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Renewable and Sustainable Energy Reviews

xx (xxxx) 1–27

**RENEWABLE
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Review

HOTRES: renewable energies in the hotels. An extensive technical tool for the hotel industry

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Received 12 February 2004; accepted 15 September 2004

Abstract

The project HOTRES aimed at the systematic implementation of conditions for future massive applications of the renewable energies in the tourism industry. Under the umbrella of this project five renewable energy technologies were promoted (solar thermal, solar passive, solar PV, biomass

Abbreviations: ADEME, Agence de l'Environnement et de la Maitrise de l' Energie; AMG, Azienda Municipale Gas; AREAM, Agencia Regional da Energia e Ambiente da Regiao Autonoma da Madeira; BEMS, building energy management system; CRES, Centre for Renewable Energy Sources; DGTTREN, Directorate General for Energy and Transport; DHW, domestic hot water; EGEC, European Geothermal Energy Council; EPIA, European Photovoltaic Industry Association; ES, energy saving; ESD, executive design sheet; ESTIF, European Solar Thermal Industry Federation; EU, European Union; EUBIA, European Biomass Industry Association; HVAC, heating, ventilation, air-conditioning; MA, Manufacturer Association; OPE, operational programme for energy; PV, photovoltaic; RES, renewable energy sources; RET, renewable energy technologies; RUE, rational use of energy; SHW, solar hot water; SME, small and medium enterprises; SODEAN, Sociedad para el Desarrollo Energetico de Andalucia; TUC, Technical University of Athens.

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1364-0321/\$ - see front matter © 2004 Published by Elsevier Ltd.

doi:10.1016/j.rser.2004.09.012

46 and geothermal energy) in parallel in five EU regions (East Attica, Sicily, Alpes-Maritimes,
 47 Andalusia and Madeira) by the corresponding agencies and promotion centers following an
 48 extensive and intensive work program be composed of six elaboration phases. The purpose of this
 49 article is to esteem the results achieved in the technical–economic field of the relevant extensive
 50 technical support project in 200 hotels as well as to validate the strategic methodology applied for the
 51 promotion of the renewable energy technologies (RETs) through the technical assistance of the hotel
 52 SMEs. Finally, by proving the liability and economic viability of RET applications in hotels, the
 53 largest European hotel installation with solar thermal is presented within technical and economic
 54 details.

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56 *Keywords:* Renewable energy; Tourism; Hotel; Environment; Solar thermal energy; Geothermal energy;
 57 Photovoltaic; Biomass; Solar passive

59 Contents

61	1. Introduction	000
62		
63	2. Energy related topics of the hotel sector	000
64		
65	3. Development of a conceptual methodology to be tested in the hotel sector	000
66		
67	4. Project monitoring and evaluation	000
68	4.1. Action 1: market survey	000
69	4.2. Action 2: tools for technical assistance	000
70	4.3. Action 3: technical assistance and follow-up	000
71	4.4. Action 4: sectorial business meetings	000
72	4.5. Action 5: support to pilot projects	000
73		
74	5. Results: information given by the hotel personnel	000
75		
76	6. Assessment of the hotel sector reaction against RET promotion	000
77	6.1. Technical–economic related results: the Executive Sheet Designs (ESD)	000
78	6.2. Marketing related results: the impact assessment	000
79	6.2.1. Impact assessment in Attica, Greece	000
80	6.2.2. Impact assessment in Alpes-Maritimes, France	000
81	6.2.3. Impact assessment in Andalusia, Spain	000
82	6.2.4. Impact assessment in Madeira, Portugal	000
83	6.2.5. Impact assessment in Sicily, Italy	000
84		
85	7. Validation of the HOTRES methodology and perspectives	000
86	7.1. Validation of the methodology	000
87	7.2. Perspectives	000
88		
89	8. Conclusions	000
90		

91 Appendix Case study: the largest solar thermal application in hotels in the EU 000
 92
 93 Acknowledgements 000
 94
 95 References 000
 96

97
 98 **1. Introduction**

99
 100 The tourism industry is amongst the most dynamic areas within the services sector, this
 101 being especially the case in the Southern Europe (France, Greece, Italy, Spain and
 102 Portugal). In all these countries the tourism sector is an essential development tool (i.e. in
 103 2000 the tourism industry is deputing the 16.3% of the Greek Gross Domestic Product and
 104 represents the most important service industry [1]).

105 Recently, in national level, EU and international tourist policy are aiming at the
 106 improvement of the existing infrastructure, the lengthening of the operation season, the
 107 improvement of alternative forms of tourism (i.e. eco-tourism, health tourism etc.) but,
 108 always minding environment [2]. As regards energy consumption in hotels, challenged
 109 represented, that is competitiveness, the importance of reducing cost and growing
 110 sensitivity to environmental factors in hotel design, which is leading to the introduction of
 111 elements with less environmental impact, all combine to create conditions favourable to
 112 the optimization of energy resources and the introduction of RETs.

113 Nowadays, EU strongly encourages the environmental performance of services and
 114 products. Additionally the public awareness and the demand of the tourism product
 115 continuously require more environmental friendly services. The implementation of RET
 116 projects in current hotel units shall give them a comparative advantage of environmental
 117 performance. Considering any forthcoming EU eco-labeling scheme in the hotel sector,
 118 any RET application would be considered a surplus advantage for hoteliers to participate
 119 in. Even though RET applications would not be involved in any mandatory approval
 120 criteria for an eco-management scheme, surely they would be accepted as the first step on a
 121 positive environmental image and marketing efficiency of an enterprise.

122 In conclusion, in order to promote RETs to the tourism sector effectively, isolated
 123 promotional activities are not sufficient. A new methodology should be worked out in
 124 order to take the interested party by hand, through all the stages leading up to the
 125 implementation of the system in the sector. This is particularly relevant in the hotel sector
 126 where you meet poor technically oriented staff, and you have to drain out who can receive
 127 information on RETs and their applications and then follow the subject of their installation
 128 themselves according to their technical knowledge.

129
 130
 131
 132 **2. Energy related topics of the hotel sector**

133
 134 In the relevant energy topics of the hotel sector, particular in the south EU, we can note
 135 down the following particularities and weaknesses:

- The majority of the units are approximately sized 100 beds (this means a ‘Mediterranean’ type, family type enterprise). These SMEs focus at providing the highest level of services in their facility, so they have no awareness about ‘how energy is produced’, in order to require technical assistance.
- Many hoteliers are willing to invest in renovation, so they welcome the concept of introducing RETs, due to the social status and the marketing argument, regarding the forthcoming requirements for the ecolabeling of their hotel units [3].
- Investment funds are not the core problem for the low profile of the RES penetration in the sector, since future investors have sufficient budgets for renovation and environmental-profile works [4].
- There is an extremely low degree of RET penetration in the sector, solar active excluded [3]. For instance, in a statistical sample of 32 Greek hotels spread out with equivalent statistical frequencies over the country’s regions and over the various hotel categories only 2 units have been found using RET, other than solar active (Fig. 1).

Nevertheless, the solar active ‘penetration’ is satisfactory (8 plants on 32 hotel units), but still there is work to be done for target-regions other than Greece which are extremely weak (these target regions selected for the applying the strategic methodology through the HOTRES project are Sicily, Madeira, Andalusia and Cote d’Ajur/Alpes Maritimes).

