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"The global chemical engineering working for a better future world"

"Chemical Engineering for a Sustainable World"

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According to the U.S. Energy Information Administration (EIA), globally by the year 2050, renewable electricity will either be the largest primary energy source or slightly below petroleum and other liquids. Solar photovoltaic (PV) is expected to be the largest electricity source not only among renewables but also among electricity generation from any individual fossil source. Direct availability of primary energy as renewable electricity rather than the historical availability of energy as heat via fossil fuel combustión is expected to have a profound impact on Chemical manufacturing. In this talk, we will discuss, through systems analysis, the various levels at which Chemical engineering will be impacted and contribute to the sustainable production of Chemicals and even the harvesting of energy.

Near 80% of the U.S. Chemical industry's energy use is for supplying heat to various unit operations and this use is also responsible for -80% of its greenhouse (GHG) gas emissions. Given this scenario, we will first examine how renewable energy in general, and solar in particular, when used as a heat source, could impact the design and operation of various unit operations such as reactors and separators. We will briefly discuss how renewable electricity could be used to dramatically reduce CO2 emissions. Next, the potential impact, due to the intermittent availability of solar and wind energy through a twenty-four-hour day, on the equipment design and energy storage requirement will be presented. In the context of renewable energy, a brief discussion will be made about the use of biomass as a source of energy as well as a source of renewable carbon.

Under the scenario when solar energy is widely used for Chemical manufacturing then in conjunction with other sectors such as transportation, a system-wide analysis of land availability for PV farms will be presented. It will be shown that in most population centers of the world, the large demand for solar electricity could lead to land constraints. This means the use of agricultural land for both food and energy harvesting may be needed. Here we will also present some results from experunents with corn production along with electricity generation from agrivoltaic farming at Purdue University. Finally, we will also present our research on the design of thin-film inorganic solar cells using solution chemistry. Some exciting recent fmdings related to stable inorganic chalcogenide perovskites will also be shared and discussed. In the evolving energy landscape, Chemical engineers can use their reaction engineering knowledge to synthesize the next generation of semiconductors for energy harvesting. The changing energy landscape and environmental concerns are providing an unprecedented opportunity for innovation in Chemical processing and are expected to bring many new aspects to the Chemical engineering fold. Indeed, this is a great time to be a Chemical engineer.