Preface to the Special Issue on Emerging Energy Technologies

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Human society is currently at a dangerous cross-road. A casual look gives an impression that it has reached the pinnacle of its development. However, in doing so, it has done almost an irretrievable damage to its environment, natural resources and social value systems. There are three interdependent parameters which have to be considered before planning sustainable development strategies viz. human development, growth and environment as schematically shown below:

Energy is at the core of all human development related activities. Close relationship and interdependency between human development and growth is quite obvious. Growth is happening at two levels viz. population growth and growing aspiration of every individual to have a better standard of living. Human development is too complex a concept to be defined in few sentences. The essential features are socio-economic development, better nutrition and health care, comfort and leisure, social value system, emotional and physical security etc. Both growth and development derive their inputs from natural resources and,

in turn, lead many times to the environmental degradation. In fact, all the three parameters viz. growth, development and environment take help from each other to foster themselves and, in that process, they themselves get adversely affected. Such an interplay has put humanity in a state of “TRILEMMA”.

For achieving any or all of the above stated three related human activities of growth, development and environment, abundant availability of *energy* is the key requirement. And hence, the answer to the question whether the human race will be able to successfully deal with its ‘trilemma’ lies mostly in the assured future availability of sustainable, renewable and clean energy supply. Each nation has to be alert on the emerging global energy scenario. In the past, we have seen that the political and economic history of the world had a strong correlation with the groups/individuals having better control and access to the various forms of energy available at that point of time. In the early days of history, it was the “muscle power” of the particular race as well as the power/speed of the tamed animals (bullocks, horses, elephants etc.) which decided the size of the ruling kingdom. Later it was the wind power (like sail boats), gun power, steam power, electricity, fossil fuel (like coal and petroleum) and nuclear power which silently and successfully took control of the history of development of human race. Nations lagging in the basic energy skills lost the race. Presently, when the days of fossil fuels are limited, all enlightened nations should look for alternative routes of energy supply like hydrogen, bio-fuel, solar energy, fuel cell etc. Innovative methods for:

- Energy generation
- Energy storage
- Energy conservation

have to be developed before it is too late.

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“Conservation” is primarily a social driven behavior while the first two are science/technology driven. The Editorial Board of Proceedings of National Academy of Sciences, India (Section A) decided to bring out a Special Issue containing original research papers as well as Reviews/Overviews related to current Energy Research. This Special Issue is an effort in that direction. The first two articles are related to Solar Energy Conversion followed by an interesting article on a novel type of Fuel Cell viz. Microbial Fuel Cell. The next two articles respectively deal with interesting materials useful for fuel cells and batteries. An interesting article deals with a doped oxide material (viz. doped gadolinium oxide) for use as an efficient light emitting nano-phosphor. One article is on the

technology of production of bio-fuel (bio-ethanol). During the production of bio-ethanol, sensors for glucose and ethanol will be necessary to control and monitor the production line and, therefore, an article is also included describing a novel type of sensor. Finally an article is given on Energy Storage through recently developed “Supercapacitors” which hold high promise for the future.

We hope that the readers will find the research papers included in this issue interesting. We wish that a few young researchers may feel encouraged to innovate in the field of energy science and technology.

Suresh Chandra
Chief Editor