, voluntary approaches and agreements, therefore, need to be dynamically conceived and to be periodically renegotiated, as a part of the overall sectoral policy (Van Rooijen et al., 2006). In particular, special attention should be paid to the market trends (e.g. sectoral tendencies, including levels of adoption of voluntary tools) and to the effectiveness of the dynamic integration of these approaches with demand-side actions (e.g. a tax from which customers can be exempted) or supply-side actions (e.g.

administrative simplifications for manufacturers) to prevent failures in terms of poor compliance or not met policy targets.

On the other hand, this evolutionary perspective has to avoid frequent changes of direction that can be coupled with negative impacts on market certainties (e.g. unstable investment climate) and on building confidence among market parties (e.g. inducing the “wait for better conditions” option).

To this end, when correctly designed, standards and voluntary schemes usually refer to existing regulation so as to foster its application (e.g.: certification schemes consider legal compliance as a pre-requisite to obtain certification) and strengthen its effectiveness. Hence, significant evolutions of the market or mandatory regulation can be often considered reasonable “precursors” (sometimes a “proxies”) of the evolution of voluntary approaches.

### *Standardization and voluntary regulation: the territorial dimension*

Concerning the GCHP sector, the IEE Ground Reach project has highlighted that in countries where the GCHP market is well-developed such as Austria, Germany, Sweden and Switzerland, the growth in numbers of the (voluntary and mandatory) technical standards is increasing: in 10 years, between 1995 and 2005, 8 standards have been published, and in 2 years, between 2007 and 2008, 7 standards have been published (IEE Ground Reach, 2008). In those countries with higher sales of geothermal heat pumps, some innovative and cross-cutting technical guidelines, forms of contractor certifications and quality awards are beginning to be set into force to protect the industry and the consumers against poor quality and insufficient longevity of geothermal heat pump systems (Sanner et al., 2003). A similar trend is expected also in emerging GCHP markets. In fact, as a consequence of the European Union RES policy, many countries – including Italy – are today launching official task forces to discuss GCHP standardization at national level.

From this point of view, it is important to remind that in Italy local competent authorities (e.g. Lombardia Regional Administration), sectoral associations (e.g. Associazione Nazionale di Idrogeologia e Pozzi Acqua – ANIPA) and also private companies and consultants, in the past have published notes and guidelines covering issues such as efficiency, safety, longevity, environmental protection and licensing. These documents represent a relevant, but sometimes discording, non-compulsory reference for designers, drillers, installers, manufactures and owners.

In general terms, as a consequence of this fragmented framework, both binding and non-binding technical guidelines and standards regarding the same issues exist at national level, while comprehensive European-wide standards do not yet exist; the only exception being the standard EN 15450 “Heating systems in buildings - design of heat pump heating systems”, that concerns the design of heat pumps systems and delivers only a general minimum framework for GCHP design, installation and maintenance. In doing that, EN 15450 refers to the EN 12170 and EN 12171 for maintenance activities and to EN 13313 for qualification and certification of the staff involved in maintenance of the systems.

To this end, since the climatic and geological environments as well as technical, infrastructural and administrative frameworks are fragmented and differ locally, it is to be considered that the less generic, the more standards require an adaptation process from the international arena to application at national level. As a first example, just the simple fact that in some countries geothermal energy is governed by the mining law and in other just thermal water is considered (Sanner, 2008), entails that different needs in terms of coordination of requirements have to be met (e.g. in the way public administrations control the quality of authorized projects). As another example, since growing business help in increasing professionalism, the fact that the maturity of the market varies from one Member State to another is to be considered too. In fact, depending on the size, specialization and organization of domestic work force, beside the (core) sectoral competences, also cross-linking and networking competences are required in establishing successful voluntary standards and regulations. For instance, it is widely acknowledged that the effectiveness of a qualification scheme for installers could be curbed by a lack of trained designers and, in general, of all those supporting



experts which act as the so called “system integrators” and have a relevant role in determining the final performances of the installation.

For the above reasons, even more, the orientation of the European legislator to foster the diffusion of certification schemes at Member State level seems reasonable and potentially effective.

Grounding on these bases, we hold that prior to a wider harmonization, Member States that are foreseeing to introduce certification schemes (or equivalent qualification schemes) for installers of shallow geothermal systems and heat pumps, today have the opportunity to start a comprehensive and wide discussion with local planners, manufactures, installers, drillers, technology providers and “system integrators” so as to ensure high environmental protection, efficiency longevity of GCHP systems, and – indirectly – customer protection.