There is lack of experienced engineers, to support and promote energy projects to the hotel management, follow up the project and maintenance to the highest level of operation, [5].

Moreover, when the liable of each hotel is interested in a specific RET, asks for an application for his enterprise, limited information is available about suppliers, manufacturing companies, third parties independents (with no partiality) about the use and results of these technologies, etc.

According to the experience of the participants of the project, the reasons for the above extremely low profile scheme of RETs penetration in the hotel sector, find their source in three market weaknesses:

(i) *Investment fund shortage.*

As it is obvious this is rather important [4].

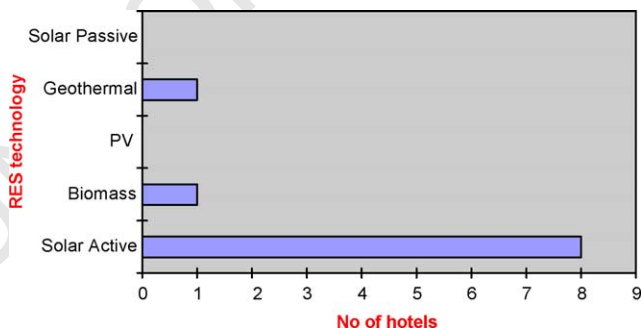


Fig. 1. Penetration degree of RET in a 32-hotel statistical sample in Greece [2].

181 (ii) *Low feasibility, viability and quality of products.*

182 This subject is also essential, since numerous installations in all the South EU territory
183 covered a part of their energy needs by using of feasible, viable and good quality RET. For
184 example in Greece over 800 hotel units (totally 7.000 units) use solar active.

185 (iii) *The lack of information and follow up.*

186 This seems to be the most crucial parameter.

187 Therefore, there is an obvious need to guide the potential investors of the tourism
188 industry through the following steps:

- 189
- 190 • Presentation of the regional market need and availability of RETs addressed to the
191 tourism sector.
 - 192 • Presentation of the RETs and successful hotel case studies in a simple, easy to follow,
193 but thorough technology support tools.
 - 194 • Performance of a ‘quick selection’ basic design of a technology in order to convince the
195 decision makers of the applicability of the system and arrange for them a visit in one of
196 an existing hotel with successful installation.
 - 197 • Arrangement of business meetings between the suppliers and hoteliers as prospective
198 investors.
 - 199 • Provision of support for pilot projects.
- 200
- 201

202 **3. Development of a conceptual methodology to be tested in the hotel sector**

203

204 Considering both, the present existing situation in the hotels and the environmental
205 performance in the sector, as remarked in the previous paragraph, an innovative approach
206 of the sector SMEs for the design of a specific action should aim at the:

207 (i) *Formulation and implementation of a strategic methodology for the promotion of*
208 *RETs.*

209 The core aspect of this methodology is the concentration on the implementation of
210 conditions for the future expansion of these technologies in the hotel sector. This will be
211 done mainly business oriented on a regional level (East Attica, Alpes Maritimes, Sicily,
212 Madeira, Andalusia) by the corresponding agencies (CRES, ADEME, AMG, AREAM,
213 SODEAN) in collaboration with equipment manufacturing associations and will be based
214 on the experience acquired within previous advanced projects (i.e. in Catalonia).

215 (ii) *It will promote the implementation of solar active installations with highlights on*
216 *innovative technologies.*

217 Solar active installations have already known technological development in the tourism
218 sector of certain countries (i.e. hotels in Spain and Greece) or in similar users [6] to other
219 regions of European countries with little or no applications of these systems (e.g. Madeira,
220 Portugal). Solar cooling technologies in hotels seem an excellent challenge for hotel
221 managers to show the use of innovative and cost effective technologies [7] with highly
222 positive environmental impact.

223 (iii) *The involvement of five regions from five countries and their local business actors.*

224 The involvement of local business actors has being considered as really necessary, for
225 example: (i) Local owners of tourism and leisure facilities; (ii) Suppliers and

226 manufacturers of RETs; and (iii) Local engineers and technicians, as partners in
227 developing the use and application of RET in the tourism and leisure industry assisting the
228 penetration of these technologies easier, helping the local market development. This is
229 particularly important for local market strategies [8].

230 Following this conceptual approach, a number of specific actions as well as the
231 respective tools for the technical support to the hoteliers have been developed and
232 extendedly depicted in the next paragraph.

233
234

235 **4. Project monitoring and evaluation**

236

237 The project specific actions were [9].

238

239 *4.1. Action 1: market survey*

240

241 Main activities:

242

- 243 • Regional market survey of the energy requirements of the tourism industry.
- 244 • Locate and list suppliers of RETs geared towards the tourism industry.
- 245 • Monitoring of five different technologies in five regions over a 3-month period.

246

247 The tool produced is a market assessment including:

248

- 249 • Five regional market surveys of the energy related equipment in the tourism industry
250 (Madeira, Andalucia, Sicily, East Attica, Alpes Maritimes).
- 251 • A hotel-oriented assessment study of existing suppliers of RES technologies (biomass,
252 photovoltaic and geothermal, active and passive solar) and a hotel-oriented technology
253 assessment study of these technologies.
- 254 • Evaluation and monitoring of five existing projects (in the above five regions) relevant
255 to five different RETs.

256

257

258

259 *4.2. Action 2: tools for technical assistance*

260

261 An executive type, business oriented folder was produced and consisted of ten double
262 sided leaflets. The leaflets were produced with a market-oriented technique and covered
263 five sectors (geothermal, photovoltaic, biomass, active and passive solar). The folder was
264 translated into Greek, Italian, Portuguese, Spanish and French.

265 For a preliminary basic design of the system 10 Executive Design Sheets (ESDs) were
266 also elaborated. Main contents: type of technology proposed, area and volume required for
267 the installation of the equipment, investment required, energy savings, CO₂ emission
268 reductions.

269 The tool produced is a folder which is used for promotion during 200 door-to-door
270 presentations (40 for each region) and the ten executive design calculation sheets.

271 4.3. Action 3: technical assistance and follow-up

272
273 *The pre-feasibility studies and site visits including:*
274
275 • Fifty hotels (10 hotels per region) that have participated in order to have the ESD of the
276 chosen (by them) specific RET applied to their case study.
277 • Twenty-five hotels (five hotels per region) that have asked the local agency-partner to
278 organize a visit to an existing installation in another hotel of the region or country.
279

280 .

281
282 4.4. Action 4: sectorial business meetings

283
284 Five regional workshops (one workshop per region) have been organized in which all
285 five RETs under promotion were presented. The manufacturing associations (ESIF, EPIA,
286 EUBIA, EGEC), who are suppliers and construction companies, have presented to the
287 audience, consisted mainly of hotel owners and managers, their existing projects in the
288 hotel sector; as well as their technologies, their products and any related maintenance and
289 installation requirements.

