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FOREWORD

Fossil fuels (i.e., petroleum, natural gas and coal), which meet most of the world energy demand today, are being depleted fast. It is expected that within twenty years, production of petroleum and natural gas will peak, and then start to decrease. Although there are larger deposits of coal (to last a few hundred years), we may not be able to utilize them for environmental reasons.

Fossil fuels have another shortcoming. Their combustion products are causing global problems, such as the greenhouse effect, ozone layer depletion, acid rains and pollution, which are posing great harm to the environment, and eventually to life on our planet. The main combustion product of fossil fuels, CO_2 emission, is causing climate changes, which in turn, result in natural disasters, such as more powerful and more frequent storms, floods and droughts. These catastrophes are undermining the global economy. The insurance companies, which insure against such disasters, have been losing money since the 1980s. As a result, they are refusing to insure industrial plants, businesses, hotels, buildings and homes in certain geographical areas, and/or increasing their premiums.

More than a quarter century ago, at the Hydrogen Economy Miami Energy (THEME) Conference of 18-22 March 1974, a handful of scientists formally proposed the Hydrogen Energy System as a solution to the interrelated global problems of energy and environment. Hydrogen is a very efficient and clean fuel. Its combustion will produce no greenhouse gases, no ozone layer depleting chemicals, little or no acid rain ingredients or pollution. Hydrogen, produced from renewable energy sources, would result in a permanent energy system, which we would never have to change.

The Journal of Chemical Industry is one of the progressive scientific journals, as witnessed by its giving coverage to the Hydrogen Energy System in several issues. I commend the Editors and Editorial Board on being in the forefront in recognizing this forthcoming energy system. There is no doubt that through such coverage in scientific and technological media, conversion to an abundant and clean energy – Hydrogen Energy – will be hastened. I wish the Chemical Industry Journal continuing success in its endeavors.

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ACTUAL HYDROGEN ENERGY OPTIONS IN GREECE AND YUGOSLAVIA

There are many actual hydrogen energy and economy options in the Balkans as a typical un developed area, which are already in progres or could be applied soon. Let us discuss the ones already considered and planned.

At the Institute of Chemical Engineering and High Temperature Chemical Processes, FORTH, Patras, Greece, a rather large EU project has started on **"Advanced PEM Fuel Cells"**, acronym "Apollon" (December 2001 – December 2004, about 4.0 Mil EUROs all together), with a great chance to become a further demonstrative EU project. The main aim of the "Apollon" project is to produce high activity, longer durability, stable electrocatalysts, with partial replacement of noble metals and a remarkably reduced amount of metals per surface area. Advanced type of catalyst must satisfy not only "CO tolerance", but also must have bifunctional properties, and thereby be active for the simultaneous anodic oxidation of both CO and H_2, but primarily of methanol as a fuel. CO becomes a fuel! The end user of this project is De Nora Company from Milan, Italy, which plans to soon form a spin–off company together with them for the supply of such unique electrocatalysts primarily for fuel cells. The same concerns their composite electrocatalysts for cathodic oxygen reduction. This is the main target of the Institute of Chemical Engineering and High Temperature Chemical Processes (ICEHT/FORTH), Patras, Greece, in which Dr. Stelios G. Neophytides coordinates the leading groups of Professor H. Boennemann from Muelheim, Germany (the leader in nanostructured colloidal precursors in catalysis), and Professor J. R. Jurado, University of Madrid, who has his own original nano–size production technology for catalysts, while Professor J. Norskov is the leading theoretician.

