

# Engineering a Sustainable Energy Future

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In the long run, it is likely that all the basic human needs will be met by renewable sources like solar energy. However, there are several challenges associated with harness, storage and use of solar energy to meet our daily needs for food, chemicals, heat, electricity and transportation. In a sustainable future, all these usage must coexist.

We will first present some results from our energy systems modeling highlighting the synergistic interactions that exist for transportation sector and production of chemicals. This will be followed by a brief discussion and analysis of candidate processes to produce hydrogen from solar energy and our modeling results for energy storage at giga Watt-hour levels.

An exciting aspect of producing fuels and chemicals from biomass is learning to produce the array of molecules that we need with minimum process transformation steps and energy use while maximizing biomass carbon recovery. In this aspect, recent advancements at Purdue by a team of chemists, biologists and chemical engineers will be presented. We will show the new pathways and the associated catalysts that have been developed for the production of fuel and chemicals.

On the sun to electricity front, we will present highlights of our research on thin film solar cells via nanocrystal ink based route. We will discuss process and technical solutions leading to power conversion efficiencies that are among the highest for  $\text{Cu}(\text{In,Ga})\text{Se}_2$  and  $\text{Cu}_2\text{ZnSnSe}_4$  based solar cells by solution based routes.