290 *The product produced was the promotion effect during these five regional workshops.*

291
292 4.5. Action 5: support to pilot projects

293
294 In order to stimulate and encourage joint efforts, a technical support was given to one
295 joint project per region/country target. The allocated amount is considered to cover a fully
296 developed technical study for the application of the RET selected as well as to cover
297 accompanying costs such as contractual support, technical consultancy to the hotel
298 concerned, elaboration of their market surveys prior to the arrangement and two reciprocal
299 travel, when needed, for technical assistance and training.
300

301
302 **5. Results: information given by the hotel personnel**

303
304 During the informative visits made to the personnel of the 200 (in total) hotel
305 establishments, the following queries on the acceptance of RES were asked to the hotel
306 managers:
307

- 308 • To rank the importance of RES introduction at a hotel;
309 • To describe whether RES investments will be achieved the next five years, at the hotel;
310 • What is the perceived knowledge on RES subjects by the company's personnel;
311 • To give some statements about RES in a modern hotel organization;
312 • To recommend possible future investments.
313

314 . The following Figs. 2–4 show the results of the answers to the first three questions,
315 since the last two questions were not always answered.

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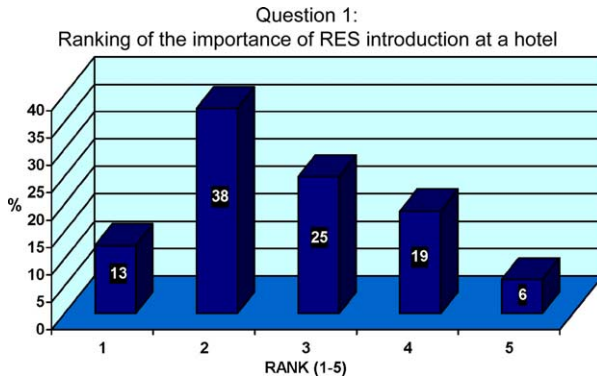


Fig. 2. Performance of RET, when the hotel personnel of 200 hotels in the EU is asked.

6. Assessment of the hotel sector reaction against RET promotion

The effect prevailed upon, after auditing 200 hotel units are of two types:

1. *Technical-economic related*: in order to prove that the RET in the hotels have today reached a high level of technological maturity and a reasonable degree of economic liability, 50 hotels of the 200 units been audited, have been assessed with software of prediagnostic type regarding the technical-economic viability of the technology selected for possible future installation with the purpose to stimulate hotel managers *in decision making*. Furthermore, monitoring studies in eight hotel units through the five regions involved and covering five RETs (solar thermal, solar passive, solar photovoltaic, geothermal energy and biomass systems) have been carried out with the purpose to prove the *liability of the systems and their energy efficiency* to the potential investors—hotel managers. Moreover, basic designs in six hotel units through the five regions involved and covering the technology suggested by the hotel owner among

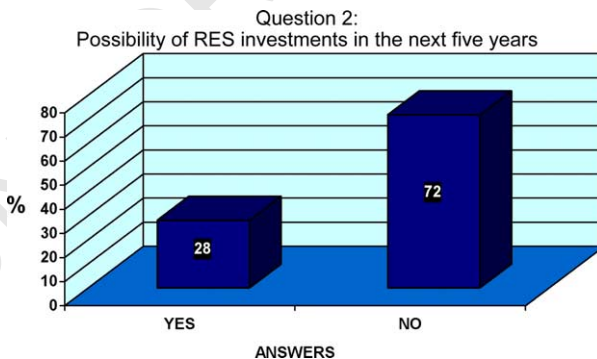


Fig. 3. Investment opportunities for RET in 200 hotels in the EU.

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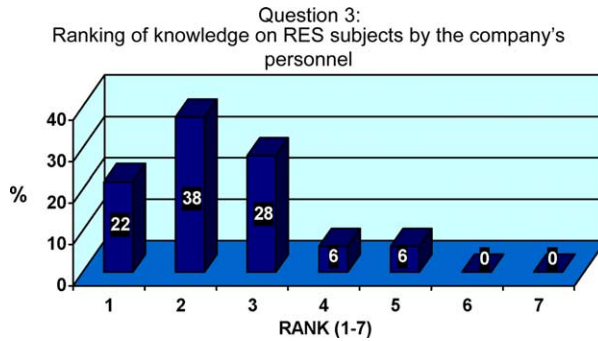


Fig. 4. Level of knowledge of RET by the personnel of 200 hotels in the EU

the five ones under promotion, have been carried out with the purpose to support future pilot project and achieve *best-practice installations*.

2. *Marketing related*: Since the tourism market meets large variety of peculiarities through out the five regions involved in the project, it has been considered that an effective way in presenting the impact assessment of the *HOTRES action plan* and its conceptual promotion methodology, is to make a geographical display of conclusions along each region.

6.1. Technical–economic related results: the Executive Sheet Designs (ESD)

It is useful and statistically representative to evaluate the results from 50 hotel units (among the 200 units been audited door-to-door), which asked the local agency-partner in order to have the ESD of the chosen by them specific RET applied to their case study.

A quick audit at the hotel was made in order to collect the various parameters required by the ESDs to obtain reliable results.

In summary, the RETs been applied in these 50 hotel units, are depicted in Table 1.

The fifty pre-diagnostic studies, based on the ten software environments, suggested to the hotel managers various technical solutions using RETs and gave to them the needed information in order to be in a position to decide for a basic design and a future RET

Table 1
Type of RETs applied in 50 hotel units in the EU

Country	Body	Bio system	Geo system	Passive system	PV system	Thermal solar system	Total
Greece	CRES		5		1	8	14
Andalusia	SODEAN				4	4	8
Sicily	AMG				5	5	10
Madeira	AREAM					10	10
France	ADEME					8	8
Total		0	5	0	10	35	50

406 project.

407 In Table 2 we give the results of the above-mentioned evaluation for the whole hotel
408 sample spread out in the five targeted regions in terms of the relevant RET, size of
409 equipment and pay back period, as an indicator of the market interest to the respective
410 RET application. The allocation of type of equipment down to the number of 51 hotel units
411 in the EU who have chosen this RET is depicted in the Fig. 5.

412 The results given in Table 2 are based on real economic and financial conditions
413 existing in the targeted regions as shown in Table 3 in terms of equipment cost, type and
414 cost of fuel displaced, cost of electricity, as well as the rate of subsidization taken into
415 account.

416 It is interesting to realize that solar thermal is the technology the most sought (66% of
417 the feasibility studies been asked by hotel managers, Fig. 5).

418 It is also impressive to notice, when examining the results shown in the Table 2, the
419 following geographical deviations, marked:

- 421 1. Solar thermal present same economic results in Greece, Andalusia and Sicily. But in
422 Madeira the pay back period rises to double and in France up to be tripled.
- 423 2. PV in Sicily and Greece present same results, while in Andalusia the pay back period
424 decreases down to the half. No preferences reported for PV in the hotels in France and
425 in Madeira.
- 426 3. Only one solar cooling study is shown in a hotel in Greece.
- 427 4. No preferences at all reported for biomass and bioclimatic systems in the hotels in all
428 five regions of the EU.

431 The above-mentioned geographical deviations are easily understood when taking into
432 consideration the economic data displayed in the Table 3, were differences have been
433 noted from one region to another.

434 Appendix shows operational and economic data from a large solar plant in a hotel unit in
435 Greece. (according to this case study, pay back period is found equal to 4.1 years).

438 6.2. Marketing related results: the impact assessment

439 It has been considered that an effective way in presenting the impact assessment of the
440 HOTRES action plan and its promotion methodology is to make a geographical display of
441 conclusions along each region instead of making a mixing of the areas, building a South-
442 European ‘mean’ figure.

