The Italian Solar City Travelling Exhibition

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INTRODUCTION

Many historical sources preserved in Italy testify to interest in solar energy from the earliest times. Archaeological evidence – unique in the world – is likewise invaluable. Italy is the land of Marcus Vitruvius (90-20 B.C.), author of De Architectura, one of the ancient texts most studied and cited in relation to solar architecture and urban planning. The "Italian Solar City Travelling Exhibition," introduced to the Congress participants by this poster presentation, aims at showing to the public how historical solar cities of the past can be a source of inspiration in designing the cities of the future.

The title of the exhibition is "Solar cities, from the past to the future - from the earliest civilizations to our own day." It recounts the vicissitudes of cities, of architecture, energy and food-supply infrastructures, and the scientific discoveries and technological developments that marked the major stages in their history, with special focus on building day lighting, heating and cooling.

The Exhibition is being promoted by GSES with the support of the Italian Ministry for Cultural Heritage and Activities. The first edition is planned at the Festival of Science in Genoa this fall.

ANCIENT SOLAR CITIES

Until fossil fuels came in less than 200 years ago, all pre-industrial cities all over the world were built and made to work practically only with the renewable solar energy stored up in wood, charcoal, straw and food. The sun, wind and water were guiding principles in urban planning. Local geography and climate shaped people's culture and built environment.

This was obviously the case in Italy, which has unique archaeological evidence of the greatest value. The remains of Pompeii, Herculaneum and the great baths in Rome and other cities of the empire provide evidence of the important developments produced by the Romans in solar energy utilization in the oriented civic architecture and in buildings.

Fig. 1 – Window panes from Pompeii, 1st cent. a.d. The Romans had learned to make flat transparent glass and use it to capture the sun's heat for their homes, baths and greenhouses. (Photo National Archaeological Museum, Naples)

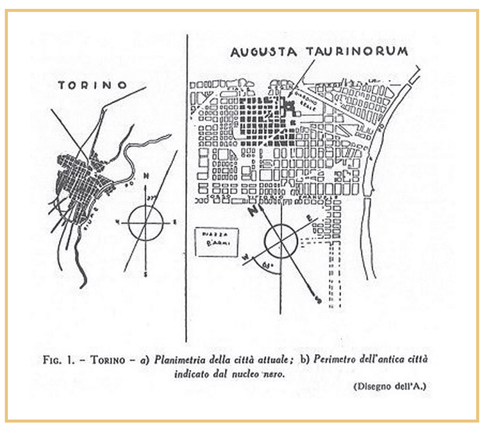


Fig. 1. – Torino – a) *Planimetria della città attuale*; b) *Perimetro dell'antica città indicato dal nucleo nero.*
(Disegno dell'A.)

Fig. 2 – Turin – The original street orientation of ancient Roman "Augusta Taurinorum", underlined in the black plan, can still be recognized in the actual city (Design by G. Vinaccia). Many ancient Italian and Mediterranean cities were designed as solar collectors, whose street texture had to optimise solar energy collection as vineyards do. Their compactness and adjacencies properly improved at the same time street, squares, and building outdoor and indoors comfort.

Fig. 3 - An aerial view of Spello, a typical Italian small town, whose shape and relationship with the surrounding agriculture fields is a clear reminder of its past. The ancient cities' nearly total dependence on solar energy set limit to their size.
(Spello, Italy, photo G. Reveane, SMA 0039 September 13, 1993).

FOSSIL-FUELED CITIES

The history of the human race is the history of human settlements and the activities related to them: agriculture, transportation and industry. With the industrial revolution and the introduction of fossil fuels, human habitats, and the agriculture that supported them, underwent very rapid changes. Relations among them changed just as quickly.

The essence of modern high-energy density cities has been growth: growth of the energy they consume, of their size, of their related energy infrastructures to power residential and business activities and as a consequence growth of travel and mobility and of environmental pollution.

Fig. 4 - Los Angeles, California.

Over the past two centuries – a short span of time, compared with the thousands of years of development of human civilizations – powerful energy infrastructures have been built to provide cities with heat, electricity and fuels from fossil and nuclear energy.

Fig. 5 - Transportation power lines cross countries and continents for long distances bringing electricity from power plants to users.

