Green Hotelling. A Feasibility Study in the Hellenic Island of Skyros.

Anna MACHAIRA, Tassos LAMPROPOULOS and Panagiotis ZENTELIS, Greece

Key words: Green Hotelling, Bioclimatic Design, Feasibility Study, Greece

SUMMARY

During the last years, ecological consciousness is gaining more and more ground amongst people around the world. Inquiry and implementation of environment-friendly solutions is now the challenge to all aspects of human activity and the construction sector is by all means part of it. The reduction of the carbon footprint of built-up environment is a main concern of the developers, not only due to the relative legislation which is recently in force, but as a motivation through low energy consumption and subsequently low operating costs, as well.

The hospitality industry has recently joined this effort and so the term “green hotels” has evolved. It is based on the bioclimatic design of hotel infrastructures, regardless of their volume, as well as on the rational management of natural resources. Apart from the ecological aspect and the goal of sustainable development, the financial profit is more than worth it.

Visiting a “green hotel” seems to be attractive to guests as well. Recent researches indicate that approximately 43.000.000 tourists, defining themselves as “eco-tourists”, consciously select environment-friendly hotels for their stay and are usually willing to spend more in order to receive eco-friendly services.

In the context of the developing “green entrepreneurship” in the tourism sector, the idea was to conduct a feasibility study for an upcoming “green hotel” on a Hellenic island, in order to document the possible solutions and to identify the most “feasible” one.

The upcoming green hotel is scheduled to be constructed in the coastal village of Achilli in the Eastern part of Skyros, strictly using the principles of bioclimatic design. Considering that no such establishment exists in Skyros already, the challenge is to design, construct and implement it, using the most feasible scenario. The location was carefully selected considering factors as accessibility, landscape, orientation, view, deviation and of course the existing competition in the hospitality sector. Achilli equidistances the island’s port, airport and capital, where the majority of the population lives and operates and hosts the only marina for crafts and sailing boats.

The selected plot of 5.500 ha is square-shaped, located only 5 minutes from the marina and is spacious enough to host the main building and the auxiliary infrastructure, as well as the surrounding space for farming and outdoor activities.

Finally the best scenario in terms of ecology, economy, development and efficiency is selected, considering all typical and bioclimatic costs, revenues, existing legislation and possibilities of exploitation through time.

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1. "GREEN" ENTREPRENEURSHIP

The construction sector is proving to be mostly aggressive towards the environment, by emitting excessive amounts of carbon as well as consuming large amounts of natural resources, being thus responsible for almost 40% of the total energy consumption on a national level. This consumption in either heat (oil or natural gas) or electricity, besides being a significant economic burden due to the high cost of energy, results in large scale carbon dioxide (CO_2) atmospheric pollution, responsible for the greenhouse effect. Statistically, 50% of the planet's natural resources are used for constructions, 50% of the produced energy is consumed for lighting, ventilation and air conditioning, while 3% of it is used during the construction process. Furthermore, 50% of the water resources are consumed at buildings, 80% of primary rural areas are exploited through constructions, and 60% of total timber quantity from deciduous and non-conifer trees (hardwoods) is used in constructions.
Thus, it is easily concluded that it is imperative to incorporate a more ecological approach to how buildings are constructed as well as inhabited.

1.1 "Green Development" fundamentals

The best way to achieve energy-efficient constructions is by reconsidering the way buildings are designed until today. Reduction of energy consumption can be achieved by simple methods & techniques, using appropriate bioclimatic design and energy-efficient systems & technologies, such as passive solar systems.
<u>Environmental constructions</u> are by definition aiming to the protection of the environment, consequently belonging and interacting with their ecosystem in harmony. Their main aspects of research in this field consist of:

- Studying the built-up environment and the problems it is producing, such as rising of global temperature, concentration of carbon pollution (cap) and blocking of air circulation.
- Designing of buildings
- Selecting structural materials considering their thermal, toxical and visual qualities

The concept of <u>ecological building</u> shouldn't have to do with complex heating-cooling systems, being rather an effort to save energy through natural resources as well as through protection from the effects of local weather conditions.
<u>Bioclimatic architecture</u> is defined as the design of buildings and spaces (interior, exterior and outdoor) based on local climate, aiming at providing thermal and visual comfort, incorporating structural elements in order to make the best use of all available environmental resources (sun, wind, water, vegetation, soil) for heating, cooling and lighting. Significant is the use of eco-friendly building materials as well as recycled or easily recyclable materials.
The reduction of built-up environment's carbon footprint as well as the preservation of the natural resources has grown into a main concern of the developers, not only due to the relative legislation which is recently in force, but as a motivation through low energy consumption

and subsequently low operating costs, as well. Both developers and occupants of buildings are becoming more aware of the benefits and are prepared to make the necessary investments into creating "green" and sustainable buildings.

1.2 Passive House vs Sustainable Building vs Green Building

Passive is a house using mainly the sun as a heating source and using approximately 90% less energy than an equivalent conventional house. The definition borrowed from http://passipedia.passiv.de states that "A Passive House is a building, for which thermal comfort can be achieved solely by post-heating or post-cooling of the fresh air mass, which is required to achieve sufficient indoor air quality conditions - without the need for additional recirculation of air" (fig. 3, 4). Passive houses were based on traditional houses around the world, "sensibly" constructed, so that no heating or active cooling is required. Amongst others the traditional stone buildings of Mani in south-eastern Peloponnese, Greece (fig.1) and the "yposkafa" of Santorini island in Cyclades complex, Greece (fig.2) are considered to be the first passive houses in history worldwide, even if the term was unknown at the time.