443 The assessment is consisting by two major evaluations:

- 444 • *Positive impact assessment*—an assessment of the positive feedback received from the
445 investors in the promotional activities of the project (i.e. energy savings, reduction of
446 air pollution, ‘green’ image of hotel).
- 447 • *Obstacle assessment*—an assessment of the obstacles that had to be overcome in the
448 promotion of the RET products (i.e. lack of investment funds by investors, reluctance to
449 the promotion of the RET products (i.e. lack of investment funds by investors, reluctance to
450

Name of hotel	Renewable energy technologies examined						Number of pre-feasibility studies	
	Place	Biomass	Solar passive	Geo-thermal	Solar PV	Solar SHW		Solar cooling
<i>Greece</i>								
Porto Valitsa	Chalkidiki			46 kW 3.9 years		30 m ² 3.1 years	2	
Metropolitan	Corfu				1.67 kWp 43 years	600 m ² 5.1 years	2	
Lutania Beach	Rhodos	525 kW 4.3 years				600 m ² 4.4 years	3	
Casino Rhodos	Rhodos			30 kW 4.6 years			1	
Colossos Beach	Rhodos			1751 kW 4.7 years		200 m ² 1.7 years	2	
Kresten Palace	Rhodos			1050 kW 4.3 years		400 m ² 3.3 years	2	
Marie Hotel	Rhodos				1.38 kWp 39 years	60 m ² 2.2 years	2	
Total in Greece				5	2	6	1	14
<i>Andalusia</i>								
Parador Hotel Atlántico	Cádiz				6 kWp 7 years	192 m ² 3.4 years	2	
Hotel San Gabriel	Ronda (Málaga)				6 kWp 7 years	20 m ² 7.7 years	2	
Hotel Tartessos	Huelva				6 kWp 6.5 years	40 m ² 4.2 years	2	
Hotel Villas de Antikaria	Antequera (Málaga)				6 kWp 9 years	320 m ² 3.5 years	2	
Hotel Molino las Pilas					6 kWp 9 years		1	
Total in Andalusia					5	4		9

(continued on next page)

Table 2
Pre-feasibility studies with to Renewable Energy Technologies (RET) elaborated in the framework of the HOTRES project.

Name of hotel	Renewable energy technologies examined						Number of pre-feasibility studies
	Place	Biomass	Solar passive	Geo-thermal	Solar PV	Solar SHW	
<i>Sicily</i>							
Addaura	Palermo					40 m ² 4 years	1
Città del Mare	Terrasini					500 m ² 5 years	1
La Torre	Mondello					100 m ² 3.5 years	1
Politeama	Palermo					40 m ² 4 years	1
Saracen	Capaci					130 m ² 4 years	1
Atheneum	Palermo				10 kWp		1
Conchiglia d'oro	Mondello				38 years		1
					20 kWp		
Cavour	Palermo				38 years		1
					5 kWp		
Sirenetta	Isola d. Femmine				38 years		1
					20 kWp		
Torre Artale	Trabia				38 years		1
					8 kWp		
Total in Sicily						5	10
						5	
<i>Madeira</i>							
Pensão Vila Vicência	Funchal					39 m ² 8 years	1
Hotel Madeira Carlton I	Funchal					95.3 m ² 9 years	1
Hotel Madeira Carlton II	Funchal					138.33 m ² 9 years	1
Village Hotel	Funchal					62.4 m ² 8 years	1
Hotel Atlantic Gardens	Funchal					82.2 m ² 8 years	1
Pestana Miramar Hotel	Funchal					69.2 m ² 8 years	1
Dom Pedro Garajau I	Caniço					79 m ² 7 years	1
Estalagem Q. Rochinha I	Ponta de Sol					20.8 m ² 7 years	1
	Sol						
Dom Pedro Garajau II	Caniço					46.4 m ² 9 years	1
Estalagem Q. Rochinha	Ponta do sol					71.3 m ² 7 years	1
Total in Madeira						10	10

Table 2 (continued)

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	<i>France</i>								
	Le Prieuré–Les Molanes	Pra-Loup			28 m ²			1	
	Chrisma	Laragne			24 m ² 15 years (gas substituted)			1	
	Les Anémones	Marseille			140 m ² 19 years (gas substituted)			1	
	Le Roc	Antibes			60 m ² 12 years (electricity substituted)			1	
	Le Val Fleuri	Cagnes sur Mer			53 m ² 18 years (electricity substituted)			1	
	Hostellerie du Vallon de Valrugues	St Remy de Provence			60 m ² 11 years (gas substituted)			1	
	Les Belles Terrasses	Tourettes sur Loup			42 m ² 10 years (fuel oil substi- tuted)			1	
	Base nautique	Embrun			17 m ² 16 years (electricity substituted)			1	
	Total in France				8			8	
	Total in all the five countries (Greece, Andalusia, Sicily, Madeira, France)			5	12	33	1	51	

Size of equipment and pay back period are shown.

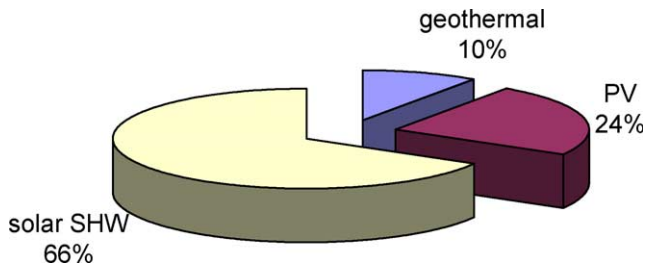


Fig. 5. Percentage of RET examined in the 51 pre-feasibility studies performed in 39 hotels in the EU.

try new technologies, deficiency of technical knowledge, previous bad experiences, failing of suppliers, cost of system).

6.2.1. Impact assessment in Attica, Greece

An important indicator of the assessment of the HOTRES project results has been the estimation of the attainment of the objectives of the project, by taking into consideration the relevant market audits, events, monitoring results of existing RES installations in the hotel sector and general information from the five regions involved in the elaboration of the work programmed.

Positive impact assessment for the Greek tourism sector.

The qualitative positive results obtained from the project monitoring are:

- the tourism sector runs yearly, with important investment programmes under the code name ‘renovation works’ and it is beneficial to relate the RETs to this code name, since the RETs offer to the enterprise an ecological image, often necessary to the hotel manager in order to compete with the upcoming and severe standards for environmental protection.
- hotels are energy consuming enterprises and this is why RETs can be a viable solution in reducing energy consumption and energy cost. They can also promote local production of technologies (i.e. solar) and most important local development.
- the strategic methodology of the project HOTRES seems to persuade the hotel managers, because the technologies under promotion are already demonstrated, in commercial scale and, most important, are in operation in hotels of their neighborhood or in their ‘competitors’ installations.
- even if we meet a poor specimen of application with RES in locally taken hotel samples, while in other sectors RES perform a rich expansion experience (i.e. building sector), we have localized numerous hotel units with very satisfactory, energy related, operation.
- many hoteliers are willing to invest in renovation projects and they welcome the idea of introducing RET, because it gives a social status and a strong marketing point, regarding the coming requirements for the ecological labeling of hotel units.
- there is great need for the announcement of subsidy programmes, from the Local Authorities, which overall act as psychological incentive.