Positions shared at European level and the experiences of the most advanced Member States, however, can be taken as useful benchmarks and can provide good practices that deserve to be considered within the negotiation process among local stakeholders.

### **Research design: key opinion leaders engagement**

According to different international experiences, most policies are designed according to the needs and aims of different interest groups, but it has to be noted that in many cases the most influential interest groups are the most entrenched ones and therefore those who benefit from the status quo. (Mendonca et al., 2009). On the opposite, if a policy is conceived and implemented to overcome the status quo and endorse the principles of transparency and understanding, then it really have to aim at benefiting individuals and communities, even those that have previously been under-represented in the political conversation around the future of energy, and at boosting free competition in the reference market.

Beside this assumption, the outputs of IEE Ground Reach project confirm that – from the offer side of the market – the certification of planners, manufacturers, drillers, installers and, generally, of all specialists that contribute to the design, installation and maintenance of GCHP systems is a very important issue in order to guarantee the proper operation of the system and protection of the consumer. In fact, a negative impact on the market can be expected if the demand increases and overall poor workmanship is delivered in countries without specific standards.

In order to set up an effective certification scheme for GCHP, i.e. one that is able, on one hand, to guarantee reliability and transparency, and, on the other, to reflect the entrepreneurs' points of view and to ensure a wide acceptance of its results, to take into consideration the different points of views of GCHP stakeholders is necessary step, even if not sufficient.

Our work particularly focuses on the latter issue, in order to take into consideration the different points of views of GCHP professional bodies and associations in sight of setting up a certification scheme. To this purpose, within our research 12 key opinion leaders have been identified and than engaged in the following actions:

1. discussion of the market dynamics with public and private stakeholders (mainly competent authorities and associations);
2. Segmenting the population of entrepreneurs (on the basis of their different activities and approaches);
3. Identification of one or two “opinion leaders” per segment (on the basis of the level of participation at public activities, at national and international workshops, etc.).

After the selection phase, the panel of key opinion leaders featured two drillers, two borehole providers, two heat pump installers, two designers, two integrated operators, one tele-heating provider and one consultancy company.

Direct interviews emerged as the most effective method to gather information.

First of all, a monitoring activity of national and international GCHP communities and of relevant projects at European level (e.g. IEE (Intelligent Energy Europe) ProHeatPump, IEE GroundReach, IEE GTR-H projects) was useful to better articulate the key topics and to design the questions for the following phases.

The presentation and discussion of the results to several GCHP communities (e.g. stakeholders meetings and public conferences such as Geoitalia 2009, etc.) provided the final tuning for the conclusions.

Due to the methodological assumptions, the conclusions cannot be *a priori* generalized, but need to be further debated and analyzed on proved priorities and, thus, serve the scope to orient further research.

### **Research methodology**

The assumption on which the methodology relies is that the introduction of a voluntary tool such as a “certification scheme” can actually generate significant (positive or negative) technical, economical and environmental impacts. Grounding on this assumption, we analyzed the relevant scientific literature and we identified approaches for evaluating policies which are mainly referred to “neoclassical” and “institutional” theoretical frameworks. In the “neoclassical” assessment methods, environmental problems are conceived as market failures (e.g. the environmental impacts are not automatically included in pricing dynamics) and internalized as external costs. In the “institutional” theories environmental problems are conceived as institutional failures, hence imbalances cannot be adjusted solely by means of neoclassical reforms. Consequently, both multi-criteria assessment and social cost assessment are utilized so as to reach the objectives of equity and social fairness. Despite the sound theoretical background, both these approaches reveal methodological weaknesses (Kim, 2007) and make it more effective to use a hybrid empirically-based approaches. De facto, the availability of data sources often guides the selection of the most appropriate methodology.

For what concerns our work, it has to be noted that in the field of standardization, many previous researches (Kim, 2007) (Ottinger, 1997) (Daly and Cobb, 1989) (Lahdelma et al., 2000) (Castells and Munda, 1999) aiming at drawing scenarios for the application of policies or certification schemes noted the importance of analyzing the actors' strategies through a quasi-institutional approach.

