

Sustaining Civilization Under Cover

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The First Nations People believed in four sacred elements, namely the earth, air, water and fire (meaning energy). Not so sacred for them, but the Babylonians, Sumerians, and later the ancient Greeks believed in the same four. The challenge we are facing today in our increasingly populated planet is how to live within such that its resources (the four sacred elements) can sustain human civilization and the natural environment in a healthy and functional state for many generations in the foreseeable future. How can we continue to improve human welfare within the limits of our planet's resources? The solution is sustainable development! In *Our Common Future*, the 1987 report of the World Commission on Environment and Development, sustainable development was defined as development that '... meets the needs of the present without compromising the ability of future generations to meet their own needs.' In other words, it is the use of renewable and nonrenewable resources in a manner that satisfies our current needs without compromising future availability of resources. Then, "What is the maximum number of people our planet can sustain?" That is, what is the sustainable human carrying capacity of our planet, sustaining the natural environment, its species, and its systems in a healthy and functional state? We are using our renewable and nonrenewable environmental resources faster than they can be replenished. We are extracting minerals, oil, and ground water without sufficient concern for their limits or the need to recycle them. As a result, there is an existing shortage of some resources and will be more shortages of other resources in the future. Therefore, we must learn how to sustain our resources so that they can continue to fuel human civilization and other living things on our planet within natural limits for many generations. Sustainability, therefore, means leaving our children and future generations a planet at least as rich as we live in today, and requires maintaining fully functional and healthy natural environment, which basically forms the foundation for our civilization. Due to the population increase, in reality, sustainability is a moving target; therefore, more resources will be required to maintain a healthy and functional status. Our choices, up to certain extent, determine both the local and global

sustainable carrying capacity for the human population of our planet. For instance, more people will mean more energy use; and in addition, people in less developed parts of the world will be consuming more energy on per capita basis when they reach higher standards of living. Today, the environmental impacts of fossil fuels are significant and may become even worse in the years to come due to the inevitable increase in their uses. Today, we optimistically believe that we have the required knowledge and technology to ensure a worry-free future, if we are to take the action now. Rather than relying on fossil fuels heavily, we have the option to build a sustainable energy future based on careful planning, innovative thinking, and a willingness to move from our dependency on fossil fuels. Here is a good place to introduce the concept of *integrated energy management*. According to this concept, a series of options need to be employed, and the range will be determined locally. The sources of energy will have to consider both renewable and nonrenewable sources. With the integrated energy management concept, we would be able to provide diverse and reliable sources of energy including more local and decentralized production of energy, considering energy efficiency and conservation measures, protect our local or global environments, and make sure that our future generations live in a healthy and functional environment with rich enough resources. The biggest challenge for a sustainable energy future however is the human aspect – changing our total way of living. The overall goal of sustainable energy development requires and maintains multiple linkages among energy production, energy consumption, human well-being, and environmental quality. And for this, local sustainability is the key.

As we get into the new renewable bio-economy era, bioenergy will be one of the major players of local and global energy mixture. However, non-food feedstock diversity and sustainability issues are important considerations. Therefore, microalgae and cellulosic (currently conversion processes are critical) feedstock alternatives will seem to provide more sustainable solutions for energy generation and use. Especially, considering the productivity levels within fully enriching cycles, microalgae will be one of the key contributors of both local and global sustainable energy development as it fully and truly cares about the aforementioned four sacred elements. Microalgae's energy and other bioproducts' potential will be realized mostly in simple controlled environments, and will therefore be sustaining our civilization under cover.