	Cost of equipment, including installation. (Taxes free)	Software used for calculations	Fuel displaced		Cost of electricity (displaced in cases of cooling, geoth, PV) (taxes free) €/kWh	Rate of subsidization for RES in hotels
			Type	Cost (taxes free) €/kWh PCI		
Greece	Solar thermal 320 €/m ² PV grid connection 6.5 €/Wp Solar cooling 7337 €/RT Geothermal 645 €/kW	Tsol (Solar thermal) PVSYST 3.11 (PV) Solhot-cool (Solar cooling) Geohot (Geothermal)	Diesel 'motion'	0.065	0.065	Solar thermal 40% PV 45% Solar cooling 50%
Andalucia	Solar thermal 440–620 €/m ² PV grid connection 6–8 €/Wp	f-chart (Solar thermal)	Natural gas Diesel oil LPG	0.026 0.029–0.033 0.042–0.049	0.066–0.096	Solar thermal 30–45% PV 50–60% <i>Comments:</i> Sale prices of the electricity generated with PV panels: 0.22 €/kWh (PV Installations > 5 kW) 0.40 €/kWh (PV Installations < 5 kW)
Sicily	Solar thermal 500 €/m ² PV grid connected: 6, 5 €/Wp	f-chart (Solar thermal)	Natural gas Diesel oil	0.054 0.070	0.12	40% 40–50%
Madeira	Solar thermal 500 €/m ²	SolTerm	Propane	0.06	0.104	35–40%
France	Solar thermal 650–800 €/m ²	Solo	Gas Fuel oil	0.04 € 0.037 €	0.11	40–50%

Table 3

Economic parameters hindering RES penetration in the Hotel sector

676 (ii) *Negative impact assessment for the Greek tourism sector.*

677 In the Greek tourism sector and more specifically in the hotel sector, regarding the
678 energy related topics, exist the following particularities and weaknesses have been noted:
679

- 680 • The majority of the hotel units are SMEs and they are sized approximately around 100
681 beds (this means a ‘Mediterranean’ type, family centered enterprise). These SMEs
682 aimed to prove the highest level of services in their facility, and have no awareness
683 about ‘how energy is produced’, so, they need technical assistance for that.
- 684 • Consequently, it seems that there is no efficiency of full-time engineers, which are
685 expected to implement energy projects, promote them to the hotel authority, follow
686 their manufacturing and maintenance of the project, keeping them to the highest level
687 of operation,.
- 688 • There is an extremely low number of RET applications in the hotel sector.
689

690 .
691
692 *6.2.2. Impact assessment in Alpes-Maritimes, France*

693 Forty-eight hotel-managers of the Provence-Alpes-Côte-d’Azur region were assessed.
694 All these persons were interested mainly in solar thermal applications.

695 Forty hotel-managers filled a visit sheet.

696 Eight hotel-managers answered to a detailed questionnaire.

697 Results from the impact analysis allow us understanding that.

698 *The impact varies from one area to another.* The analysis of the number of hotel-
699 managers shows clearly a difference in term of involvement relative to RES development,
700 from one area to another. Alpine and mountainous areas are far more involved than coastal
701 areas, unless they profit from the best sunshine of all the country (more than
702 5.2 kWh/m²/day).

703 *The type of equipment depends on the type of hotel/tourist structure.* It seems that most
704 motivated managers are managers of camping-sites. Their operating period perfectly fit to
705 the sunniest period (April–October). The commercial concern seems to be more important
706 than the environmental one.

707 (i) *Positive impact assessment for the French tourism sector.*

708 *Numerous projects are in progress.* The results of the survey are very positive:
709

710 Eight percent of the hotel studied already realized what a solar installation is,.

711 Thirty-eight percent are doing so (of which half have already done the pre-diagnostic
712 studies).

713
714 Some of the projects-managers are waiting for their loan/subsidies agreement and the
715 installations should be implemented in the following months.

716 Only 3 projects have been abandoned, of which one without any reason, one because of
717 a poor sunshine (the hotel is mainly shaded) and a last one is postponed.

718 (ii) *Negative impact assessment for the French tourism sector.*

719 Poor concern for RES is noticed within the hotel–tourist field; it seems that hotel-
720 managers of the coast area have poor concern for RES. Managers of the other areas of

721 the region seemed more motivated but generally, hotel-managers seemed to be poorly
722 interested and concerned.

723 The interest to invest in the RES is low k but needs to be developed through information
724 campaigns; 66% of the managers who answered the questionnaire wish to renew their
725 investment in RES (that is more than 2 on 3!). This result is encouraging.

726 Thus, information campaigns should be organized to develop and expand this interest.

727 *Knowledge of the persons relative to the RES is poor.* Only two managers feel confident
728 with RETs and defined themselves as ‘expert’. The majority of the persons have idea of the
729 technical matters and technologies used.

730 Twenty-three percent of the persons contacted said that they do not know what it is
731 about, at all!.

732 It seems that only the manager of the hotel, in charge of the project, is informed of the
733 technologies.

734 *Knowledge of existing solar installations in the hotel sector.* Generally speaking,
735 knowledge of the hotel-managers in term of existing solar installations is poor. 4 out of the 5
736 managers are unable to give any example of an existing installation. Usually, the example
737 given is related to bad impressions (the installation is old, not working, working badly).

738

739 6.2.3. Impact assessment in Andalusia, Spain

740 During more than 30 informative visits made to hotel establishments in Andalusia, a
741 series of aspects relating to the qualitative impressions of these with respect to the
742 possibility of the use of RES in the hotels of the region have been detected.

743 Within the RES proposal, some of them are conditioned by the climate and geographic
744 conditions of our region. Due to this, some of the RES are discarding, for example,
745 geothermal, in benefit of others, such as solar energy.

746 It should be commented that geothermal energy is not used due to the difficulty of
747 finding geothermal wells close to urban centers and biomass presents a series of problems
748 for the hotel responsible due to the lack of nearby suppliers, the need for storage and the
749 difficulty that these are seen in a direct relationship with the ‘green image’ caused partly by
750 the emissions of smoke.

751 In addition to these reasons, a special interest in solar energy in comparison to others
752 has been identified, due to the current existing implementation in the hotel sector and its
753 greater knowledge. This is caused, among other reasons, mainly by the promotion and the
754 existence of subsidies to applications of solar energy in Andalusia. It is for this reason that
755 this study finally focused on the promotion of solar energy as a RES for its use in the hotels
756 of the region. The decision makers of the sector showed a greater interest for active solar
757 systems, especially solar thermal for hot sanitary water and solar photovoltaic.

758 *(i) Positive impact assessment for the Spanish tourism sector.*

759 The members of the sector, interviewed in Andalusia, showed really great interest in
760 using solar energy systems in their hotel establishments.

761 Among other positive aspects emphasized by the hotels contacted, the *saving in fuel*
762 *consumption and* in consequence, the energy saving, that is possible to obtain from the
763 installation of these systems.

764 Another positive point that should be indicated is the good acceptance of the whole idea
765 due to the existence of *subsidies* for the installation of solar thermal systems of hot sanitary

766 water and photovoltaics, both stand-alone as well as connected to the grid that reduces the
767 initial investment of the installation of these systems. It should also be noted that some
768 hotels that have received some type of subsidy complain of the time and administrative
769 steps that they have had to follow when requesting these subsidies.