To our purpose, the choice of the research methodology lies on two fundamental assumptions. First, in order to reflect the “evolutionary” and multidisciplinary nature of this research field, the investigation of entrepreneurial strategies has to address the needs of different interlinked and dynamic dimensions, i.e.: regulatory, technical, economical and managerial. Second, collaborative efforts may actually generate positive “externalities” in terms of an expanded pool of entrepreneurial opportunities compared to the zero-sum game between first movers and imitators. Hence, the focus of the multi-dimensional investigation is a pool of heterogeneous and proactive entrepreneurs that act as opinion leaders.

Effectively, one of the most straightforward approaches used to analyze a company's multi-dimensional strategic position is the SWOT analysis (strengths, weaknesses, opportunities and threats). This methodology postulates that effective strategy is possible whenever there is a fit between the company's external environment and its internal characteristics. In fact, since 1950s, many authors (Smith and Christensen, 1951) (Andrews, 1971) developed SWOT as the most effective tool for the analysis of an organization's internal and external environment, with the aim of identifying internal strengths to be coupled with external opportunities and of avoiding external (and possible internal) threats, while addressing weaknesses.

A large number of applications by both researchers and consultants witnesses that the typical shortcomings of the SWOT analysis are the lack of prioritization of strengths, weaknesses, opportunities and threats and the respondent-related biases, e.g. towards the tendency to foresee more opportunities than threats (Hill, Westbrook, 1997).

For this reason, a number of academics have tried to devise various modified frameworks to better focus the SWOT analysis, in order to improve its outcome and enhance the planning process. These approaches induce decision makers to be more systematic and consistent in their environmental appraisal, in relation to current available methods, by being more inclusive and directing focus on

the important areas that need to be addressed. In the largest number of cases, SWOTs are not intended to replace other environmental analysis techniques, but rather to consolidate on them in a systematic method (Panagiotou, 2003).

According to past experiences, an adaptation of SWOT methodology is here proposed so as to:

- analyze the determinants of the potential standardization environment;
- synthesize multiple and independent inputs and points of view through a systematic procedure;
- prioritize the judgments for each evaluation parameter;
- assess the overall entrepreneurial alignment with the potential standardization environment.

In details, this methodology consists of two steps:

- defining the overall entrepreneurial attitude towards the market's future and the willing to take risks for economic gain;
- identifying and evaluating the potential standardization environments on the SWOT basis.

The first step is a qualitative investigation that, based on direct interviews, expert evaluations and literature reviews, aims at selecting the managerial model that the opinion leaders better fit into. This is due to the need to determine entrepreneurs' attitudes by answering such questions as: "what are the determinants of entrepreneurial strategies?"; "decisions are driven by short or long term strategies?", etc.

According to the literature review on RES organizations (and to the conceptualization of typical managerial models), this means to characterize Italian GCHP entrepreneurs' attitudes by trying to understand to what extent they really adopt "green management"-oriented strategies and behaviours and, consequently, if GCHP-SMEs show signs of "ecological restructuring" or, on the contrary, fit into traditional management paradigms (Gladwin et al., 1995).

Such debate on old-, "extractive-" (based of traditional extractive techniques of non renewable resources), short-term economy versus new, long-term, "green" economy finds a general rationale in G8+5 study on the Economics of Ecosystems and Biodiversity (TEEB) and in the Green Economy Initiative launched by UNEP in 2008.

Accordingly, relevant indications on a possible classification of the "green entrepreneurial attitudes" rely on the definition of sustainable entrepreneurship as the of "*how opportunities to bring into existence future goods and services are discovered, created, and exploited, by whom, and with what economic, psychological, social, and environmental consequences*" (Cohen et al., 2007). This definition assumes that significant and pervasive market imperfections exist across multiple industries with respect to environmental concerns, and this generates different entrepreneurial opportunities in the marketplace, in addition to the ones which are created by massive changes occurring in the natural environment (e.g.: the GreenHouse effect). Under an operational point of view, this definition is consistent with the concept of "green management" which is defined as "*the organization-wide process of applying innovation to achieve sustainability, waste reduction, social responsibility, and a competitive advantage via continuous learning and development and by embracing environmental goals and strategies that are fully integrated with the goals and strategies of the organization*" (Haden et al., 2009).

According to these definitions it is possible to identify four interdependent "cardinal points" that can explain and "measure" the degree of maturity of "green management" in the company's strategies: the prerequisite of technological adequacy (C1), the commitment to (long-term) economical sustainability (C2), the attention to environmental sustainability (C3) and the aim to enhance social acceptability (C4). Furthermore, as control parameters, four typical approaches describe the way green managers act, and might therefore be used as "markers" to identify a green management attitude: the integration of local resources and vocations into production assets (A1), the use of multi-disciplinary assessment (A2), the analysis of the investments under a life-cycle perspective (A3), the central role given to reputation management, based on the precaution principle and a "sense of responsibility" (A4).