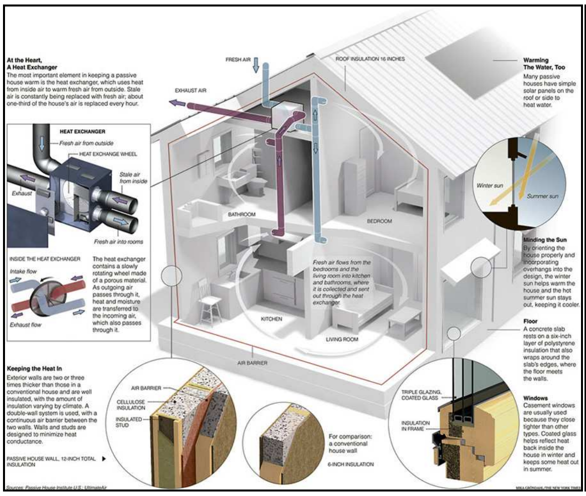
fig.1: The traditional settlement of Vathia, Stone buildings in Mani, Greece (photo by Venia Apostolidi)

fig.2: Hotel "Heliophos" in Santorini island An "yposkafo" converted to a hotel (photo by www.heliophos.gr)

Passive house design is affordable increasing conventional costs by 5-10%. In terms of energy saving, it requires only 10% of energy needed for heating and cooling than a conventional building, setting it self-sufficient and emission-free, with the implementation of a small solar or wind system. The quality of the air and the internal temperature are remarkably pleasant in the building due to the continuous recycling through the smart ventilation system, providing high-quality living conditions. Passive house design can be applied to commercial and public properties as well.

Passive Houses are often referred to as Sustainable Buildings. According to the Brundtland's definition "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The same principle applies to buildings, setting as a top priority for sustainable buildings' design the reduction of negative consequences to the environment, to the society and to the economy, through the entire life-circle of a building: construction, operation, maintenance & demolition.

Green is a building that minimises harmful consequences to human health and environment, is built by environment-friendly materials & techniques, aims to zero emissions, operates solely on renewable energy sources (RES) and leaves as a small ecological footprint as possible.



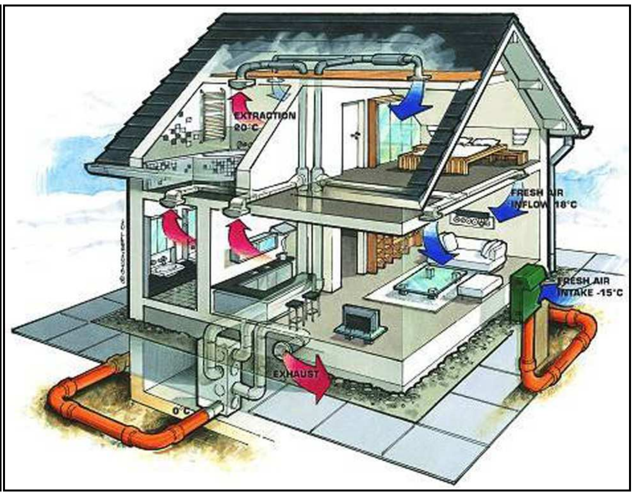


Fig.3, 4: Passive House and Sustainable Building principles and design
(sources: New York Times / www.flashnews.gr)

1.3 Green Entrepreneurship

“Green entrepreneurship” is an emerging way of doing business, arising from the increasing demand for green development and the transition to environment-friendly entrepreneurship.
As an idea it is not so innovative, existing since pre-historical times. It began developing when the first environmental problems appeared, mainly referring to the protection of nature and the relationship between people and the environment. In modern times relative legislation was widely implemented worldwide, global treaties for the protection of the environment were voted for (Natura, Ramsar etc) and all aspects of entrepreneurship were adjusted to it through environmental consequences studies, relative certifications, eco-labels etc. The first relative legislation attempts in Greece were made in 1938 with the declaration of two National Parks at the mountains of Olympus and Parnassos. Since then many things have changed and nowadays entrepreneurship is designated by lots of local and European laws as well as by the opinion of relative authorities.
Some fundamental characteristics of such types of businesses, according to their scale, are:

- possibility of co-existence with local features and ability to designate them (small scale)
- determination of high environmental necessity (large scale)
- contribution to a national scale of environmental adjustment of the economy with as few consequences to the local environment as possible (supralocal scale)

Other individual characteristics that should be taken into account are quality and innovation, systematic and collective approach, forward thinking, planning and realism, economic and environmental feasibility, attachment to local economic and social prosperity and lack of existence of many similar businesses and consequently weakening and dispersion.
A special strategic tool was recently implemented by the United Nations called “Agenda 21” which is a comprehensive plan of action to be taken globally, nationally and locally by

organizations of the United Nations System, Governments, and Major Groups in every area in which human impacts on the environment. It was adopted by more than 178 Governments at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, 3 to 14 June 1992. [http://www.un.org/esa/dsd/agenda21/]
The operational framework of green entrepreneurship consists of certain decisive factors:

- location of the business, needing protection, prudent management of resources and designation of its natural and cultural identity, ensuring a brand awareness (recognition)
- identity of the business, built through economical, technical, legal, political, cultural and ecological processes, forming its special features and novelties
- quality of the business, strongly connected to adhering to the terms and criteria of sustainable development and to certifying its co-existence with the environment.
- competitiveness of the business, depending on the two previous factors and
- financial resources, looked for through subsidy programs, usually in the public sector (for infrastructures), needing special management planning and expenses allocation.

The strategy of a new business should comply with three types of approach, door-to-door, outer networks and dynamic structural spreading, in order to consolidate the new market, followed by necessary infrastructure, sufficient exposure and development of opportunities.
Green entrepreneurship could contribute to the development of Greece in the sectors of tourism and especially eco-tourism, rural development and cultural activities, combined with ecological management of free time and environmental architecture. [Stamatiou E., 2008]

2. GREEN HOTELLING

2.1 Tourism vs Environment

Tourism is one of the largest industries worldwide with 640.000.000 people each year worldwide making leisure trips, whilst 30% of them visiting the Mediterranean. The impact of this kind of magnified activity can be catastrophic for the environment. Already 85% of the European coasts hosting approximately 2/3 of the European tourism industry are in immediate danger of environmental and economic collapse due to over-development. Considering that tourist activity in the Mediterranean refers to a large number of arrivals in a relatively short period of time, especially by carefree people being on holidays, reckless waste of natural resources along with other environmental consequences are more than expected.
Moreover, due to greenhouse effect, scientists are warning that in the near future we will globally experience the average temperature increase and the rise of the sea level, especially in Northern Europe, the Mediterranean and Northern America, where changes will be higher than the global average. For instance, the Mediterranean is expected amongst others, to increase temperature $0,3^{o}$-$0,7^{o}$ C per decade, to increase number of days with temperatures higher than 40^{o}C and to double days with temperatures over 30^{o}C.

