Opening Remarks: Third National Workshop on Solar Energy Utilization for Sustainable Development. CSIR NEERI, Nagpur, February 1, 2018

Dr Rakesh Kumar, Director, CSIR-NEERI, Professor D.D.Sarma, Dr. Ms Sadhana Rayalu, Dr. Amit Bansiwal, other distinguished members on the dais, participants to this National Workshop on Solar Energy Utilization for Sustainable Development, ladies and gentlemen,

I am indeed honoured to be invited to be present here this morning at the Inaugural Function of this Workshop. I compliment CSIR-NEERI and Dr. Ms Sadhana Rayalu and her team for having put together an excellent programme. The subject of the workshop is extremely important, timely and relevant.

India has taken, in recent years, some bold steps in building capacities and capabilities for renewable energy, especially, Solar. At an international level, India has become a spokesperson and assumed leadership for transition to a low carbon economy, using clean fuels and clean energy. Contrast this to a few years ago, when India was hesitant and was seeking exemptions from the global order in the guise of the country being an emerging economy whose energy demands could not be constrained by global demands. Today the tables have turned; Indiais a strong advocate of decarbonizing the global economy, whereas, the US wants to recarbonize its domestic economy!

It is clear that the inevitable momentum of clean energy is finally here. The clock is unlikely to be turned back, irrespective of individual decisions nations take in their self-interest. This momentum is resulting in manufacturing scale, cost reduction, technology improvements and widespread deployment of Solar Energy at a scale the world has not witnessed before. It took Solar Energy technology almost fifty years, since it was first demonstrated by Bell Labs, to reach the inflection point of

exponential growth. Whether this is driven by humanity's concern for the environment and climate change or mere economics or both is worth pondering. One thing is certain. The price of oil or the fact that it is a finite resource was not really a factor as it was once assumed to be!

India has set for itself large ambitions, to grow Solar and other renewable energy at a rapid phase. The precipitous drop of cost of solar installations, thanks to China, has provided the economic impetus. At a levelized cost for 25 years of Rs 2.40 per kWh, SolarEnergy today is cheaper than electricity from coal (at Rs 3.20 per kWh). This could not have been anticipated even two or three years ago. Society and technology led disruptions are becoming harder and harder to predict and plan for. It is hoped that Solar will account for 15 % of India's electricity generation by 2022.

In light of these developments, it is pertinent to ask where does India standsin the technology front. Sadly we have ceded the entire Solar PV technology leadership to China and to an extent, even to, countries like Korea and Malaysia. With no domestic silicon production capacity, India is likely to transition from an oil-importing nation to Solar PV technology importing nation. There is no conceivable way India can today produce polysilicon at US $ 25 per kg nor a solar cell at 30 cents per watt or a solar module at 72 cent per watt, the price at which China produces these materials! India imported US $ 2.2 million worth of solar equipment, 87 % of this originating from China, in 2017. As India's ambition in solar energy grows, be it for power or for electric vehicles, China will walk all the way laughing to the bank! Just like the semiconductor chip, the solar energy materials and technology opportunity has bypassed us.

Yet, there are risks in solely depending on one country for all supplies and replacements for a technology as strategic as power generation. What are the future vulnerabilities that we are likely to expose our self?

The transition to renewable from coal and fossil resources for electricity generation is also not as easy as it is made out to be, nor it will occur in a few decades as many may lead us to believe. This is the nature of such technologies. In the interim period, many energy technologies will coexist creating both opportunities as well as barriers for growth. The challenge of keeping traditional perennial modes of electricity generation economically viable while transitioning to the intermittent nature of renewable energy in an "electricity surplus environment" will pose a great existential challenge to legacy technologies. Additionally, with increasing emphasis on EV's, if we do not manage this transition with deliberate and purposeful planning, we will merely shift the pollution problem from the tail pipe of vehicles to smoke stacks of thermal power plants!

Given this situation, we also need to ask where is it that India can add value to Solar PV technologies. Clearly we can do very little in manufacturing. We can only be creative and innovative in developing India specific applications at a value and price, which the Indian consumers will aspire for and can afford.Captive roof top solar power generation is one example where India can truly benefit. The other area is solar powered micro-grids for isolated or urban communities. Another area is replacinghighly polluting diesel generators for standbypower with Solar PV. There is a great opportunity of about 100 GW of diesel stationary power to switch to clean energy in the near future.

In the area of power generation, the challenge in solar PV will be to how to maximize energy conversion efficiencies over its lifetime. It is already evident that high ambient temperature, atmospheric pollution as well as dust and particulate matters can cut solar power yield as much as by 25 %. It is believed that 4 % light transmission is lost per g / sq. meter of dust. Under Indian environment, these issues are not trivial.

There has been an irrational exuberance in the way the solar power market has grown in the last five years. Much of it is unsustainable as a business. One can expect an industry shakeout in the next five years leading to rationalization of capacities and better RoI's. Many of today's company will either quit or fold in the next few years. Solar energy requires patient capital and the determination to hold the ground, in spite of short-term disruptions, especially, with regard to policy. This business is for the brave, who can fight it out in the market place, not for someone who is looking for making quick money.

I hope the deliberation of this workshop will try and understand the many nuances of this technology and business and will chart a path for industry and research institutions to explore together pertinent innovations in solar energy utilization.

Thank you