

ENVIRONMENT DAY LECTURE

on

WORLD ENVIRONMENT DAY

at

NEERI, NAGPUR

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It is indeed my privilege to address this august gathering on the occasion of the World Environment Day 2012. It is especially appropriate that I perform this pleasant task at CSIR's National Environmental Engineering Laboratory, Nagpur, the only institution in India devoted to the problems and stewardship of our environment. Environment has come to occupy a central part of the discourse of our times. In the cacophony of voices and views, we need evidence based debates on issues. Only a National Laboratory like NEERI can provide the sanity that is badly required in this discourse. This also places enormous responsibility on the scientists and staff of NEERI. They have to be scientific, ethical, responsible and balanced. They must be undeterred by powerful lobbies, either from within the Government or outside. Every scientist of NEERI must only be accountable to the planet and its inhabitants, present and future. This is an awesome responsibility.

We celebrate today the 40th anniversary of the World Environment Day, a day that commemorates the day when UN Environmental Programme was initiated in 1972. The theme of this year's anniversary is "The Green Economy: Does it involve you?" The theme focuses on improved human well being and social equity, while significantly reducing environmental risks and ecological scarcities by adopting a low carbon, resource efficient and socially inclusive path for our growth and development.

This anniversary is also an appropriate time to look back on the evolution of environmental consciousness of our society. We will agree that as a society we are far more aware of the human impact on our environment today than any time in the history of man in this planet. What forces shaped humankind's awareness of the fragile nature of this planet's ecosystem and how critically human life depends on it? After all, in this vast cosmos, planet earth is the only place which is hospitable to life, as we understand it, sustains and nourishes humans as a crowning achievement of the evolutionary process of species and is home to a vast repository of documented history, culture and knowledge. It is the uniqueness as well as the

fragile nature of planet earth in the solar system that makes it so precious, deserving of preservation for habitation by succeeding generations of people.

However and surprisingly it was only about fifty years ago that consciousness about our environment became a part of human thought. I list three watershed moments in our recent history that were responsible for making our habitat and environment a part of everyday discourse. Civil society, governments and industry woke up to the reality that positive intervention was urgently needed, if our planet has to be saved from catastrophic oblivion.

The first was the publication of a book “The Silent Spring” by Rachel Carson in 1964. It drew attention to the harmful effect of indiscriminate use of chemical pesticide on our environment. For the first time, the book brought environmental concerns to the attention of the people. With its publication, public perception of chemistry and chemical industry changed for ever. Industry first reacted with retribution and vindictiveness, but wisdom prevailed and a period of deep introspection began. In fact the reverberations caused by this book still sounds loud and clear, as the chemical industry increasingly embraces the concept of “sustainability” in its growth agenda. The book also marked the involvement of the government with the setting up of the US EPA and eight years later the UN set up the UNEP. The oft heard aphorism that the pen is mightier than the sword found its true meaning in the writing of Rachel Carson.

Although hailed as a messiah now, in her life time she was vilified, scorned and abused by powerful lobbies that saw her as a threat to their interests. But Rachel Carson was no armchair environmentalist. She was a marine biologist by training and had accumulated evidence to back her arguments. In the end truth triumphed, a lesson all of us must learn from her life.

The second was the epoch making curiosity driven research by Rowland and Molina on the influence of chlorofluorocarbons and the contribution of Paul Crutzen on the influence of nitrous oxide on ozone depletion in the stratosphere. Two papers appeared in the early 1970's, namely, “The Influence of Nitrogen Oxides on the Atmospheric Ozone Content” by P. Crutzen, *Quart. J. Roy. Meteor. Soc.*, 96, 320-325 (1970) and “Stratospheric Link for Chlorofluorocarbons: Chlorine Atom Catalyzed Destruction of Ozone” by F. S. Rowland and M. Molina, *Nature*, 249, 810 (1974). These papers showed for the first time how human activities can cause irreversible environmental damage, leading to unintended consequences such as diseases of the skin and eye. More than 75% of the halogenated compounds are released in the environment by humans. Once again, the ideas of Rowland, Molina and Crutzen met with great resistance till atmospheric studies provided incontrovertible evidence of “ozone holes” in the Antarctic Circle. The international community sprung into action and the landmark Montreal Protocol was adopted by 197 countries and the EU. Through voluntary compliance and actions by all countries and eliminating the use of certain chlorinated and fluorinated compounds, the world expects to recover the ozone layer by 2050. Rowland, Molina and Crutzen shared the Noble Prize for their revolutionary discovery in 1995. When science (and especially, chemistry) is often blamed for the ills of man, the work of Rowland, Molina and Crutzen is a supreme example of how science alone can find solutions to the problems of mankind.

The third was the constitution of the International Panel for Climate Change (IPCC) by UNEP and WMO in 1988. A broad body of professionals around the world were asked to study

available data and make judgements on how humans impact climate change. Four assessments reports have been published so far. The assessments of IPCC have been controversial, provocative and have served the useful purpose of stimulating intense debates on the state of our environment. Once again, it is clear that anthropogenic carbon dioxide emission is the most probable cause of global climate change; and that half of this emission comes from burning fossil fuels for generating electricity and providing mobility. In a landmark report submitted to the UK Government by Nicholas Stern, titled "The Economics of climate Change" in October 1996, the governments began to fathom the implication of climate change to their model of growth as well as cost to their economies, making for the first time, an irrefutable connection, between environmental science and developmental economics. Terms such as "low carbon economy" and "carbon tax" entered the lexicon of economics.