In our analysis, by means of open interviews, the identification of opinion leaders in each determinant (A1-A4, C1-C4) is expressed by a six-level rating scale: 1) perceived as fundamental

and fruitful; 2) perceived as important and sometimes fruitful; 3) perceived as important but not fruitful; 4) perceived as useless but not dangerous; 5) perceived as useless and sometimes dangerous; 6) perceived as misleading and dangerous.

The entrepreneurs' attitude towards management is considered to fit into “green management” in case of predominance of 1 and 2 and absence of 4, 5, 6, as average levels registered among all the respondents.

The second step of our analysis is quasi-quantitative investigation that, based on direct interviews, aims at gathering the “expressions of consensus” of the opinion leaders on a set of factors determining the potential standardization environment emerged from preparatory expert evaluations, literature review and a cross-analysis of sample experiences (e.g. foreign standards).

Linguistic descriptors effectively serve the scope of describing the alternatives through a morphological analysis. Here, after the definition of the main variables, the various states that each variable could take are given with the answers of the experts' group. All the possible combinations characterize morphological field which contains the total of the feature states such as they rise from the assumptions made on the states of the variables (Cantin et al., 2007). Hence, morphological field generally contains a great number of scenarios (for  $n$  variables with  $a$  alternatives the field is made of  $a^n$  futures).

It is important to note that, due to the incommensurability of the multi-level decision drivers, our analysis aimed not at selecting one optimal solution, but at identifying the one that has the higher compatibility with the average entrepreneurial attitude.

The potential standardization environment is described through alternatives for a set of key and independent decisions. Given  $n$  decision nodes and  $a$  alternatives per node,  $n*a$  determinants are investigated by the means of SWOT parameters. A parameter of compatibility between determinants is externally assessed, so as to eliminate the itineraries characterized by internal inconsistency (a criterion for exclusion is defined by the constraints which make unrealizable several families of solutions). Finally, fitting all the combinations of one alternative per each node, a software elaborates the average SWOT parameters along  $a^n$  itineraries.

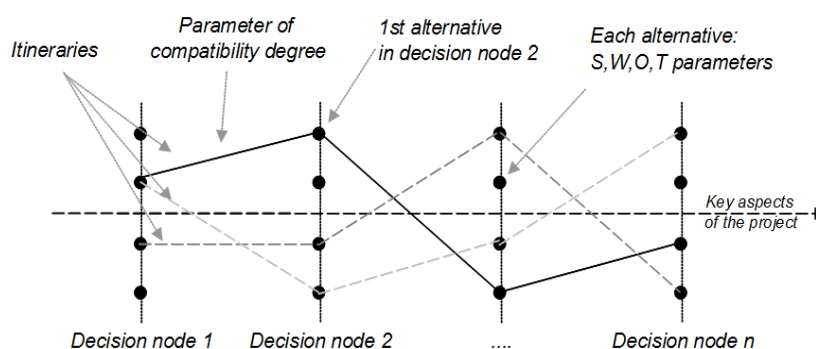


Fig. 2 Scheme of SWOT analysis through itinerary aggregation

In practice, starting from the basic concept that, in order to achieve a quality leap in the market, the EU's Climate Action & Renewable Energy Package and the RED Directive states that "*Member States shall ensure that certification schemes or equivalent qualification schemes become available by 31 December 2012 for installers*", many options are developed according to expert evaluations, literature review and a cross-analysis of sample experiences. The process of development of the potential standardization environment is conceptualized through three alternatives per each basic information (how, what, who, when, why). Relevant fields and dimensions to be investigated include such questions as “what are the needs that standardization must satisfy?”, “what are the roles and responsibilities of key-actors?”, “what are the auditing schemes to be implemented?”, etc.