2.2 Green Tourism

Tourists themselves grow increasingly environmentally sensitive and many of them already are concerned and estimate the energy footprint that their trip leaves to the environment. It is likely that in the future, that energy footprint will influence the choice of destination, means

of transportation, accommodation and activities at the destination of the tourists.
Recently an agenda has been configured, according to which climate is influenced by tourist transportation and especially air-transportation. Hospitality industry, recognizing the harmful consequences of the annual touristic activity on the environment, joined a worldwide effort for the adoption of more ecological consciousness and incorporation of “green” aspects to the touristic activities and thus the term “green tourism” has evolved.
Green tourism is based on the bioclimatic design of hotel infrastructures, regardless of their volume, as well as on the rational management of natural resources.
Visiting a “green” hotel seems to be attractive to guests. Recent researches indicate that approximately 43.000.000 tourists, defining themselves as “eco-tourists”, usually coming from mid-upper social classes, consciously select environment-friendly hotels for their stay and are usually willing to spend more in order to receive eco-friendly services. However, this group of tourists represents the population that consciously selects a green building over a conventional one. They are the type of people who probably lead their lives eco-friendly or even live in a house with green features incorporated, due to their ecological consciousness rather than due to the economical benefits an energy efficient building could offer.
Apart from the ecological aspect and the goal of sustainable development, the financial profit of green infrastructure is more than worth it. Numbers talk for themselves; for example, “Hilton Hotels” have reduced by16% their energy consumption and saved about $10.000.000 in 4 years, while “Aldemar Hotels” in southeastern Greece are based by 85% on solar energy. It has been recorded that hotel units can reduce their water consumption up to 40% using simple low-cost technology such as special plugs attached to the taps, and their energy consumption by 30% with the installation of solar systems, amortization of which can be quite direct.

3. BIOCLIMATIC ARCHITECTURE

As mentioned earlier, bioclimatic architecture’s evolution leads a parallel course to the evolution of the human kind. Since prehistoric times when people were living into caves where the environment was stable, through centuries of traditional settlements wisely making the most of nature, until now - using sophisticated techniques and high technology equipment and materials, people have been naturally trying to exploit in the best way local microclimate, positioning, winds, humidity, underground streams, tellurian currents, electromagnetic fields and a good choice of materials to create a building cheaper, more pleasant and above all healthier. The term “bioclimatic” results from an effort to define the relation between architecture and climate and the influence they both have on humans’ organism. According to www.adoss.com, a more accurate definition would be "evolved traditional architecture".
According to another definition bioclimatic architecture is the architectural design of buildings that takes into account the topography, climate, ground relief, orientation, solar radiation, wind, temperature, humidity, rain etc in order to restrain their consequences to the shell of the building, as well as to exploit them to achieve conditions of thermal ease and healthy living in the inside, aiming to cleaner environment with less emissions and energy saving through restraining the use of conventional power sources. It is essentially an effort to commit to natural and renewable energy sources as the sun and the wind.

3.1 Basic Elements of Bioclimatic Design

The basic elements of bioclimatic design can be divided into 3 major categories:

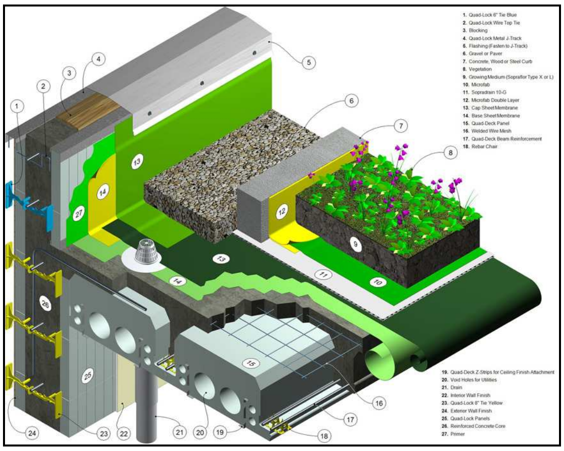


fig.5: Setting-up a green roof,
(source: www.quadlock.com)

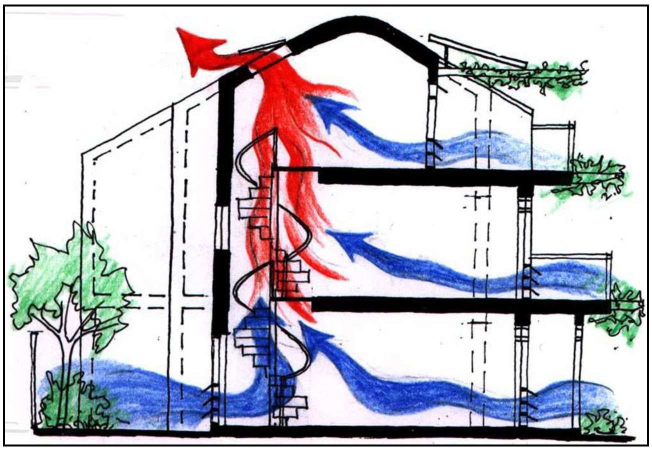


fig.6: Schematic of natural ventilation
(source: 3.bp.blogspot.com)

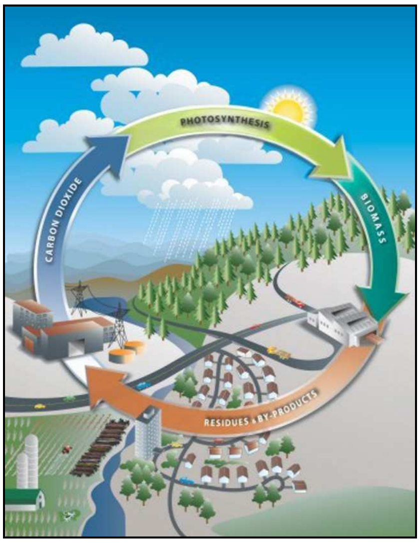


fig.7: The biomass cycle
(prosandconsbiomassenergy.org)