770 The importance that the hotel responsible of these establishments granted to the
771 *environmental image* has been observed; particularly, from those which their clients
772 looking for of an ecological tourism. In any case, a huge part of tourism in Andalusia
773 comes from central and northern Europe where there is greater awareness of the
774 environment. In this sense, the hotel establishments that use RES are favored by this
775 tourism.

776 Finally, in rural type lodgings, located in *natural spaces* away from conventional
777 energy sources, it is positively valued the autonomy, from the energy point of view, that
778 these types of installations offer, the saving that is introduced in transport and fuel
779 consumption and the ecological image in accordance with the philosophy of tourism that
780 goes to these natural spaces.

781 *(ii) Negative impact assessment for the Spanish tourism sector.*

782 The main obstacles to the implementation and use of RES in the hotel sector, indicated
783 by the responsible of the sector, are the following.

784 It emphasizes the high *initial investment* that is needed for undertaking the equipping of
785 this type of installation. It seems, however, that it is smoothed by the subsidies to which
786 reference has been made previously, and each time offers fewer obstacles at the time of the
787 introduction of these energies.

788 Another important obstacle is in the *organizational structure* of the hotel sector in
789 Andalusia. Many of the hotel establishments of our region belong to great chains of trans
790 national or multinational character or the managers of these hotels deprived the power to
791 undertake, independently, the investments in RES systems. Specifically, 20% of the hotels
792 surveyed belong to hotel chains.

793 The difficulty of the *architectural integration* and the possible visual impact, in some
794 cases, is an impediment in which the active solar systems are found. Some of the hotels
795 visited are located in historical areas of cities and sometimes even the hotels are historical
796 buildings and, therefore, have to adapt to the regulation requirements that make the
797 installation of solar collectors, thermal or photovoltaic, difficult.

798 Currently the existence of *subsidies* is reclamation in the hotel sector for the installation
799 of solar energy systems in these establishments, but the slowness and difficulties of the
800 bureaucratic procedures that are necessary for its concession, can bring about the contrary
801 effect: refusing to request for the subsidy. This elevates the initial investment necessary,
802 and can cause the renunciation of installing the solar system.

803 Certain *distrust* in the effectiveness and reliability of the RES has also been detected.
804 This distrust is due to the ignorance of the technology and to past negative experiences
805 with badly designed or inadequately maintained installations. It seems that this problem is
806 being surpassed with the installations made during recent years, which work correctly.

807 It is important to indicate, in this sense, that new procedures for the use of these
808 energies are currently rising which would reduce this problem, like the sale of energy, the
809 development of contracts from guaranteed solar results, etc.
810

811 6.2.4. *Impact assessment in Madeira, Portugal*

812 (i) *Positive Impact Assessment for the Madeira tourism sector.*

813 The project had an important role, specially, concerning the results of the monitoring
814 done to the solar thermal system, to clear the image of this type of solar systems, because
815 during many years, this technology had very bad results due to the lack of knowledge in
816 how and where to implement the solar systems.

817 The distribution of the folder, and the meetings held between AREAM and the hotel
818 managers, contributed greatly to enhance the idea of the ‘green’ image and social
819 awareness image of the enterprises to the general public and possibly to increase their
820 market value.

821 It also, showed to the hotel managers, how these technologies could aid them in
822 introducing environmental management schemes, where energy and money can be saved
823 and avoid pollution simultaneously.

824 (ii) *Negative impact assessment for the Madeira tourism sector.*

825 The main obstacle was the international situation of the tourism market. The potential
826 investors are not very favourable to make additional investments, not being sure of the
827 development of the international situation in short-term.

828 Many investors are still reluctant to try new technologies in this area, due to the lack of
829 suppliers and technical knowledge. If a problem is encountered in the system, neither
830 assistance nor maintenance services are available.

831 To register, the previous bad experiences of some technologies implemented in the
832 Region some years ago, became an obstacles too, for the development of this kind of
833 projects, mainly solar thermal.

834 During the development of the project, AREAM had to play the role of the potential
835 supplier, because of the absence of them in the region, and the suppliers did not show
836 interest in this action.

837 Another important obstacle is the cost of the system, which is highly increased, adding
838 the transportation cost to Madeira island.

839

840 6.2.5. *Impact assessment in Sicily, Italy*

841 As monitoring of 40 technical visits carried out at hotel structures in Sicily, a series
842 of features relating to the quantitative and qualitative impressions of these with respect
843 to the possibility of the use of RES systems in the hotels of the region have been
844 evaluated.

845 Sicily is the largest island in the Mediterranean (25.700 km²), over 5.000.000
846 inhabitants; 15 small islands around the coast; located between 38.5° and 37.0° N.
847 Lat., 25% of mountain territory; mild climate (26 °C average in summer, 12 °C
848 average in winter); 8 millions toe of energy demand in year 2000; solar potential:
849 1.650 kWh/m² per year, equivalent, from energy point of view, to 170 l of oil; the
850 regional energy demand is equivalent to the solar energy falling on 50 km² area (0.2%
851 of the territory).

852 AMG has focused its activity within HOTRES project on the solar technologies.

853 Actually the members of the hotel sector showed a greater interest for active solar
854 systems, especially solar thermal for hot sanitary water and medium power solar
855 photovoltaic grid connected.

856 (i) *Positive impact assessment for the Italian tourism sector.*

857 The main positive points in opinion of the stakeholders of the sector interviewed are
858 shown, relating with the application of solar energy systems in hotel establishments in
859 Sicily.

860 The good results of the monitoring of energy performance of solar thermal installations
861 in hotels, confirmed that, the cost benefit analysis can be very effective (solar factor—
862 percentage of the consumption covered by solar energy—more than 65% and relative pay
863 back time less than 8 years, without any public support, respect to an average life of the
864 solar facilities of at least 15 years).

865 The diffusion of these results during the technical visits and the business meetings has
866 contributed to overcome the common distrust respect to the application of RES.

867 To avoid distrust, it is important also to guarantee a high quality of installation,
868 management and maintenance and to disseminate the existing local best practices.

869 Among other positive aspects, it was emphasized by the hotels contacted, the saving in
870 fuel consumption and in consequence, the economic saving, that is possible to obtain from
871 the installation of these systems. The distribution of the folder, produced for this project,
872 and the meetings held between AMG and the hotel managers, contributed greatly to
873 enhance the idea of the ‘green’ image and social awareness image of the enterprises to the
874 general public and possibly to increase their market value.

875 More over, they have informed the hotel managers, how these technologies could aid
876 them in introducing environmental management schemes, where energy and money can be
877 saved and avoid pollution simultaneously.

878 The existence at regional (*Structural Funds, Objective 1 Region*) and national level
879 (*10.000 PV Roofs Programme, Solar Thermal Programme—Ministry of Environment*) of
880 subsidies for the installation of solar thermal systems of hot sanitary water and
881 photovoltaics, both stand-alone as well as connected to the grid, that reduces the initial
882 investment of the installation of these systems. It should also be indicated that some hotels
883 have received a type of subsidy, complained about the long and complex procedures that
884 they had to go through in order to obtain subsidy funds.