The second international end user is the company "FRIGOREX" of Greece, which has its network of factories in many countries all over the world, practically supplying half of the world and covering such markets in refrigerators (Greece, India, Indonesia, Ireland, Kenya, Nigeria, Norway, Poland, Romania, Russia, Spain, South Africa and covering all of Africa), in both developed and undeveloped countries with an annual production of 400,000 units. In the undeveloped world of Africa and Asia, "FRIGOREX" supplies old type ammonia cycle refrigerators mainly for independent power supplies of street cantinas, beach stations, mobile selling track or bus stations (the latter being 10,000 units per year). This implies that "FRIGOREX", which entered into the realization of the "Apollon" EU project ordering hydrogen or methanol fuel cells of 0.5 to 1.0 kW capacity, mainly conceived for places with no electrical network, to replace economically no langer approved ammonia cycles, mainly for these street cantinas, mobile refrigerator units for food, etc. This is the actual and main approach in hydrogen energy options in Greece.

Greece already has numerous and further develops its so called "SOLAR VILLAGES" as a rather sunny country. This program is rather attractive and rapidly spreading to many of villages. This is a chance in the solar–hydrogen (Hysolar) energy combination. There are already numerous applications, and it might be a good approved example for many other countries, in particular for such networks.

Another EU project from the EU INCO Program Copernicus for the Balkans, has started promoting cooperative work and bringing closer scientific collaboration on an **"Advanced Membrane Type Hydrogen Generator for Water Splitting"**, including Greece (the coordinator is ICEHT/FORTH, Patras), Bulgaria, Yugoslavia, Croatia and FYR Macedonia. This project which intends to a produce membrane electrolyzer of 5 W capacity (2002–2004), which then might be multiplied and further developed (engineering aspects) for any capacity at will. This is a great concrete project (750,000 EUROs) for hydrogen generation primarily as a fuel. The end user is the Chemical Industry "ŽUPA", Kruševac, Yugoslavia, which has spare capacity on its 400 V, 50 kA silicon type rectifier. Two aspects are imposed here: (a) advances in new nanostructured electrocatalysts to remarkably reduce the cell voltage, and (b) the substantiation of a rather compact electrolyzer structure and multi–cell construction of negligible interelectrode distance provided by conductive polymeric membranes of several millimeters thickness. There are at least two other groups in Japan dealing with the same problem of an advanced hydrogen electrochemical generator, but the main goal of the project is to show the advantages of the developed novel type of bifunctional electrocatalysts in the forthcoming market for membrane water electrolysis. This is just a starting project with a precisely defined goal and proven technical and scientific abilities.

Concerning Yugoslavia, there already exist two large chloralkali electrolyses, one large OLIN, the exact copy of the same electrolysis unit from Charleston, Houston and another one the De Nora type mercury cells in Kruševac. Almost all of the cathodically produced hydrogen (amalgam decomposition) into the both units goes into the atmosphere. One of many ideas is to use this hydrogen for filling city buses, at the beginning just covering fixed expenses, to pay for bus credit in ordering them, and further successively to come to a compromised economical price of hydrogen fuel. This is an actual and great possibility for feeding, I estimate, about 50 buses and it might be a great impulse for further development there and an example for other countries.

Yugoslavia even in its former integral shape, was an electrical power producer and exporter, and mainly it concerns Serbia, which has large amounts of coal, as well as relatively good hydropower capacity. Unfortunately, there is a great imbalance in overnight electrical consumption and several hydropower stations during the night allow water to by–pass such stations and lose thus available energy. Since Yugoslavia already has rather good infrastructure and experience in the electrochemical industry, even spare capacity at their rectifiers, my suggestion has been to make a study and show the opportunity to build water electrolysis only to overnight hydrogen productioon and selling it as a fuel to developed countries or for one's own uses. The same proposal was made ten years ago (1990) for Norway in the study "Hydrogen Energy Options in Norway". Namely, Norway is one of the most energized countries in the world per capita, with great excesses of electrical power during rights and this study indicated the advantages of using low price energy to produce hydrogen overnight instead of selling it cheaply!

Yugoslavia has very good areas along its rivers and in the big valley Vojvodina to establish powerful wind farms and associate them with hydrogen energy. However, this is a potential prospect, while such a country of destroyed economy, with rather poor roads and many other more urgent concerns, lacking infrastructures and industrial capacities, is not able to consider wind farms at the present time, but it might be the compromise of international investment and use over a longer period to recover such investments.