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Energy: an interdisciplinary study for advanced solutions

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Interdisciplinary research (IDR) is a mode of research by teams or individuals that integrates information, data , techniques , tools , perspectives , concepts, and / or theories from two or more disciplines or segments of expert knowledge in order to promote knowledge at a fundamental level or to solve problems whose solution is beyond the scope of a single discipline or area of research. Each of the disciplines involved must be able to provide its more advanced aspects , acquiring those of the other in order to arrive at a new common ground
The interdisciplinary thinking is rapidly becoming an integral part of International Research , thanks to four major " drivers": the inherent complexity of nature and society, the desire to explore problems that are not limited to a single discipline , the need to solve the problems of company that is also complex , and the power of new technologies. Successful interdisciplinary researchers have found a way to intersect and synthesize disciplinary depth with breadth of interests , visions, and skills.
The purpose of this paper is to propose an interdisciplinary approach to help solve the energy problem in the Twenty-First Century . The situation of the energy issue will be briefly outlined, demonstrating how an interdisciplinary approach is probably necessary to sketch out a solution. A few case studies will be proposed: they will be the subject of development during the research, as part of a general methodology that will put them into a vision of the overall problem.

In the twenty-first century energy is no longer just a technical issue. In science, the discipline that studies energy has rapidly expanded its sphere of competence. On the other hand, the charm of energetics has always resided - starting from 800 - on its basic principles - those of thermodynamics - the implications of which in the human sciences (eg irreversibility and entropy) are now shifted from pure speculation to current events and more urgent issues. The considerations of Thomson (Lord Kelvin), before with the second principle and then with Tait in "Treatise on Natural Philosophy" (1867) and the alarm of Barry Commoner in the "Circle to close" written a century later - so seemingly distant ideologically until a short time ago - found today in the finiteness of the universe at man’s disposition a way to merge: Thomson and Commoner were talking about the same problem
Addressing the issue of energy means now talk about the environment , society , dissemination and availability of information , and of historical contextualization . It should however not be attracted by the vastness of the problem to be reduced to generalizations of surface leading to a too general approach: the general view is essential, but must be accompanied by the implementation of two actions to purely technological content:
1. Simple solutions that aim to reduce the growing need for energy , focusing on efficiency, savings and conversion , and that will lead to the reduction of social and geographical disparities in its availability and its use .
2. Most advanced technological innovation , aimed at increasing the efficiency of the existing tools, but above all to seek new sources of energy and high-tech energy-intensive approach. The large flows of masses fuels and materials, transportation, high pollution, belong to the past scenarios. The

equivalent of Einstein's mass-energy on one hand , and the imitation of energetics of living beings, on the other one, are two guiding concepts to keep in mind when looking for new sources
The analysis of the world's energy needs in historical growth , the global distribution of per capita demand concentrated in developed countries, future predictions all consistent , so far as scenarios variables , in predicting a trend towards growing energy demands , the depletion of fossil fuels , the issue of security of supply and increasing environmental concerns help to understand the relevance of the problem and the need for both simple and innovative solutions .
The current energy economy based on fossil fuels is not sustainable in the long term. Need alternatives , concrete, and therefore able to withstand the economic, environmental and social that provides the current boundary conditions.
One solution to the energy problem does not exist. What exists - and must be tried by all means technological and political - is a set of solutions appropriate to specific local context that includes a mix of energy sources and technologies and can guarantee a real lasting and sustainable energy development . It should take the best from each one , without ever neglecting a whole to promote the reduction of costs, monitoring environmental impact local or global security.
Global figures are impressive: people belonging to the world's population, 1.4-1.6 billion have no access to electricity , another 1 billion have no access to reliable electricity networks , 2.8 billion rely on biomass for domestic needs , not 2.4 billion have access to basic health services , 1 billion lack access to safe drinking water , 0.85 billion have no access to primary education , 0.80 billion suffer from chronic malnutrition .

The theme of Energy is strictly connected to the themes Water , Food, Health , and to the issue of resources : these are systemic issues as far as skills and technology are concerned, and require studies on local environmental and social aspects (not just technical) responsibility of the individual (individuals) , social responsibility (companies and institutions) , and continuous innovation .
The interdisciplinary scientific research on energy must be asked as targets primarily the enrichment values, ie the development of new skills and abilities , to strengthen and make more concrete design skills in any context of research and innovation that concerns the energy . Scientific research becomes a tool with which to overcome geographic boundaries , technological cultural, social restricting human development in this area and consequently in general.

The energy issue can be solved with four reference points :
1. Rational use of energy
2 . Abandonment of a development model based on endless growth
3 . Equalization of per capita consumption in the world
4 . The fourth point - that is essential but useless without the other three - is the innovation and development of new sources of energy.

This paper develops now briefly some proposals on the last point, and develops inclusion in a broader interdisciplinary approach. It is based on two guiding concepts cited above : the equivalent of Einstein's mass-energy on the one hand , and the imitation of energetics of living beings on the other.
For the first concept , the energy from thermonuclear fusion is a candidate as a solution that can help you create a harmonious balance between energy, development and environment . The results of the JET (Joint European Torus) of the European Community , together with those of other experiments in the United States and Japan, have been instrumental in deciding to design the next experiment , ITER , the construction of which the European site of Cadarache (France) needs , given the grandeur and the cost of the project , a collaboration unprecedented world (Japan, Russia ,

India, China , Korea , Europe and the United States, representing more than 60 % of the inhabitants of the planet, and almost all of technologically advanced countries) . A reactor based on nuclear fusion reaction would effectively solve the problems that have prevented the spread of nuclear fission waiting , ensuring clean energy is as radioactive emissions from the point of view of waste, safe even in case of severe accidents, and based on a fuel widely available but it should be not retrace the paths that lead to repeat the technological difficulties that led to nuclear energy from fission current impasse .

For the second concept , innovative renewable energy is an important area in which research should be focused. Materials science , nanotechnology, biology , computer science , electrochemistry form a new discipline, innovative renewable energy , eg solar panels based on plastics , cheaper and more environmentally friendly than traditional silicon . Bioenergetics, cells that mimic the action of the leaves (artificial photosynthesis) to accumulate the energy of the sun and others that exploit the ability of bacteria (cyanobacteria) to produce energy and simultaneously purify water . Devices such as fuel cells that use hydrogen to directly produce electricity, without having to produce heat and steam, with the only waste product being water; however they need a source of energy to produce hydrogen which is not is the one currently used , ie fossil fuels. It should be studied the coupling with innovative sources of energy