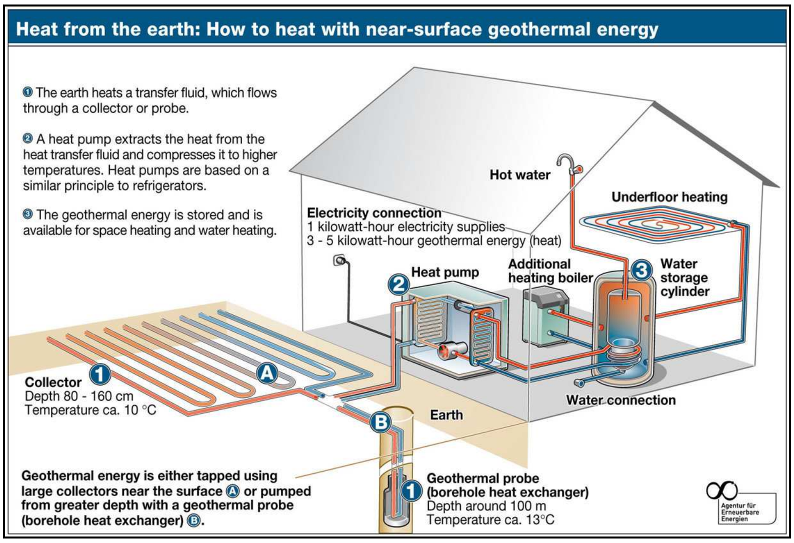


fig.8: How to heat with geothermal energy,
(source: www.unendlich-viel-energie.de)

Passive systems, which constitute structural elements of a bioclimatic building, they operate without mechanological support or power supply and heat or cool a build naturally. They are separated as follows:

- Passive solar heating systems, used for collecting, storing and distributing solar energy, mainly for heating and lighting at winter time, such as southern orientation openings, thermal storage walls and ventilated walls
- Passive natural cooling systems and techniques, mainly for cooling at summer time with less energy consumption, such as planting trees around the building, creating ponds, and designing green roofs (fig. 5) with a mean energy saving percentage of 20%.

- Natural ventilation systems and techniques, mainly for cooling at spring and fall times, such as one-side, side-to-side & chimney-style natural ventilation (fig.6) with a mean energy saving percentage of 15%.

Energetic systems, with minimum or zero emissions local energy producing systems, using renewable sources to produce thermal and mechanical energy, such as solar air-conditioning.

Renewable energy sources (RES) installations, in order to minimise energy consumption effects to the environment, such as photovoltaic systems (on roofs, facades or shades), biomass energy (fig.7), geothermal energy (fig.8) and solar energy for hot water (for heating and everyday use).

Bioclimatic Architecture is best achieved using a combination of the systems above, slightly increasing construction costs, but managing significant energy saving percentages.

3.2 Ecological Criteria of Selecting Construction Materials

Referring to ecological constructions, apart from making the most of the bioclimatic design principles, one should seriously consider evaluating the structural materials used. Their selection is based on several economical, environmental and energy parameters, since their production, life cycle and rejection have significant consequences to the environment, as well as to the buildings' behaviour and to the health of the users of buildings.

The most crucial parameters defining the quality of the materials are their life cycle assessment (LCA), their raw materials, their collection, processing and recycling process, the energy, toxicity and radioactivity they contain, their thermal and optical qualities and CO_2 & NO_2 emissions throughout their life-time.

4. FEASIBILITY STUDY ON THE DEVELOPMENT OF A BIOCLIMATIC HOTEL

In the context of the developing "green entrepreneurship", a feasibility study was conducted for an upcoming "green" hotel on the Hellenic island of Skyros, in order to examine whether it is profitable for a developer to invest on the construction of a "green" hotel. The study contains a financial assessment of the upcoming hotel unit. The business will be regarded as economically feasible if it is able to produce the expected services and still return a profit to the owners.

4.1 Tourism in Greece

Tourism is probably the main industry in Greece, taking into consideration that (along with the other components of the service economy) it accounts for over 78,8% of the GDP, while industry contributes with 17,9% and agriculture with 3,3%. Greece attracts more than 16.000.000 tourists each year and the percentage of jobs, directly or indirectly, related to the tourism industry is approximately 19% of the total labour force.

The Hellenic Archipelago takes up to 11.242 km of the county's total 15.320 km coastline, consisting of 9.835 islands, islets and rocks, no wonder why the Hellenic Islands gather 58,5% of the country's lodging establishments and 62,6% of hotel beds, resulting in massive tourism activity with catastrophic environmental consequences.

Within Greece more than 100 "green" hotel units are located at the time, while more than 365 other existing hotel units have expressed over the last year their desire to convert into “green”, due to the environmental as well as the economical profits they provide. Green entrepreneurship is getting more and more appealing to Greek hotel owners, considering the current financial crisis, as well as the minimisation of the cost premium for “green” constructions against conventional ones over the years, and the low operational costs as the know-how is getting stronger.