Fig. 6 - A nuclear power plant..

Fig. 7 - Oil and natural gas travel long distances through pipelines and tankers.

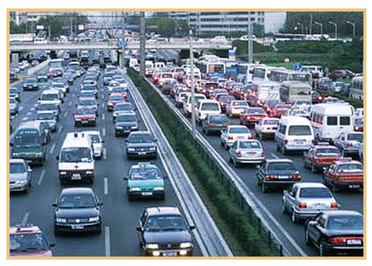


Fig. 8 - Transportation and mobility are responsible for about 25% of primary energy world demand. (A busy highway in Beijing, China).

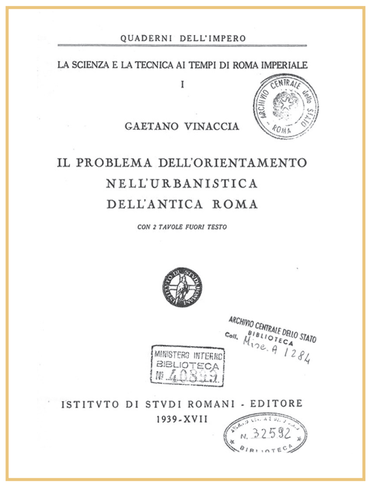
In the last century, by providing growing energy flows of high energy density, fossil fuels and electricity made it possible a predominantly urban civilization and changed the way we design cities and buildings. Our relationship with indoor and outdoor built environments has been changed too, even in the Mediterranean Europe where citizens are Inhabitants of square and streets.

The industrial culture of building indoor comfort, originated mainly in cold climatic regions and based on technologically sophisticated mechanical systems, allowed designing building envelopes independently of local geography and climates and gradually brought to loose traditional relationships between buildings and their urban contexts.

Cities and buildings became placeless. This freedom to design any building shape for all climates and sites is wasting large quantities of high quality energies for heating and cooling, heat at high temperatures or electricity. In the past, before fossil and nuclear fuel were introduced, that work, was wisely done by solar energy with the technology and knowledge of the time.

MODERN SOLAR CITIES

Gaetano Vinaccia (1889–1971), a great solar architect and engineer, who authored more than 100 books and articles on city planning and solar architecture, pointed out that to build the cities of tomorrow, "We need first of all – to save time and effort – to retrieval old paths considered useless by people who think the past is a lead ball bound to humanity's feet so as to prevent our triumphant march toward progress.



The fruit of thousands of years of intelligent work, the selection that centuries of experience has contributed to it, cannot be bypassed, cannot be modified, cannot be refuted except through centuries of very hard and serious work."

"Il problema dell'orientamento nell'urbanistica dell'antica Roma".

Fig. 9 - Cover of Vinaccia's work on the "Problem of Orientation in the Urban Planning of Ancient Rome" (1939).

Giovanni Francia (1911–1980), mathematician and engineer, who pioneered fresnel linear and point focus reflector technology in real systems for industrial applications, in early 1960's proposed large solar plant highly integrated in urban context. In 1970 he even envisioned and designed a city module entirely powered by solar energy.

Fig. 10 – Giovanni Francia behind a honeycomb structure that he invented and presented at the UN Congress in Rome in 1961, with which he could get temperature up to 200 °C without sun tracking.
(Photo courtesy of Francia's heirs, 1976).

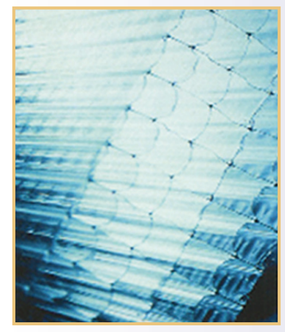


Fig. 11 – Transparent insulating materials widely used in Northern Europe.

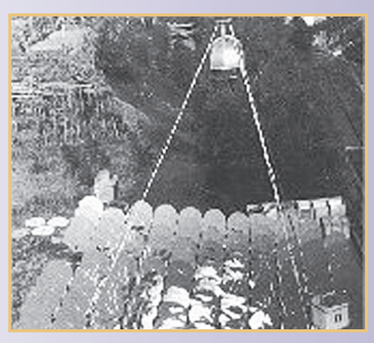


Fig. 12 - The first point-shaped solar boiler to produce steam at 150 atm and 500°C, installed at Sant'Ilario di z in 1965 (Photo courtesy of Francia's heirs).