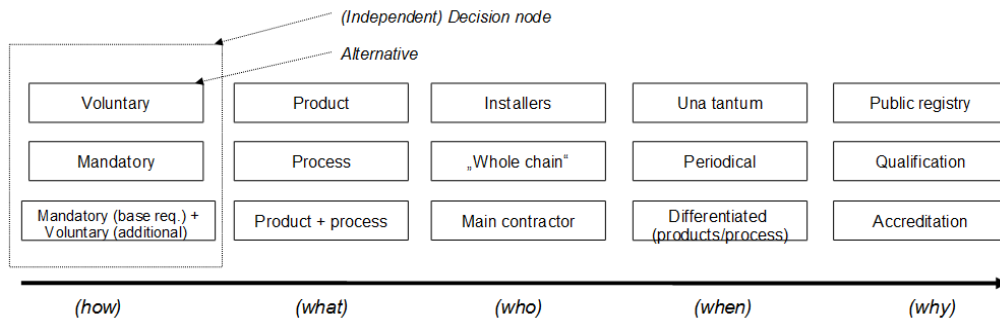


Fig. 3 Decision nodes and alternatives for GCHP standardization

On the basis of the outputs of the IEE ProHeatPump project (IEE ProHeatPump, 2007), the alternatives have been set also according to such external constraints as the Energy Performance of Buildings Directive, the Directive on Energy End Use Efficiency and Energy Services, the Eco Design Directive, the Energy Star Regulation, the Labelling Directive.

It is important to note that, as stated in IEE GRT-H project, it is acknowledged that professional competence - specifically in the geothermal area – should preferably be a prerequisite of certification schemes, and the optimal target should be to build multi-disciplinary and multi-sectoral competences. In fact, as an example, building consumption can be largely cut back through improving efficiency (Lee et al., 2004) with great impacts on input data for GCHP designers.

Concerning how the certification scheme should work, the three options concern the possibility to adopt it on voluntary basis (that is for providing strong evidences of certified organization's excellence, credibility and commitment), on mandatory basis (that is to give a common performance baseline among sectoral organizations), or on a compromise between the two (depending on the specific requirement).

Within the definition of the scope of the certification scheme, the alternatives deal with the management of products (so as to stress the intrinsic characteristics of goods or services put on the market), of processes (so as to stress the dynamic conformity to suitable policies and procedures) or of both of them.

Another important “decision node” concerns who is the actor of the certification scheme, i.e.: who can take part in the scheme and apply for certification. Among the alternatives, the first option is the one that is namely mentioned within the RES Directive: the certification schemes is for installers. The second option considers that in GCHP projects the responsibility for the final result can not pass from one to another and, for this reason, a main contractor can be profitably indicated as a guarantor of the overall project quality. As the third option, the conformity to the certification scheme requirements can be assured by every organization participating in the project.

In any case, the conformity verification entails auditing activities that can be non-recurring (una tantum), periodic (random or scheduled), or – as a mix of the two and inspired to the usage of CE qualification within certified processes – non recurring for products and periodic for processes.

Finally, the last choice concerns the way to make the certification visible in the market. A first option foresees the publication of a register of certified products or organizations so as to be easily accessible by customers. The second option provides the possibility for products of organizations to demonstrate, when asked to, credentials against binding requirements through their certification. Finally, the third option simply deals with the possibility for products of organizations to communicate to the market or potential customers that they have passed voluntary performance and quality assurance tests.

In any case, the basic assumption is that, as widely stated for environmental performances in building sector (Lee et al., 2004), if the certificated service or product truly reflects enhanced performance (that would be treasured by prospective buyers), such scheme would encourage market

players to develop higher performances.

## Results

During step one, the analysis of linguistic descriptors through the so-called “fuzzy logic” shows that the strategies of Italian GHP managers (opinion leaders) can actually be linked, despite a partial operational maturity, to “green management” models.

Calculating the score for each determinant in the six-level rating scale as the average of respondents' scores (without the extremes), three determinants are perceived as fundamental and fruitful (A1, C2, C3), one perceived as important and sometimes fruitful (C1) and four perceived as important but not fruitful (A2, A3, A4, C4).

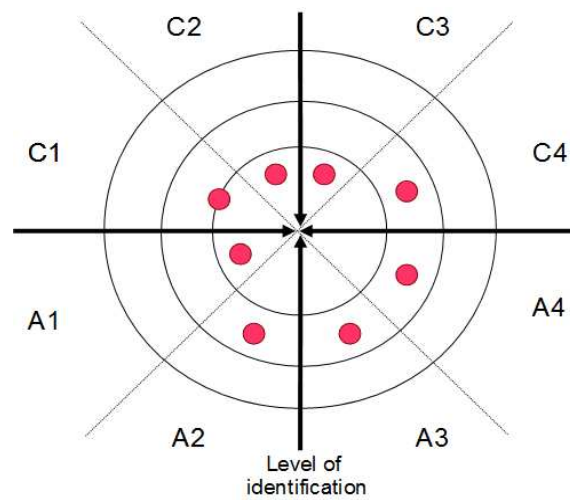


Fig. 4 Identification of Italian GCHP entrepreneurs with green management veining elements