4.2 Location of the Investment

The island of Skyros is located at the Aegean Sea, being the biggest island of the complex of Northern Sporades occupying 210 sq.km and having 2.960 inhabitants (census 2011). It is mostly mountainous with a Mediterranean climate characterized by cool summers and mild winters, northern winds, rare rainfalls and lower temperatures throughout the year compared to the mainland. Skyros can easily be reached by local flights from Athens and by ship from the port of Kymi in Evia. There are 69 lodging establishments in total on the island and as tourism destination it has presented a growing rate of 30% in arrivals in the last 5 years. Skyros is strongly connected to its tradition and is well-known for Skyrian ponies (fig.10), marbles, embroidery, furniture and stock breeding products. People are mostly occupied with agriculture, stock breeding, fishing, apiculture, pine tar collection and various crafts.
A very large area (approximately one fifth of the island) in the south, around Kochylas Mountain is protected by NATURA 2000, due to rare flora and fauna species.
The capital is the village of Skyros (fig.9) and is surrounded by 20 more settlements scattered around the island. Achilli settlement is a small coastal village located just over Achilli golf, in the middle of Skyros, with a northern orientation and equidistancing the island’s port, airport and capital, where the majority of the population lives. Today, it hosts a marina for small boats and a fishing refuge and has approximately 15 permanent inhabitants.

fig.9: Location of Skyros in the Aegean Sea
(source: www.greeka.com)

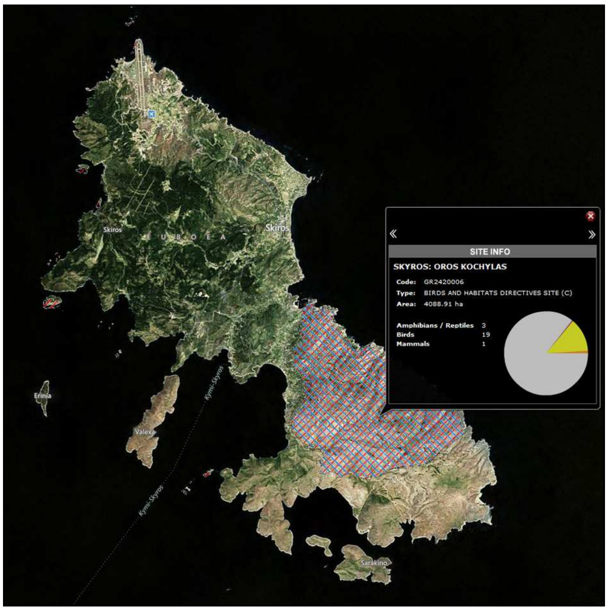


fig.10: Natura 2000 Viewer
(source: http://natura2000.eea.europa.eu/#)

fig.11: Panoramic view of the village of Skyros
(source: www.trekearth.com)

fig.12: Typical Skyrian Pony
(source: skyrianoalogaki.blogspot.com)

fig.13, 14: Location and outline of Achilli settlement in Skyros (images from Google Earth)

4.3 Feasibility Study

The operational, financial and technical analysis of a business problem is called a Feasibility Study, usually aiming to roughly estimate the feasibility of a business plan, by quantifying costs and benefits, resulting to the decision to proceed if found feasible or not. Feasibility studies are used in various types of investments and so its structure and contents are rather flexible, generally referring to market analysis, product marketing, analysis of the production procedures, infrastructure and equipment, financial analysis and social consequences analysis. Making some adjustments to the model structure of feasibility studies [Karvounis, 2006] to fit our project, we arrive at the following chapters:

4.3.1 <u>Basic idea, description and history of the investment project</u>

Our investment plan refers to the development of a hotel unit in the settlement of Achilli in Skyros, based on bioclimatic design and ecological operation.
The particular land-plot was taken for granted, setting a dilemma to make the best investment proposition for it. It is regularly-shaped, located 5 minutes walking-time from the marina and with a sea-view. With an area of 6.181,40 sq.meters, it is spacious enough to host the main and auxiliary infrastructure and the surrounding farming and outdoor activities (fig.15).
The 3*** hotel unit will be containing 27 independent apartments to rent (of either 50 or 100 sq.meters each) of 60 beds in total, a main administration building of 200 sq.meters with the reception, office & the restaurant and auxiliary space in the basement for parking and storage.
The key features in order for the hotel unit to be more attractive to potential visitors, will be:

- standard services: security, 24/7 room service, free parking, restaurant, etc
- state-of-the-art services: bioclimatic design & operations, BMS smart systems operation
- added value services: Skyrian ponies farm, free bicycles provision, biological products

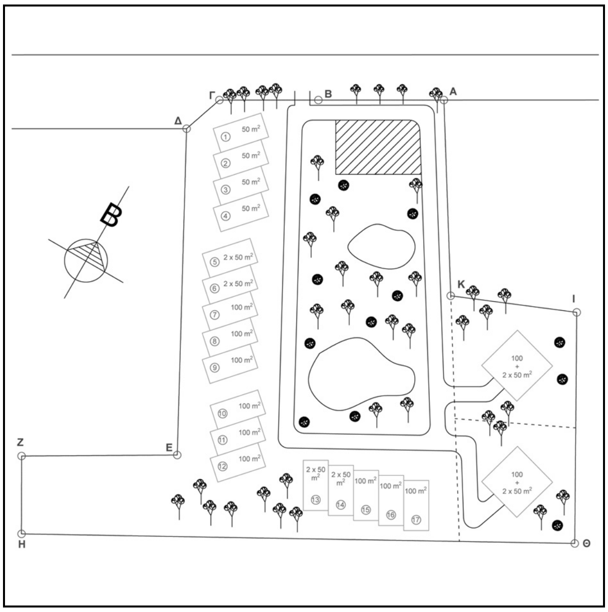
The land-plot has a northern orientation, setting a challenge for the best exploitation of renewable energy sources and ecological materials, since in this case, passive systems cannot particularly pay-off.
Two basic scenarios were built in order to arrive to conclusions about the most efficient financial solution. It should be noted that cash flow analysis was not conducted, since the purpose was to check the feasibility of the scenarios:

- Development of a hotel unit plus 6 independent residences to be sold in advance, at estimated market prices, in order to gain extra capital to cover the construction costs.
- Development exclusively of apartments to rent, postponing the investment's first income until the first year of operation and after the completion of constructions.

The analysis indicates that the only feasible solution is the second, unless the residences were sold in prices bigger than their market value. Having finalised the ownership status, it is time to check the efficiency of a bioclimatic designed hotel against an equivalent conventional one through cash-flow analysis, considering that the two of them are identical except for the renewable energy sources systems and the bioclimatic technologies.
The comparison of the Internal Rates of Return (IRR), the Net Present Values (NPV) and the Break-Even Points of the two solutions will give the final answer or whether the investment should be made or not.