Proposals to replace non renewable fossil and nuclear energy with renewable solar energy very often don't take into account the radical difference between energy quality, its high or low temperatures, its forms, electricity or fuel.

Technical capacity and economic competitiveness of solar, wind, and other renewable technologies are currently compared to those to convert fossil and nuclear energies to supply high quality energies, such as heat at high temperature or electricity.

This approach has the consequence that we usually think of a modern solar city to work as a fossil fuel city, i.e. using high temperature energy based systems, even for applications at low temperatures.

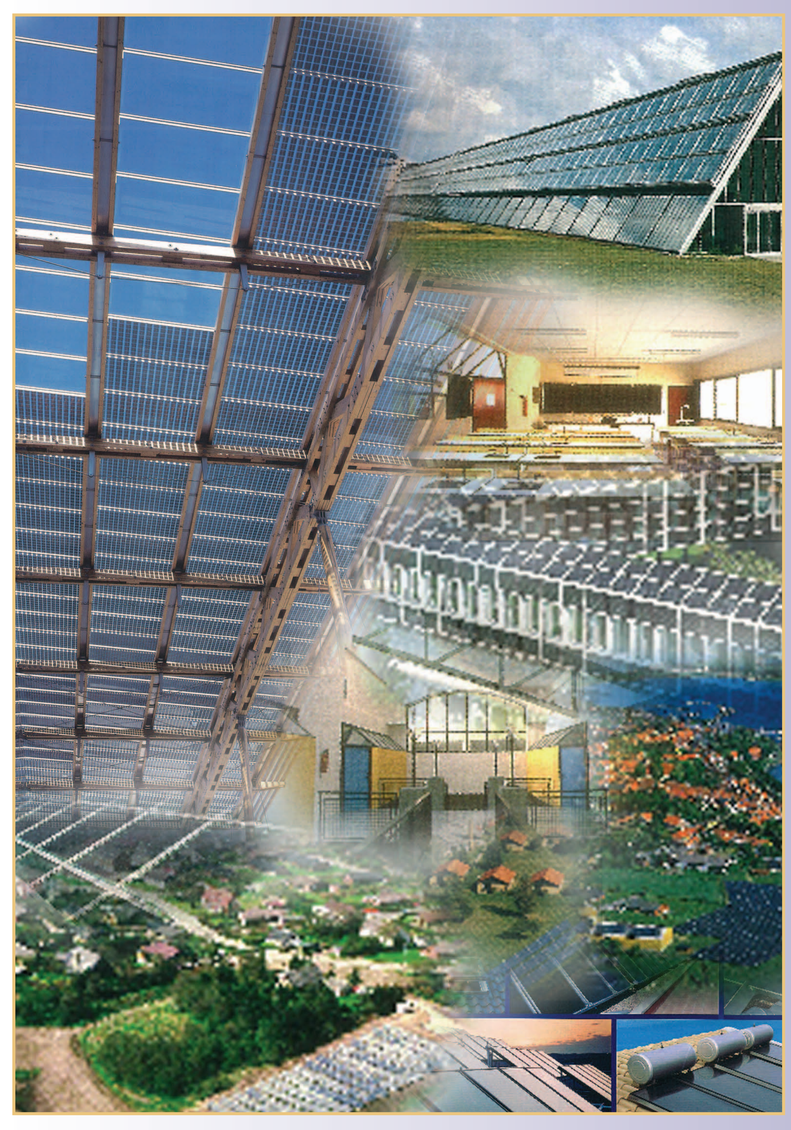


Fig. 13 – Current solar components, systems and urban models that might become commonplace in a modern solar city in the future.

CONCLUSION

The "Italian Solar City Travelling Exhibition" aims 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.

The special environment offered by the Science Festival of Genoa, during which the exhibition will take place this fall, should contribute in addressing the scientific challenges and research directions that will enable an increasing efficient and economic use of solar energy in cities.

The exhibition will show how to rethink of our future energy infrastructure and its technological, organisational and cultural implications.

How to supply solar-generated electricity and heat to homes, hospitals, schools, industries, offices 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.