885 The hotel manager gives generally a great importance to the environmental image; in
886 specific, from those, who their clients are looking for of an ecological tourism. In any case,
887 a huge part of tourism in Sicily comes from central and northern Europe where there is
888 greater awareness of the environment. In this sense, the hotel establishments that use RES
889 are favored by this tourism.

890 In rural type lodgings, located in natural spaces away from conventional energy
891 sources, it is positively valued the autonomy, from the energy point of view, that these
892 types of installations offer, the energy saving that is introduced in transport and fuel
893 consumption and the ecological image in accordance with the philosophy of tourism that
894 goes to these natural spaces.

895 (ii) *Negative impact assessment for the Italian tourism sector.*

896 The main obstacles noticed to the implementation and use of RES in the hotel sector,
897 are the following.

898 The high initial investment that is needed, for undertaking the equipping of this type of
899 installation; it seems, however, that it is smoothed by the public subsidies available at
900 regional and national level. Another important obstacle is in the organizational structure of

901 the hotel sector in Sicily; many of the hotel establishments of our region belong to great
902 chains of trans national or multinational character or the managers of these hotels have
903 deprivation of powers to undertake, independently, the investments in RES. Specifically,
904 25% of the hotels surveyed belong to hotel chains.

905 Sometimes the architectural integration and the possible visual impact constitute the
906 installation of active solar impossible. Some of the hotels visited are located in historical
907 areas of cities and sometimes even the hotels are historical buildings and, therefore, have
908 to adapt to the regulation requirements that make the installation of solar collectors,
909 thermal or photovoltaic, difficult.

910 The wish to invest in the RES is weak but needs to be developed through information
911 campaigns.

912

913

914 **7. Validation of the HOTRES methodology and perspectives**

915

916 *7.1. Validation of the methodology*

917

918 Taking into consideration the above analytical conclusions and the specific market
919 aspects of the hotel sector in each region, we are able to validate the applied scheme of
920 promotion methodology, which has been centered on the following five key-directions.

921 *(i) The partnerships*

922 Five RET have been promoted. Wind and hydraulic energy, since it gives often grid-
923 connected systems, are not included in the project; the numbers of potential investors in
924 the hotel sector are rather weak. The following RET have been included and have been
925 assessed by the respective EU level Manufacturing Association:

926

- 927 • Solar thermal (ESIF—European Solar Industry federation).
- 928 • Geothermal (EGEC—European Geothermal; Energy Council).
- 929 • Solar PV (EPIA—European Photovoltaic Industry Association).
- 930 • Biomass (EUBIA—European Biomass Industry Association).
- 931 • Solar passive.

932

933 It has been proved that Solar Thermal and Geothermal energy are the strong candidates
934 for future expansions in the hotel sector. Solar PV energy is rather important, while
935 biomass energy presents a poor profile.

936 It is very surprising that Solar Passive energy, which should be the strongest product to
937 penetrate the hotel market, is very low in inquiries, despite the strong promotion during
938 events.

939 *(ii) The regional and sectorial approach*

940 In the past, national actions offered important statistic results; but they could not
941 implement conditions for the expansion of the technologies. The regional approach is
942 compatible with the hotelier psychology: ‘he will install geothermal since the competitor
943 in the region has put it’. The hotel sector must be addressed within sectional studies in
944 order to allow to the MAs (Manufacturers Associations) to pursue sector product needs
945 and enlarging the market in order to proceed in the future with new product designs.

946 The regional approach, offering the technical support to hoteliers has been proved very
947 useful and crucial key-direction due the positive impact of the competition between
948 hoteliers.

949 *(iii) Business orientation, promotion of commercialized products*

950 Due to the involvement of MAs in these projects, oriented business achievement has
951 been made, helping the campaign to spread out and be successful.

952 The promotion of commercialised products in the hotel units has been also a successful
953 key-direction, since the hoteliers showed a particular interest in inspecting and visiting
954 existing installations under operation.

955 *(iv) Third party information.*

956 Very often, in the past, the hotel sector received quotations and feasibility studies, RET
957 related, with non-compatible information or even with misleading or defaming
958 information against other competent RET or conventional technologies. Therefore there
959 is a strong need for a third party independent information in order to enlarge markets. This
960 independent role has been supported by the involvement of the Energy Agencies (CRES,
961 ADEME, SODEAN, AMG and AREAM).

962 We estimate that this key-direction of the HOTRES project has consisted its strongest
963 point for having achieved an effective promotion.

964 *(v) Show the viability of the technologies*

965 In order to overcome the doubtfully of the hoteliers–investors regarding the RET,
966 their viability, their feasibility, how easy is to use, their satisfactory level of
967 maintenance needs and related energy performance must be documented.
968 Therefore there is need for monitoring of the existing installations. This role has
969 been supported by the promotion centers and by regional agencies, carried out in
970 eight hotel units.

971 The documentation of the above-mentioned monitorings has been a valuable tool for
972 justification into the technico-economic analysis of 50 prefeasibility studies carried out in
973 the project.

974
975
976 *7.2. Perspectives*

977
978 The HOTRES project focused at devising and implementing the strategic methodology
979 for the promotion of RET. The core aspect of this methodology has been the concentration
980 on the implementation of conditions for the future expansion of these technologies in the
981 hotel sector. This has been done mainly by business oriented on a regional level, by
982 agencies with equipment MAs.

983 The action plan of the HOTRES project aimed at the hotel sector; in future it must apply
984 to a larger amount of countries, or to different form of establishments (i.e. mountain hotel
985 units) and different climate regions (i.e. Northern European).

986 It has been emerged from the conclusions of the HOTRES project that future projects
987 must foresight at:

988 TARGET GROUP 1b, RUE (Rational Use of Energy) and ES (Energy Saving)
989 technologies in the hotel sector.
990

TARGET GROUP 2, must aim at the second target group of companies with tourism activities, (catering, leisure, museums, entertainment, etc), promoting both RETs, and RUE/ES technologies.

TARGET GROUP 3, must aim at a third target group of companies—suppliers to which we must promote both RES and RUE/ES technologies. This important of the third target group companies is the whole chain of SMEs which act as suppliers to the tourism industry, such as.

- Spa and water services suppliers or manufacturers,.
- Laundry equipment manufacturers,.
- HVAC equipment manufacturers,.
- Lighting and internal decoration SMEs,.
- others.

8. Conclusions

The results of the actions pursued by the consortium, following this HOTRES project, have been plenty, such as the exchange of information, the network effects, the possibilities for trans-European and international collaboration, the installation of permanent information infrastructure, the elaboration of co-operation meetings inside workshops.

As type of actions we created 5 workshops, related to 5 regional campaigns, we have edit a brochure in 2000 copies per language (5 national languages), 200 door to door meetings, application of 50 executive preliminary diagnostic designs, elaboration of 8 monitoring to existing installation of RETs inside hotel units, 25 at the point visits and application of 6 basic designs.

Following the above rich action plan, actual market actors met with regional hoteliers and their business operators. We expect in future, as a follow up, applications of the RET in the regional hotel sector and, in medium term, local manufacturing of RES products after a know-how transfer phase or trade agreement that will obviously create labour development and in the long term a general economic local development.