4.3.2 Market analysis and products marketing

Market analysis is one of the most crucial factors that could determine the realisation of an investment or not. The size of the target-market, the volume of the demand, the participants in the market's environment (consumers, suppliers and competition) and every technical, physical, political, legal and administrative parameter, are to be carefully collected and studied. The future trends of the market should also be considered in order to forecast the potential of the investment. Marketing strategies and tactics are also of great importance.
A market research in the hotel industry of Skyros, revealed that there already 69 operational lodgement facilities of various categories, mainly on the eastern side of the island as shown in figure 16. There is no other hotel unit operating in Achilli so far, while no other green hotel units exist on the whole island, making the upcoming investment unique and appealing especially to eco-tourists, but to general tourist population as well.



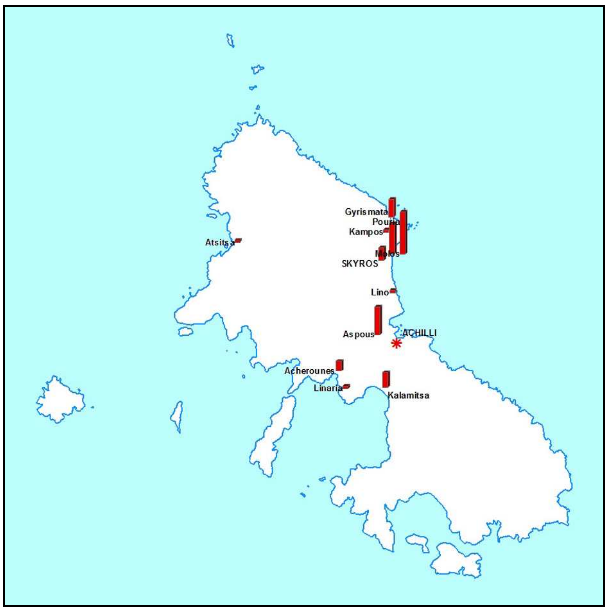


fig.15: Schematic layout of the new hotel site   fig.16: Distribution of the hotels in Skyros (on-site research / ArcGIS map)

As for real estate market values and hotel prices:

- Mean market values for new residencies range from 1.800 to 1.900 €/sq.m.
- Hotel prices per night in the high-season: 70€ (50sq.m. room) and 100€ (100sq.m. room)
  in the low-season: 55€ (50sq.m. room) and 85€ (100sq.m. room)

4.3.3 Technology, mechanical equipment and raw materials

All the technology, mechanical equipment and materials used for the specific kind of development, either for the built-up areas or for the installations of the surrounding spaces are categorised and listed in the table of figure 17, with their construction or implementation costs, energy-saving percentage and contribution to the total construction cost.

Mechanical Equipment					
Actions		Description	#	Costs	Saving
Building Shell	Double glass windows	Heating-Cooling energy saving system		200 €/sq.m.	10%
	Openings with thermal interruption	Heating-Cooling energy saving system		350 €/sq.m.	
	Double insulation	Heating-Cooling energy saving system			50%
	Ecological paints	Heating-Cooling energy saving system			
	Shading systems	Heating-Cooling energy saving system			20%
Renewable Energy Sources systems	Geothermal energy	Heating-Cooling system	1	30.000 €	50-60% / 200sq.m.
	Solar water heaters	Water heating for use	21		
	Biomass radiators	Heating system	7	16.600 €	65%
	Photovoltaics	Electrical power production	7	247.000 €	15%
Passive systems	Evergreen trees planting	Natural passive cooling system			
	Artificial ponds	Natural passive cooling system			
Bioclimatic elements	Underfloor heating	RES systems optimal performance		50 €/sq.m.	30%
	Wooden floors	Ecological structural materials			
	Linoleum floors	Ecological structural materials		20 €/sq.m.	
	Ceramic tiles	Ecological structural materials		10 €/sq.m.	
	Fluorescence lighting	Energy saving system			82%
	Rainfall water collection	Water saving system	1	10.000 €	
	BMS systems	Energy saving system	4	40.000 €	15% / system
Total				**364.600 €**	

Construction Cost for a 100sq.m. Residence (per sq.m.): 1.090 €		
Construction Stages	**Percentage**	**Costs**
Planning & building permit	4%	4.360 €
Excavations / earthworks	2%	2.180 €
Reinforced concrete framework	24%	26.160 €
Masonry - bricks	4%	4.360 €
Plaster	6%	6.540 €
Insulations totally	3%	3.270 €
Windowpanes	3%	3.270 €
Ironworks	2%	2.180 €
Windows - doors - closets	7%	7.630 €
Marbleworks	3%	3.270 €
Floors	8%	8.720 €
Electricityworks	5%	5.450 €
Kitchen cabinets	5%	5.450 €
Paintworks	7%	7.630 €
Sanitary articles - tiles - faucets	5%	5.450 €
Heating system	4%	4.360 €
Water supply - sewerage - natural gas	5%	5.450 €
Various (fireplace, door handles etc)	3%	3.270 €
	100%	**109.000 €**

Total Construction Costs	
Expenses Category	**Cost**
Construction Costs	1.765.800 €
50sq.m. equipment	24.000 €
100sq.m. equipment	26.100 €
Biological treatment	20.000 €
Restaurant & Reception construction	160.000 €
Restaurant equipment	10.000 €
Reception equipment	6.000 €
Surrounding spaces	80.000 €
Cultivations costs	30.000 €
Basement construction	320.000 €
Extra costs	200.000 €
RES systems	364.600 €
Construction Management	60.000 €
	3.066.500 €

fig.17: Total construction costs of the investment, allocation

4.3.4 Financial analysis

Over the last 30-40 years, financial analyses have been a very useful tool in order to decide on

the feasibility of a potential investment or even to justify the decision for an existing one. Strict or approximate these analyses need an interdisciplinary approach and supplementary scientific support in order to consider other parameters as well (political, environmental, social) that could lead to the cancellation of an economically promising project or vice versa.
Financially, an investment is a long-term commitment of economic resources with a view to produce and receive pure profit in the future, deducting the total initial investment cost.
Since profit equals income minus expenses, some basic assumptions should be made (fig.18, 20), to aid the determination of the investments potential profit. All the calculations will be made for both a conventional and a bioclimatic hotel and at the end their break-even points will be compared (fig.19, 21) in order to see which investment is the most profitable.