In general terms, the fact that intents gather more consensus than operational approaches demonstrates that the opinion leaders are acting in a developing environment, with a common “green” vision but without a clear tactic and/or consolidated tools. Hence, commitment to (long-term) economical sustainability, attention to environmental sustainability, integration of local resources and vocations into production assets are largely agreed upon concepts by GCHP entrepreneurs that, probably due to the lack of shared experiences, still do not benefit from the availability of well-established methodologies. For this reason, still no relevant advantages are expected from such important actions as the adoption of multi-disciplinary assessment, the analysis of the investments from a life-cycle perspective and the integration of the principles of precaution and “sense of responsibility” in the decision making process. Similarly, the necessity of enhancing social acceptability is deeply felt, but there is still no clear idea on how to effectively achieve such a goal.

Furthermore, the adoption of “state of the art” technologies entails the awareness that environmental protection and performance improvement can both play a fundamental role in the completion of internal market and in ensuring present and future earnings.

On the whole, these results suggest that, despite other national experiences criticize the theory of an ecology-driven evolution of builders (Revell, 2003), in Italy some environment-driven restructuring is taking place. This is mostly happening within high-quality and integrated niches of building industry as, de facto, SMEs consider it an opportunity to align with the ecological win-win philosophy, largely endorsed by local public administrations. From our interviews it also emerges that, as it often happens, this is explicitly due to both the perceived threat of future legislative actions and to the will to protect sectoral marketshares through the marginalization (or exclusion) of poor quality installations.

Unfortunately, the market is not yet signaling to GCHP entrepreneurs that new customers can be automatically “conquered” by embracing technical and environmental best practices. Hence, supporting actions have to be taken so as to spread awareness on the relationships between best practices and life-cycle (technical and economical) performances.

According to these results, through the second step of the analysis it was possible to go even further, by answering such questions as “Could a certification scheme be compatible with the application of a “green management” model among GCHP-companies?”, “Could the greening of GCHP-SMEs be encouraged by such certification policy?”.

The elaboration of SWOT parameters along the 243 possible itineraries indicates that the itinerary that maximizes the opportunities while minimizing the threats (which calls for the higher conformity to "green management attitude"), consists of a combination between product and process approaches. At first, the introduction of mandatory technical standards for products (incl. design software) and, eventually, a list of accredited products are required. Beside that, the availability of voluntary and specific quality management schemes so as to certificate main contractors (e.g. purchasing, training, monitoring, etc. procedures) is seen as desirable too.

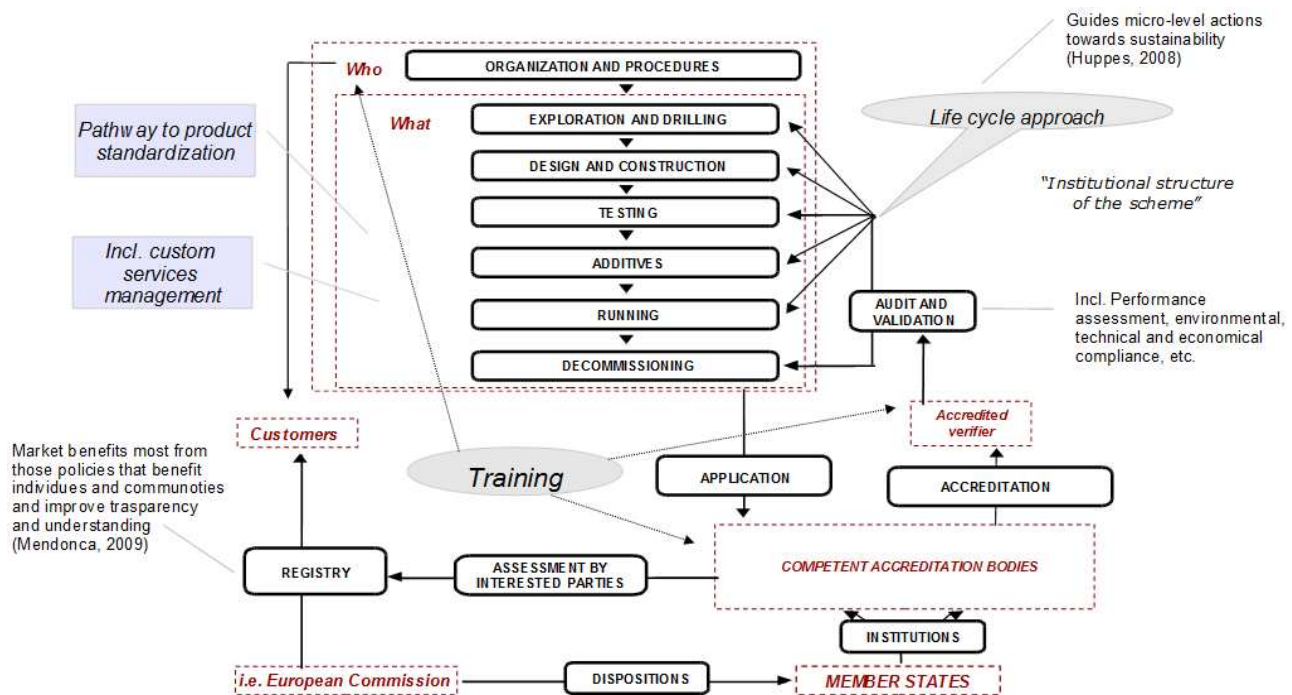
In GCHP entrepreneurial' opinion, the reliability of the overall scheme has to be provided by the carrying out of periodical third-party audits, while the benefits has to be enhanced thorough the institution of a Public Registry of certified products and organizations.

