



078 - HISTORY AND FUTURE OF THE SUN'S ENERGY USE IN CITIES

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Abstract

This poster presentation aims at introducing to the EuroSun 2008 participants the exhibition “Solar Cities From the Past to the Future: Scientific Discoveries and Technological Developments” opening in Rome in the spring of 2009. Now in its second edition, the first of which took place in 2006 at the Genoa Science Festival, the exhibition will be installed at two prestigious and symbolic venues, the Museum of Roman Civilization and the Central State Archive. In Genoa the message was: for thousands of years, and until just 200 years ago, human beings developed experience in building and operating cities run on solar energy alone. Can this experience be useful in designing the solar cities of the future? Is it possible to return to the use of the sun's energy for lighting, heating and cooling buildings, for producing electricity, fuels, and construction materials for the cities of a technologically advanced world? The upcoming event in Rome will continue to explore these and other questions. Solar features of models of houses, baths, villas, preserved at The Museum of Roman Civilization, will be highlighted with the heliodon approach. The thesis that future or modern solar cities have their main roots essentially in the past will be reiterated.

1. Introduction

Renewable solar energy – what the sun sends us every day, the driving force of all forms of life on earth, of the winds and the water cycle, the growth of forests and other biomass – has always been, is and will always be the principal energy source on our planet.

All over the world, people used solar energy alone until barely 200 years ago, when fossil fuels – coal, oil and gas (actually fossilized forms of solar energy) – began to gain sway. Like nuclear fuel, these forms of energy are not renewable and eventually will be exhausted.

The use of renewable solar energy is thus an age-old experience marked by fundamental discoveries that made it possible to build cities that ran on solar energy alone, ranging from the discovery of fire, which enabled humans to use the solar energy stored in forest wood and other forms of biomass, to the discovery of agriculture and the birth of the first human settlements. The ancient Greeks' discovery that streets and buildings can be oriented so as to exploit the sun's light and heat directly and naturally gave birth to solar architecture. The Greeks' idea was built upon by the Romans, as codified by Vitruvius in *De Architectura*, and handed down for centuries.

These discoveries characterize what I would call the primitive or ancient solar age. Though we take them for granted today, they are still of the greatest importance in our daily lives. It's as if an ancient renewable-solar-energy soul were living on in the cities of our modern world, nearly forgotten and not accounted for in official energy-use statistics.



If our forbearers were able to build and run cities with renewable solar energy alone for thousands of years, is it not possible for us to do so in the future? This question was raised explicitly in the 1st edition of the exhibition “Solar Cities From the Past to the Future: Scientific Discoveries and Technological Developments” promoted and organized by the Italian Group for the History of Solar Energy (GSES), and the “Italian National Committee ‘The History of Solar Energy’” (CONASES), a multi disciplinary non profit entity established in 2006 by the Italian Ministry for Cultural Heritage and Activities. The exhibition was held during the Genoa Science Festival at the Doria Pamphilj Prince’s Palace from October 26 to November 7, 2006 [2][3].

The exhibition traced the evolution of the Italian human habitat from antiquity to the present day and with a look to the future. It recounted the changes in cities, architecture and energy and food-supply infrastructure, and the scientific discoveries and technological developments that marked the major stages in their history, for instance the Romans' introduction of flat window glass 2000 years ago [1].

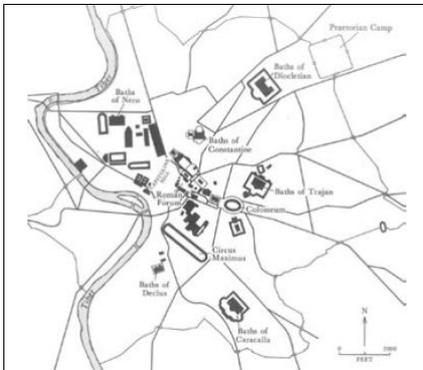


Fig. 1 . Map of Imperial Rome, showing locations of the major baths, facing south or southwest (From a Golden Thread, by K. Butti and J. Perlin, 1981)

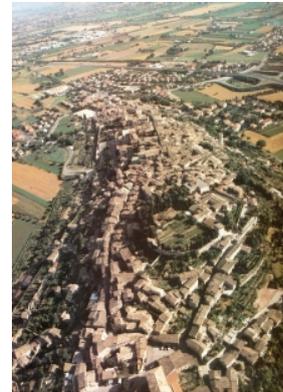


Fig. 2 . An aerial view of Spello, a typical Italian small town, whose shape and relationship with the surrounding farmland is a reminder of its solar past (Foto G. Reveane, 1993).

Visitors to the exhibition at the Prince’s Palace were able to explore solar city past, present and future with the aid of more than 40 posters, various videos, seminars and conferences. A brief video report of the exhibition is available on You Tube [4].

A city of modern or future solar age has its roots in the discoveries and inventions made during the Renaissance and the scientific revolution. One example of the progress made over the past five hundred years is the giant steps taken in the understanding how light works by great scientists such as Galileo, Leonardo, Newton, Huygens, Maxwell, Planck and Einstein. The explanation of the photoelectric effect by Einstein contributed to underscore other aspects of the structure of the atom, the nature of light and the electrical origin of the cohesive forces in molecules and matter. All this has opened fascinating prospects for the use of direct solar energy in the modern or future solar age, from solar cells with efficiency ratings of 50% or more to smart glass and photon solar architecture and city planning.

Will scientific discoveries and technological developments allow us to build the solar city of the future, a city powered solely by solar energy?



