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Abstract

Climate change, need for alternative energy and increasing asteroids in size and number represent key issues yielding growing challenges that must be tackled with more determination by the world community. The meeting set in Paris for December by the United Nations represents an unique opportunity to outline a common strategy for them as here outlined.

Keywords

Climate change, CO2 emission, Solar energy, Asteroids

Introduction

Climate change requires significant reduction in global greenhouse gas emission. Improvement of existing technologies is not sufficient and significant innovation is indispensable. Climate change is also a global issue and it is essential for governments, business and academia around the world to tackle this challenge together. Exactly what has been apparently attempted with the Innovation for Cool Earth Forum organized in Tokyo (Japan) in October 6-8 2015 which I had the privilege to attend upon invitation of the Minister of Economy Trade and Industry [1] and was aimed at addressing climate change and new energy through innovation. The Science, Technology and Society Forum just ended in Kyoto the day before with participation of many Nobel laureates, head of states, Ministers of Science and Technology and CEO of leading companies worldwide [2] confirmed the critical stage of scientific and technological progress in Energy and Environment, incapable to find solutions for effective carbon dioxide reduction and for new energy sources really alternatives to nuclear fission, gas, oil and carbon still dominating the scene worldwide many years after the Kyoto Protocol on Climate Change was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005 [3], and this despite vocal worldwide commitments and superficial hopes being raised on nuclear fusion, energy storage and hydrogen energy for which quite more is needed and should be done more aggressively and highly focussed to make the difference. Similarly while artificial photosynthesis is actively removing CO2 from atmosphere, hybrid and electric vehicles are key technologies appearing capable to reduce total CO2 emissions. In order to do this more effectively however, even if biofuels, solar energy, smart grid, geothermal, wind power and zero energy could be somehow continued, nuclear fission on one side and iron, steel and cement utilizing fossils on the other side should be promptly discontinued maintaining only the essential carbon capture technology. Several countries do not appear indeed intentioned to do it and Paris has to face the problem with more determination, introducing
other useful alternatives as thorium fuels [4] and pursuing the uncoupling of nuclear armaments from civil nuclear plants. It has been estimated that the nuclear energy available in thorium is greater than that available from all of the world’s oil, coal and uranium combined. Major reason why thorium use for energy production has not made more progress over the past decades is that thorium is not nearly as easy to weaponized. ICEF indeed investigated via discussion in the forum what innovative measures should be developed, how the innovation should be promoted, and how cooperation should be enhanced among the stakeholders. ICEF is held every year since innovations require time and continuous efforts, and 2015 ICEF steering committee made the decisions regarding the agenda and program to reflect the wide range of views of the international community with participation of researchers, businesspersons and policy makers from around the globe. An Online Discussion promote further discussion among participants throughout the year [5] with many people responsible for the future of this planet actively joining to deepen the discussion and to find concrete solutions.

Towards a Low Carbon Society

Based on a proposal by Prime Minister Shinzo Abe, the Government of Japan began hosting the annual Innovation for Cool Earth Forum (ICEF) last year in order to provide a platform to discuss the climate change through innovation promoting cooperation around the world in order to address innovation relating to energy and environmental technologies. About 800 prominent global business leaders, researchers, and policymakers from 80 countries and regions gathered for discussions at the 1st meeting held last October sharing a vision and establishing partnerships for lasting global reduction in greenhouse gases through innovative low-carbon technologies. Many speakers have used the wording “low carbon society” in the plenary session including Vice Minister of METI, despite the fact that the total amount of carbon on the earth is fixed. Carbon exists in CO₂ in the air and the sea, in carbohydrates of plants and animals, and in hydrocarbon of fossil fuels, and by circulation between different forms maintains the balance for a greenhouse gas reduction pursued by the United Nations Framework Convention on Climate Change (COP21) which will be held in Paris in few weeks.

The Top Innovations

As an event in ICEF which was started this year under the name “Top 10 Innovations” a competition was intended for low carbon innovations (Figure 1). Among more than 500 participating innovations born worldwide in the past one year, about 150 cases were selected as candidates for the top innovations. Researchers develop high-performance ionic-liquid-based membranes (Figure 2A) capture CO₂ by 3M Company (US), University of Colorado, Boulder (US). The University of Colorado at Boulder and its partner 3M Company, have developed and fabricated innovative new thin-film composite membranes that can capture CO₂ at a cost of less than $15 per ton, level that is significantly lower than today’s best carbon capture technologies. The researchers have demonstrated the first example of TFC gas separation membranes, which are created by coating polymer composites as thin layers onto porous support structures in such a way that the membrane has good mechanical strength. This new membrane pulls CO₂ out of coal-derived flue gas at twice the rate of current technologies, while restricting the flow of other materials through it. French-German partnership achieves 46% PV conversion efficiency (Figure 2B) france-based semiconductor maker Soitec and technology firm CEA-Leti in partnership with Germany-based Fraunhofer Institute for Solar Energy Systems have tested a multi-junction photovoltaic cell that converts 46% of solar light into electrical energy. The achievement marks a new world record for PV conversion efficiency. The new cell is a four-junction cell, with each of its sub-cells converting one quarter of the incoming photons in the wavelength range between 300 nm and 1,750 nm into electricity. A special challenge that had to be met by this cell was the exact distribution of the photons Company, have developed and fabricated innovative new thin-film composite membranes that can capture CO₂ at a cost of less than $15 per ton, level that is significantly lower than today’s best carbon capture technologies. The researchers have demonstrated the first example of TFC gas separation membranes, which are created by coating polymer composites as thin layers onto porous support structures in such a way that the membrane has good mechanical strength. This new membrane pulls CO₂ out of coal-derived flue gas at twice the rate of current technologies, while restricting the flow of other materials through it. French-German partnership achieves 46% PV conversion efficiency (Figure 2B) france-based semiconductor maker Soitec and technology firm CEA-Leti in partnership with Germany-based Fraunhofer Institute for Solar Energy Systems have tested a multi-junction photovoltaic cell that converts 46% of solar light into electrical energy. The achievement marks a new world record for PV conversion efficiency. The new cell is a four-junction cell, with each of its sub-cells converting one quarter of the incoming photons in the wavelength range between 300 nm and 1,750 nm into electricity. A special challenge that had to be met by this cell was the exact distribution of the photons...
among the four sub-cells. This has been achieved by precisely tuning the composition and thicknesses of each layer inside the cell structure. Compared to conventional solar cells, multi-junction solar cells are more expensive to manufacture. However, by using concentrating optics to focus the sunlight onto these cells, it is possible to minimize cell size to only a few square millimeters. This principle enables these modules to be manufactured inexpensively and is potentially capable to significantly contribute along with recent implementation of organic light-sensitive nanomaterials [6, 7] to bring electricity to the 1.5 billion humans which are still lacking of it in many regions of the world.