In order to explain the rationale of these findings, it is important to notice that long term strategies and administrative burdens entail selling not only a product, but also services and know-how. to guarantee both environmental and customer protection. In this way, leading companies can capitalize on dynamic (and non-casual) market niches. This means that the request for product-related mandatory technical standards aims at guaranteeing the customer from unexpected negative performances and, in general, at protecting the sector from events that might bring discredit to GCHP technologies. Beside that, the availability of voluntary management schemes so as to certify main contractors serves the scope to institutionalize a framework for distinguishing verified best practices from hundreds of self-defining effective “praxis”, as well as reliable operators from under unprepared and opportunist ones.

Well designed standardization models should usefully encompass both product and process stakeholder protection requirements. Moreover, a general discussion with opinion leaders confirms that voluntary approaches and certification schemes are perceived as an adequate solution to make most local resources respond to GHP managers' needs.

Grounding on the empirical facts above (and on literature), a potential certification scheme has been simulated so as to synthesize the opinions emerged from the discussions. Such scheme has been publicly presented in Geoitalia Conference on “Sustainable use of low-enthalpy geothermal resources: studies, projects and applications” - Unified Session (Rimini, September 2009) and than discussed, agreed upon and further improved.





Here, the alignment between the intents and the operational tools is realized by introducing a pathway to product standardization as pre-requisite of design and supply management procedures. The main contractor, in fact, includes this element of quality assurance within a comprehensive quality-assured life-cycle process management.

The certification can be carried out by trained agencies. These agents, due to administrative and managerial boundaries, are better from private sector and meeting public dispositions.

The external auditing and validation of the voluntary process is considered important under different points of view. For example, as already mentioned, customers could benefit from such “evidence of quality assurance” and, in addition, as stated in IEE GTR-H project, technical parameters used to assess eligibility for a Financial Incentive Scheme (FIS), it should be strictly oriented to any European standard and certification in place (IEE GTR-H, 2007).

The GCHP project management is considered as the main service provided by the certified organization. According to that, certified organizations demonstrate the implementation of an effective “management system” by giving evidences of the adoption of best practices in carrying on (or coordinating) exploration, drilling, design, construction, testing, monitoring and decommissioning activities. Such best practices could refer to specific guidelines or external standards (e.g. foreign standards). As broadly wished, further participatory approaches will help to set challenging standards both for products and processes.

A first indirect implication is that this scheme highlights as cardinal targets of training actions both auditors and GCHP operators (main contractors and manufacturers).

A second implication concerns policies that aim to increase customer awareness, benefiting from transparency and reliability of bi-directional transaction. In this prospect, the scheme should work as follows: organizations demonstrate that products and services meet clear quality requirements and customers award the same organizations and products by shifting their preferences to entries from the Registry. In this way, the scheme intrinsically responds to the need of giving proper market visibility to GCHP best practices.

Last, but not least, from a practical point of view such scheme could be easily implemented through the integration of specific guidelines (for GCHP organizations and auditors) in ISO 9001 and ISO 14001 standards.