A thesis presented in Genoa by GSES and CONASES was that to bring the modern solar city into being we must intelligently combine and integrate the experience gained by the ancient cities – not only in terms of technical know-how, but also of art, culture, relations and communication – with the many solutions made available by the scientific discoveries and extraordinary technological developments of the past two hundred years, especially the most recent decades. In other words, as suggested by Norbert Lechner, “Use the best of the old and the best of the new.” [5]. This thesis will be reiterated in Rome’s exhibition.

2. The 2nd edition of the of the Italian travelling exhibition on Solar Cities From the Past to the Future

GSES and CONASES, on the basis of the experience gained in Genoa, are currently promoting and organizing the 2nd edition of Solar Cities From the Past to the Future: Scientific Discoveries and Technological Developments at two prestigious and symbolic venues: the Museum of Roman Civilization and the Central State Archive. The opening of the exhibition will be in March 2009.



Fig. 3 . Museum of Roman Civilization, Rome, Italy.



Fig. 4 . Central State Archive, Rome, Italy.

The installation designed for Genoa has been completely revised for Rome, where there will be a much larger display space, longer opening time, site-specific models and documentation. In parallel to the exhibition, as in Genoa, a series of conferences, seminars, debates and shows will also be held. Details will be published in the fall.

2. The Exhibition at Museum of Roman Civilization

The Museum of the Roman Civilization is a unique venue for an exhibition on solar energy. The two sections, historical and thematic, present a synthesis of Rome’s history, from its origin to VI century B.C., and the various aspects of Roman expansion. It holds a large collection of reproductions and models that illustrate the history of the formation of the city of Rome and of the Empire, as well as the use of sun’s energy in hospitals, villas, baths, etc. [6][7].



Fig. 5 . Solar Architecture: Model of a Roman Hospital (courtesy of the Museum of Roman Civilization).



Fig. 6 . Archeological remains (Frigidarium) of the Baths of Trajan and Hadrian, Cyrene, Libya.



The solar features of these buildings will be illustrated by the use of a heliodon, which will reproduce the sun's path in various moments of the day as well as different seasons.

3. The exhibition at the Central State Archive

At the Central State Archive, documents from public and private archives will be on display in an area of 600 square meters to recount the efforts made by the pioneers of the 19th and 20th centuries in order to achieve with solar energy the same things accomplished with fossil and nuclear fuels, i.e. heating and cooling buildings, illuminating day and night living and working spaces, powering farms, industries and other human activities.

Gaetano Vinaccia (1889-1971), an architect and city-planner, is the author of dozens of little known publications and articles on solar urbanism and architecture. Among them is the 385 page book "Il corso del sole in urbanistica ed edilizia" ("The path of the Sun in urban planning and building construction"), published in 1939 in which Vinaccia reviewed systemic architectural and city-planning aspects of the use of solar energy over the ages, in the conviction that the past has to be placed at the centre of any enterprise headed for the future [8][9].

Giovanni Francia (1911-1980), a mathematician and engineer, thought that solar heat, abundant at low density and temperature, needed to be collected at high temperatures in order to be useful in modern societies to run industries and power plants. He was the first person ever to apply the Fresnel Reflector Technology principle in real systems, linear, in Marseille in 1963, and point focus, in S. Ilario in 1965. He envisioned a modern city powered only with solar energy. In 1970, before the 1973 oil crisis, working with two young architects, Bruna Moresco and Karim Armifeiz, and other collaborators, Francia developed a visionary project for a model energy-independent city, with a population of about 100,000 that would rely on solar energy. He called it "The solar city – Hypothesis for a new urban structure [10][11]."

Francia was one of the first people in modern times, if not the very first, to propose the idea of the solar city so explicitly. It was precisely because of this pioneering intuition of Francia's that GSES and CONASES decided to organize the 1st Solar Cities exhibition in Genoa, and to honour him with a 20-minute DVD [12]."

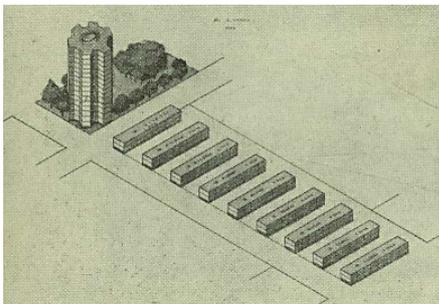


Fig. 8 . Two different approaches, vertical and horizontal, offering the same living space, Gaetano Vinaccia (1889-1971), "For the City of Tomorrow" [8][9].



Fig. 7 . Model of a solar powered city presented by Giovanni Francia (1911-1980) in Nice (France) in 1970 [10][11].



In Rome new documents and pictures on the Solar city project preserved in Brescia in the Francia Archive will be on display.

At the venue of the Central State Archive highly visible projects of solar buildings and cities headed for the future, selected either from Italy or from other countries, will be exhibited as well.

6. Conclusion

The "Italian Solar City Travelling Exhibition" is part of the "Italian National Solar Energy History Project" whose purposes are first and foremost cultural. It aims at changing the perception people have about solar energy and at envisioning that it is possible to combine the knowledge of the past, as recommended by Vinaccia, with the introduction of the most advanced solar technologies, as those pioneered by Giovanni Francia, on a large scale in a modern or future city [13].

The special symbolic environments offered by the Museum of Roman Civilization and the State Central Archive, should contribute in addressing the scientific challenges and research directions toward either the past or the future, in order to use the best of both as suggested by Norbert Lechner. The exhibition will show how to rethink our future energy infrastructure and its technological, organisational and cultural implications. How to supply solar-generated electricity, heating and cooling to homes, hospitals, schools, industries and offices, for transportation and other economic activities. It will especially focus on the importance of solar light and heat, as directly available in nature, for day lighting, heating and cooling buildings, that are the greatest consumers of energy in modern cities.

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