Road to Paris and Beyond

What can be expected from the series of annual ICEF conferences was established in 2014 in order to stimulate the awareness concerning the role of innovations towards solving the global warming issue. We all know that present technologies and practices to produce and consume is not sustainable, particularly in the field of energy. Thus new approaches are needed. The task is particularly challenging as the greenhouse where remain huge uncertainties related to almost all aspects of climate change, including science, technology and economy. We are not sure of the future impacts of climate change whether there exists a particular temperature increase level (threshold) above which our society cannot tolerate. We are not sure whether and when unknown challenges exist in the sustainable future of energy systems. A revolutionary power source needs to occur to achieve almost zero carbon generation. Energy is an important global need and is a critical factor fueling the development and competitiveness of economies around the world along with technology and infrastructure. Moreover increased productivity and energy consumption drives the development of industries, nations, and livelihoods. Which technology or innovation is most critical in achieving a sustainable and affordable low carbon energy system? Stabilization of the global surface temperature requires almost zero emission of CO₂. Considering that more than 85% of primary energy mankind depend upon are fossil fuels, we mankind are required to make drastic efforts. One lesson from the German Energiewende is that crucial is the system integration of low carbon technologies. For example, photovoltaic has become a promising technology as its investment costs have sharply declined. Therefore the number of competitive markets and market niches are largely growing. The top innovations fall mostly at the crossing [7, 8] of Electronics, Biotechnology and Nanotechnology being successfully in place since 1996 within the framework of Molecular Bioelectronics [9, 10], but they appear incapable to make a substantial difference with overall energy production being still 2/3 for fossils and 1/3 for nuclear fission (the latter is a still pending disaster in Japan due to tsunami and earthquake, and in the future an open referendum appears useful to decide on the situation as was done in Italy many years ago). The time is running out on us also to replace both fossils close to terminate soon or later (in 200 years humanity consumed what has been accumulated in more than 5 million years!) and traditional nuclear fission too strongly coupled to nuclear armaments, as highly debated in Kyoto (Figure 3).

Space Asteroids

What suggested above must become the World Priority along with the Asteroids recently pointed out also in world popular media [11] as an additional real priority. It is clear that the probability of a direct impact is extremely low, but being the effect catastrophic, or worst threatening our survival on earth, it would make sense to at least prepare a plan to protect our planet (Figures 4 and 5). As shown also in a Planetary Defense Conference [12] and in a recent movie entitled 51 Degrees North which inspired Asteroid Day [13], quite few Asteroids appear indeed now bigger than 1.300 feet and on the track to smash Earth more sooner than later (debate is growing exponentially about the big one approaching earth in 25 years), being able thereby to cause epochal irreversible damage to human civilization. Even if present deterioration of the international situation makes unfortunately prohibitive a cooperation among USA and Russian Federation towards a new SALT agreement capable to transfer resources from nuclear and strategic Armaments to the overall key hard science and technology (as should be needed!), the world community

Figure 3: Claudio Nicolini and Fuchs Alain President French CNRS debate on Energy and Environment during the Science Technology Society Forum in Kyoto on October 4 2015 at the presence of Prime Ministers of Japan (Abe) and France (Valls), Deputy Prime Minister of Russian Federation (Dvorkovich), Executive Office of the President United States (Holdren).
should unanimously set up means and organizations to blow these asteroids and overcome their related problems, as Teller [14] from USA and Kurchatov from USSR correctly and independently anticipated long time ago prior to the new emerging facts of our time. More than 150,000 asteroids are now registered in the Smithsonian's Minor Planet Center and NASA estimates that more than 1,000 are characterized by NASA as NEO (Near-Earth Object) and they can be stopped only by nuclear weapons which are in the hands essentially of United States of America and Russian Federation and which should then be urged to joint their efforts in this direction with proper urgent actions and deliberations to save humanity once this should occur!

Conclusions

The present review of the state of the art of the emerging technologies indicates that the Paris meeting of the United Nations should be able to provide a strategy to the Energy and Environment problems in front to us but in our opinion the situation is so deteriorating that all of this combined with the Asteroids threat will be further discussed in an ad hoc session of the first NanoWorld Conference called in Boston for April 4-6 2016 to measure progress and to accelerate our search and initiatives.

Acknowledgments

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