## Conclusions

Italian GCHP-companies demonstrate a “Green Management” attitude. Despite that, a certain immaturity of the market sometimes induces myopic strategies.

The lack of operational tools has been faced through trying to align their design and implementation to entrepreneurs' strategies. The resulting “standardization trajectory” highlights the commitment to pursue a sustainable development of GCHP market.

Within such a framework, the application of a certification scheme is likely to improve the overall quality of the market supply-side and to help rationalizing the required operational tools. The enhancement of control procedures, of customer awareness, of consumer protection and the possibility to consolidate and improve both the technical and managerial know-how on GCHP are the other primary positive impacts within opinion leaders' expectations.

Some authors argue that policies designed to correct incipient market failures generally increase marginal private cost, so to equate it with marginal social cost and, thus, affect income and policy acceptability (Caviglia-Harris et al., 2003). An adequate policy design should limit such a distortion and be able to maximize satisfaction among stakeholders. Unfortunately, it is difficult to predict *a priori* whether the positive market quality effect will outweigh the potentially negative price effect, as this depends on the price elasticity of the demand. This justifies the opinion leaders' call for demand-side actions to raise customers' awareness, as an element which can play a crucial role in determining the success of the whole policy.

Another important issue is the need of external funding. Public financial support can rely on two major types of instruments: subsidy and catalyzing support. Both are suitable to foster the adoption of certification schemes (e.g. direct coverage of certification costs, green public procurement, etc.). In relation to previous experiences, the magnitude of the “energy impact” is averagely larger than the subsidy instruments, but end-use technologies linked to catalytic measures can reach even higher effects (Lund, 2007). According to this theoretical framework, the management of cost/effectiveness of the policy is therefore deferred to further and more specific analysis.

Finally, it is important to underline that product standards emerged as a necessary baseline from the analysis, but they have to adapt to market needs under an evolutionary perspective. In fact, high barriers and long periods of stability (e.g. path dependency and lock-in) have to be avoided so as to achieve improved sustainability (Sartorius, 2006). This is particularly true in the Italian GCHP market where, due to the lack of complete knowledge about the set of available alternatives (e.g. perspectives of medium enthalpies exploitation), actors cannot maximize the expected utility of alternative choices. In this context, flexibility and versatility have to be preferred to predefined and stable technological trajectories. An evolutionary perspective is desirable also for entrepreneurial partnerships. In fact, as one side of the coin, the networking capability of the main contractor and the quality of the whole-cycle project management has a tremendous impact on the creation of value and, thus, on market perspectives in the short term. For example, as shown in IEE GTRH project, the availability and the costs associated with data collection have shown to be sometimes inhibiting private investments and growth in the sector. Here, strategic partnerships contribute to remove such barriers. In the same way, profit uncertainties and incomplete risk assessment induce financial barriers. Again, the engagement of non-core knowledge, as a part of the entire quality management of the process, contribute to guarantee high and stable performances with this matters. In a long term perspective, as the other side of the coin, it is argued that networks do not have to be unduly stable (e.g. due to incumbent industry) so as to allow “windows of opportunity” and increased sustainability in the long period (Sartorius, 2006).

All these elements bring to the conclusion that standardization and voluntary schemes could provide an effective set of tools to encourage the greening of the Italian GCHP-SMEs in the short-term, while laying the foundations for evolving sustainable policies in the longer run. With that intent, and grounding on above findings, the scenario that represents the consensus of GCHP entrepreneurs appears readily implementable by means of further, better focused and participated in detail policy design.

### **Areas for further research**

This paper analyzes the Italian GCHP entrepreneurs' attitude towards voluntary approaches and their operational philosophy. As argued in the text, an effective sectoral policy relies on a multiplicity of actions (both from supply- and demand-side of the market). Hence, further investigations can be usefully undertaken so as to:

- profile the knowledge basis of the conjunction with stable financial support assessing the effectiveness of the voluntary approach by analyzing which groups of stakeholder benefit most from the design of the policy (Mendonca et al., 2009);
- detecting the long term impacts of standardization on entrepreneurs' attitude towards technical innovation in GCHP sector.

These research actions are expected to improve the theoretical basis for defining a reliable and effective sectoral policy, which emerges as a major challenge at present.

Finally, to make further steps forward in providing an insight into stakeholder relationship management and industrial strategies, an extension at the European level should be useful in order to understand how to make sure that upcoming national regulations address shared goals while not preventing the exchange of work and services in the common market.

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