All the three major developments that have shaped our environmental consciousness over the past fifty years have raised enormous controversies. The views were first outright rejected. However, the force of evidence and painstaking advocacy by a courageous few have ensured that the basic paradigms of science are re-evaluated and human impact on the natural world and its unintended consequences are far better understood now than anytime in the past.

While many issues appear manageable, the dependence of economic development on energy intensity as well as stress on "blue" water continues to be of great concern. With 17 % of world population India has just 1 % global forest resources and 4 % of water. Half of India's arable land is water stressed. By 2050, 50 % of our fresh water will be used for producing electricity and in manufacturing and 35% for irrigation, leaving a mere 15% of this resource for other needs of mankind

However, today I will restrict my observations about the issue of energy. Energy is stated to be "the single most important scientific and technological challenge facing humanity in the 21st century" (C&EN, August 22, 2005)

Clean and abundant source of energy is one of the key concerns of our times. It is clear that the world cannot continue to burn fossil fuels for energy without causing long-term damage to our planet. The emerging economies of the world, such as China and India, have large needs for energy to sustain their economic growth and lift vast sections of their population out of poverty in one generation. Yet, energy is a commodity and its use is shaped not only by policy but also in large part by cost. There is no imminent threat of this world running out of hydrocarbon resources; so mere market forces will not drive us into using non fossil fuel energy resources. However, continued use of fossil fuel as energy resource will put us on an irreversible course with regard to the management of carbon dioxide inventory. If we were to limit the carbon dioxide emissions to the present level, say, 400 ppm by 2050, it would necessitate reducing carbon emissions to near zero by 2050. Business as usual cannot accomplish this goal.

Citizens and policy makers must pay attention to "deep time" or the very slow changes that accompany the deterioration of climatic conditions or natural resources, for the benefit of third, fourth or fifth generations.

Solutions that have stood the test of time in the last century in more developed part of the world require critical reexamination in the context of the energy needs of economies of countries in Asia, Africa and Latin America.

Yet, solutions based on science are likely to be available. It is believed that use of synthetic fuels, alternative energy carriers, new lighting devices, solar energy and increased focus on energy efficiency can reduce carbon dioxide by as much as 50% from the current levels. Renewable carbon neutral energy resources have intrinsically low carbon intensity with emissions per unit of energy output typically less than 10% that of fossil fuels

Yet migration to a new world order in energy is beset with huge structural difficulties.

The energy sector in 21st century is akin to advent of coal and steam engine in the 19th century or liquid fuels in the 20th century when cataclysmic changes in the pattern of energy use occurred. It should also be noted that such changes occurred over a time span of a century and half. JP Morgan's office in New York was electrified by Edison's incandescent lamp in 1882; however, wholesale shift to electricity occurred only in the 1930.

We are witness to another such transition in energy use pattern today

It is difficult to put a time line for this transition or define the architecture of the future energy systems; however, radical reconfiguration of the existing order is certain. Changes in energy use pattern require alignment of technology, policy, infrastructure, markets and people. The difficulties in changing cannot be underestimated and involve embedded capital, consumption pattern and vested interests intent in protecting the status quo. Radical change is possible only when technology and infrastructure get locked in a synergistic embrace.

The complexities of technologies that are available today in the energy field are humongous. Each of the technology has its "up and down-side". Rational choices are not easy and can easily become biased. Yet, building energy infrastructure is time and capital intensive. Typically, a thermal power plant or nuclear power plant has a pay back period of thirty to forty years before it can deliver a reasonable return on investment. Consequently, the infrastructure that we build in the next ten to twenty years will decide, by a large, what our country's energy mix is likely to be in the next fifty to seventy five years. For example, what share of the domestic energy requirements should be off grid, both in rural and urban households? How much new investments must be made on mega- grids versus mini-grids, which are more compatible with renewable energy? How many of our households can meet their electricity needs through roof top solar PV's? What should be the share of energy investments in nuclear versus non-nuclear low carbon energy?

In the energy sector, the Government continues to be a major investor. Therefore, decision in favour of one or other technology is made by the Government.

One of the risks of Government intervention in specific technologies is that alternatives tend to be ignored since funding is directed towards "preferred" technologies. Technology evolves through multiple iterations and we must be cautious in believing too much in the predictions of pundits. Additionally in sectors, such as energy, technology gets locked in for centuries. Once the choices are made, technology shift is not easy. So choices must be driven by true costs coupled with efficiency and long term sustainability.

The principal dilemma facing any developing society in making rational choices is moving away from “either –or” to “both- and” One has to cultivate the habit of being “for” without being “against”. The question is how can we balance, low cost and high quality, high economic growth with low environmental impact, more growth with more inclusion, include the non- included without excessive government subsidies and make development inclusive and sustainable

The challenge the world faces today is food, energy, water, climate change and sustainable livelihood. We cannot address these challenges with the policies and strategies of yesterday. As Peter Drucker once said “The greatest danger in times of turbulence is not the turbulence; it is to act with yesterday’s logic.” Let me conclude with a perceptive statement by Wright in a book called “The Short History of Progress”, and I quote, “If civilization is to survive, it must live on the interest, not the capital of nature”