Investment: 3.520.000€ + VAT = 3.637.333€ (conventional)
3.940.000€ + VAT = 4.071.333€ (bioclimatic)

Income: 16 rooms x 85 €/day x 55% vacancy x 200 operational days = 272.000 €/year
11 rooms x 110 €/day x 55% vacancy x 200 operational days = 242.000 €/year
27 rooms x 15 €/day x 55% x 200 days = 81.000 €/year (room services)
30 days x 15 €/day x 180 days = 36.000 €/year (restaurant earnings)
Sum = 631.000€ (for both conventional & bioclimatic)

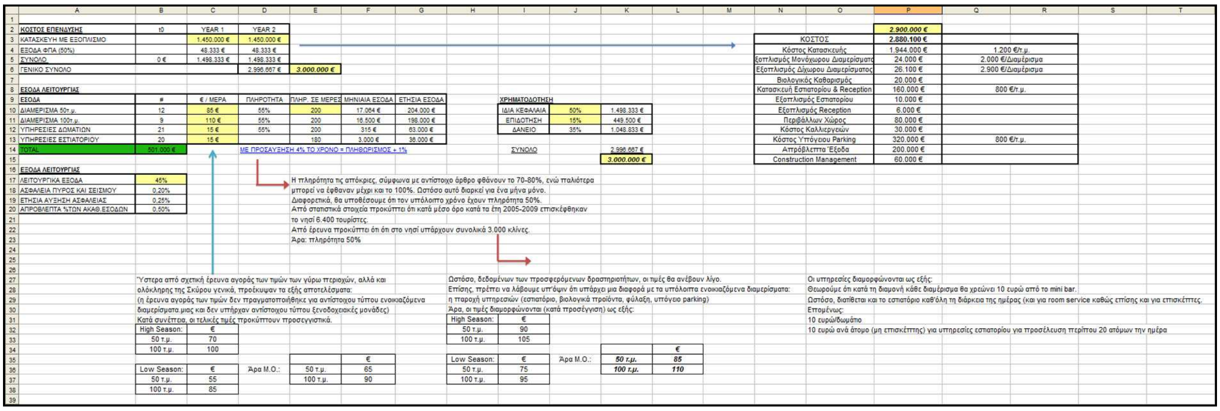


fig.18: Financial analysis of the conventional hotel option (in Greek)

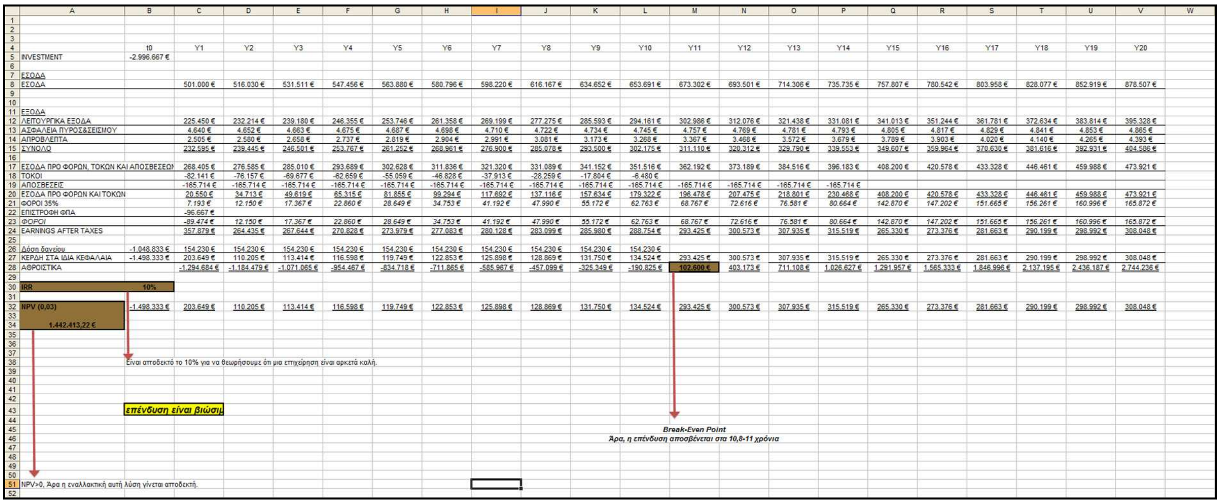


fig.19: 20-year cash-flow analysis of the conventional hotel operation (in Greek)

Expenses: 45% (operational expenses - conventional)
30% (operational expenses - bioclimatic)
0,20% + 0,25% per year (fire & earthquake insurance - both)
0,50% of gross income (extra expenses - both)

Financing: 50% investor's capital + 15% state's subsidy + 35% bank's loan
1.818.667€ + 545.600€ + 1.237.067€ = 3.637.333€ (conventional)
2.035.667€ + 610.700€ + 1.424.967€ = 4.071.333€ (bioclimatic)

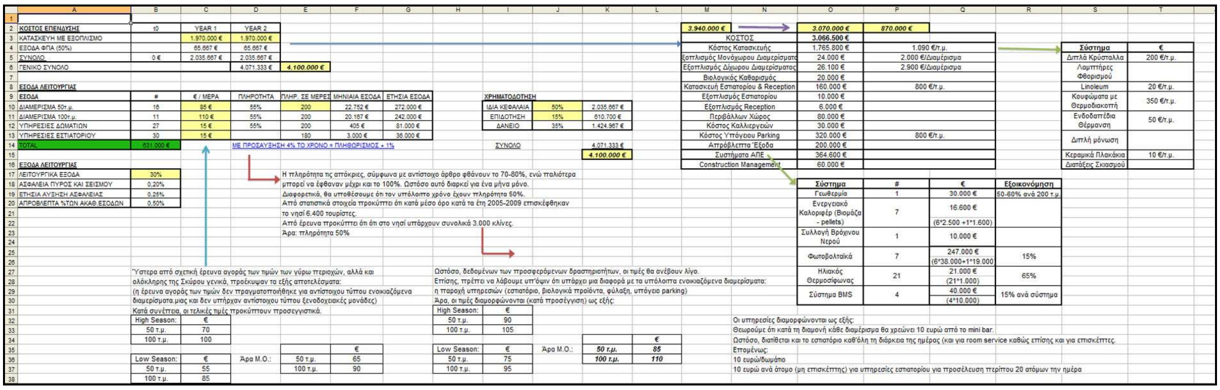


fig.20: Financial analysis of the bioclimatic architecture hotel option (in Greek)