It has been considered that the best way to present the efficiency of the HOTRES project is to display them within three axes:

- Results attained in a quantitative basis, especially related to technical and economic issues.
- Impact assessment of the HOTRES project, positive or negative (obstacles).
- Validation of the HOTRES methodology and perspectives.

The quantitative conclusions from the technical and economic issues are related to the volume of the relevant market, the average size of the equipment, the type of the RET applied in 50 hotel units and last the estimated pay back period of the investment.

These quantitative results attain are:

- Fifty hotel units with no RET application in the 5 targeted regions have been addressed with a menu of ten products related to five RET technologies (PV unit grid connected,

1036 solar thermal cooling, solar Domestic Hot Water (DHW), solar heating of swimming
1037 pools, olive cores burner for space heating, geothermal heat pumps, direct geothermal
1038 space heating, planted roofs, atriums for artificial lightning and solar thermosiphonic
1039 systems with panels).

- 1040 • PV unit grid is more common in Italy and Spain, where the specific promotion result
1041 has been proved more effective.
- 1042 • The market reaction has been friendly to three of the five RET under promotion with
1043 the following shares: 66% to solar thermal (including solar cooling), 10%
1044 geothermal (uniquely geothermal heat pumps) and 24% to PV units grid connected,
1045 Fig. 5).
- 1046 • The RETs examined in these 50 case studies have showed an interesting level of cost
1047 effectiveness. This effect is highly important when subsidies of local governments are
1048 taken in account. The shortest pay back period refers to the solar thermal. For the three
1049 RETs in question we achieved the following results
- 1050 • for the solar thermal it varies from 1.7 years in Greece up to 19 years in France.
- 1051 • for the solar PV it varies from 6 years in Spain up to 43 years in Greece.
- 1052 • for the geothermal heat pump it varies from 3.9 years up to 4.7 years in Greece.
- 1053 • the cost of solar thermal systems vary from 320 € in Greece up to 800 € in France and
1054 this variation can explain the relevant variations in the respective payback periods (it is
1055 impressive to notice that solar thermal in France displays electricity, which is extremely
1056 cheap).

1057
1058 Secondly, the conclusions from the impact assessment are related to the objectives of
1059 the HOTRES project, by taking into consideration the relevant market audits, events,
1060 monitoring results of existing RES installations in the hotel sector and general information
1061 from the 5 regions involved in the elaboration of the scheduled work.

1062 These qualitative results attain are:

- 1063 • the tourism sector apply yearly, important investment programmes under the code
1064 name ‘renovation works’ and it is beneficial to relate the RETs to this code name, since
1065 the RETs offer to the enterprise an ecological image, often necessary to the hotel
1066 manager in order to compete with the upcoming and severe standards for environmental
1067 protection.
 - 1068 • hotels are energy consuming enterprises and this is why RETs can be a viable solution
1069 in reducing energy consumption and energy cost. They can also promote local
1070 production of technologies (i.e. solar) and the general local development.
 - 1071 • the strategic methodology of the project HOTRES seems to have a positive impact to
1072 the hotel managers, because the technologies under promotion are already demon-
1073 strated, in commercial scale and, most important, in already operating hotels of their
1074 neighborhoods or in their ‘competitors’.
 - 1075 • even if we meet a poor specimen of application with RES, locally, while in other sectors
1076 RES perform a rich expansion experience (i.e. building sector), we have localized
1077 numerous hotel units with very satisfactory, energy related, operation.
 - 1078 • there is great need for the announcement of subsidy programmes, from the Local
1079 Authorities, which overall act as psychological incentive.
- 1080

1081 Finally, the conclusions from the validation of the applied methodology are related to
1082 the partnership scheme, to the sectorial approach, to the regional approach, to the business
1083 orientation, to the third party orientation, to the measurement of the viability and the cost
1084 effectiveness of the RETs and to the design of the perspectives.

1085 These validation results attain are:

- 1086 1. As far as partnership concerned, it has been proved that the hotel sector needs agencies
1087 to implement RET projects and Manufacturing Associations to supply reliable
1088 technical information.
- 1089 2. Concerning the approach by the sectors, it has been proved that hoteliers are motivated
1090 to invest when other hotel managers do it first.
- 1091 3. As far as regional approach is concerned, it has been proved that hoteliers are motivated
1092 to invest by visiting applications of RET in other locally placed hotels, mostly
1093 competitors.
- 1094 4. Concerning business orientation hoteliers need commercialized solutions, they do not
1095 accept easily ‘new technology’ projects.
- 1096 5. As far as third party orientation, hoteliers highly appreciated the fact that the HOTRES
1097 project supplied them with technical information, with no extra cost and effort.
- 1098 6. Concerning the viability and the cost effectiveness of the equipment, the hotel actors
1099 visited 25 existing installations in other hotels and have been supplied with 50 pre-
1100 diagnostic studies suggesting RET equipment with reasonable pay back period, often
1101 competitive to conventional sources. This last has been particularly true for the solar
1102 thermal water heating in hotels.

1103 1104 1105 **Acknowledgements**

1106 The authors would like to thank the DG Energy and Transport (DG TREN) of the
1107 European Commission, which supported the HOTRES project (ALTENER contract
1108 2000/Z/133 of DG TREN). CRES coordinated the project with the following partners:
1109 ESIF, EPIA, EUBIA, EGEC, ADEME, AMG, AREAM, SFH, SODEAN. The Greek
1110 National Tourism Organization and the Panhellenic Association of Hoteliers were also
1111 supporters of the project.

1112 1113 1114 **Appendix. Case study: the largest solar thermal application in hotels in the EU**

1115 a. *Aldemar (Royal Mare, Cretan Village, Knossos Royal Village).*

1116 Hotel details.

1117 Location:	Crete
1118 Geography:	Beach
1119 Class:	De luxe
1120 Clients activity:	Tourist
1121 Number of beds:	2300

1126	Operational season:	Full
1127	Built area:	2.783 m ²
1128	Name of contractor:	Sol energy
1129	Year of erection:	2000

1130

1131 **b. Investment features**

1132

1133 Installation of a solar system, including 2.783 m² of collector field for hot waters
 1134 production and 150 m³ hot water reservoirs (Figs. 6 and 7).

1135 Upgrade of all mechanical equipment and a number of changes in order to maximize
 1136 the annually energy savings.

1137 Heating of seawater in order to use it for the spa center.

1138 Reservation of energy performance and protection of mechanical equipment against
 1139 corrosion.

1140 Central Building Energy Management System (BEMS) with energy management
 1141 applications, programmable controller, monitoring station. BEMS measures and keeps
 1142 historic data of power consumption and manages energy conservation.

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1144 **c. Energy requirements before/after investment.**

1145 Target thermal energy annually requirements

1146 (LPG, Diesel) 3.57/4.484 MWh diesel, LPG

1147 Energy produced annually (audits) 1.322 MWh/year

1148 Fuel saving annually 29%

1149 Energy performance annually (audits) 480 kWh/m²/year

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Fig. 6. View of Aldemar hotel complex.

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Fig. 7. Flat plate collectors' central solar system.

d. *Investment financial features–benefits.*

Investment budget	1.212 M€
Operational Programme for Energy (OPE)	
has subsidized the project:	Subsidy 50%
Estimated payback period	4.1 years (taking into account the subsidization)

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