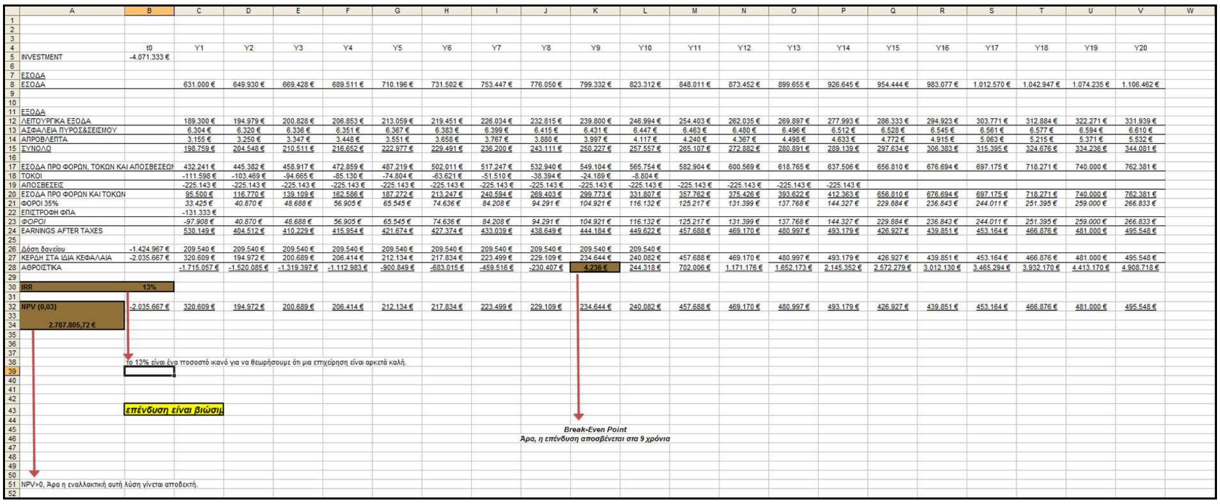


fig.21: 20-year cash-flow analysis of the bioclimatic architecture hotel operation (in Greek)

The 20-year cash-flows that have been created show that the break-even point of the bioclimatic design hotel is approximately at 9 years, whilst the one of the conventional hotel is approximately at 11 years, proving that the bioclimatic architecture hotel is a more profitable investment.

4.3.5 Environmental consequences

A complete and interdisciplinary study of the environmental consequences of the investment should be conducted in order to determine how important they are on the social, economic,

financial and technical potential of its implementation. Usual kinds of negative consequences are various types of emissions, solid-liquid-gas waste, smoke, byproducts, noise etc. affecting the natural environment, the flora & the fauna, people, materials and infrastructure (as the acid rain). Some of them are measurable and can even be included in the cost-benefit analysis. For the European Union, they are obligatory, and describe the technique and procedure during which relevant data is collected from the investor and other sources and are taken into account on whether the investment could proceed or not.
In Greece, Law 1650/1986 provides the legal framework on studying environmental consequences and has applied since 1990. It is obligatory for complex hotel units, whilst for small and traditional units a simple questionnaire of environmental terms is filled-in.

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BIOGRAPHICAL NOTES

Anna Machaira is a Surveyor Engineer. Although she has recently concluded her studies in the National Technical University of Athens, she has gained professional experience through the last 6 years in the fields of constructions, surveying and real estate valuation. She has attended a two-week specialization seminar on real estate valuation, as well as many other scientific conferences and seminars. She speaks excellent English and good French and has significant computer skills in general and technical software.

Tassos Labropoulos is a Surveyor Engineer and a Ph.D. Student, NTUA. He is currently concluding his Ph.D. dissertation in the field of real estate mass appraisal. He has 14 years of academic teaching and research background & 15 years of professional experience in Valuation, Real Estate, GIS applications, Civil Planning and Surveying. He has more than 30 publications in national & international conferences and magazines and vast experience in computers, technical software, etc. He is a member of the Hellenic Institute of Valuation (HIV), the Association of Valuers in Greece (AVAG), the Hellenic Geographic Information Society (HellasGIs) and various other professional groups and committees.

Dr. Panagiotis Zentelis is a Civil Engineer, a Surveyor Engineer and a Professor in the NTUA. His expertises extend in the fields of "Cadastre", "Land Information Systems" & "Real Estate". He has more than 95 Publications & Announcements in various national & international scientific magazines & conferences. His academic experience is dating since 1970 through teaching in various graduate and post-graduate courses, seminars, diploma theses and Ph.D. theses, along with research activities and vast professional experience in relative fields since 1968. He is a member of the Hellenic Society of Photogrammetry and Remote Sensing, the Association for Geographic Information (AGI), the International Association of Assessing Officers (IAAO), the Urban and Regional Information Systems Association (URISA), the Hellenic section of the International Council of Monuments and Sites (ICOMOS-Gr), the Hellenic Institute of Valuation (HIV), the Urban Land Institute (ULI Europe) and numerous committees, working and task groups.

CONTACTS

Ms. Anna Machaira
12, November 17th str., 15127, Melissia, GREECE
Tel. +30-210-8040109
Email: anna.machaira@gmail.gr

Mr. Tassos Labropoulos
National Technical University of Athens, Greece (School of Rural & Surveying Engineering)
9, Iroon Polytechniou str., 15780, Zografou, GREECE
Tel. +30-210-7722652, Fax + 30-210-7722677
Email: taslab@central.ntua.gr
Web site: www.survey.ntua.gr