Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Energy Science Center

## Institute of Energy Technology – Professorship of Renewable Energy Carriers

# *Invitation to a Seminar*

**Date:** Wednesday, October 3rd, 2012
**Time:** 16:00-17:00
**Place:** Maschinenlaboratorium ETH Zürich, ML-J25/26

**Speaker:** **Prof. Jacob Karni**
Environmental Science and Energy Research
The Weizmann Institute of Science, Rehovot, Israel

## *Title*: Solar-Thermal Power Generation – Description & Performance Analysis

***Abstract*** – The seminar provides a brief description of the various concentrating solar-thermal configurations – *Line-Focus*, *On-Axis* and *Solar Central Receiver* systems. It then describes some key characteristics and offers definitions of parameters in the determination of the system's performance. The *Levelized Energy Cost* (LEC) is singled out as the ultimate performance parameter of any solar power generation system, and the *overall annual* system efficiency is found to be a fundamental factor in its determination. A performance analysis of different solar-thermal systems, leads to the conclusion that there are several configurations with a potential for significantly higher system efficiency, and thus lower LEC, than those of the most commercially advanced solar-thermal systems. The highest predicted *annual average* system efficiency is that of a combined cycle based on an array of dish-concentrators, each with its own microturbine whose residue heat is transported to a central steam-Rankine station. The analysis also shows that the development of (i) high-efficiency Brayton microturbines at the power level of about 100 kWe, and (ii) steam-Rankine PCU's, or alternatives such as a supercritical $CO_2$ Brayton cycle, at 10-100 MWe, would boost the commercialization of high-efficiency, low LEC solar-thermal systems.

***Biosketch –*** Jacob Karni received his B.S. Civil Engineering (1979), and M.S. (1982) and PhD (1985) in Mechanical Engineering, all from the University of Minnesota. In 1984-1989 he was an Assistant Professor of Mechanical Engineering at the State University of New York at Stony Brook and joined the Weizmann Institute in 1989. Karni research centers on the utilization of concentrated solar energy. He is interested in the development of new methods for concentration, absorption, conversion, transmission and storage of solar energy, and implementing these methods in genuine solar power-conversion systems. Together with outstanding co-workers, Karni developed several novel solar receivers capable of working at high temperature and highly concentrated sunlight, while supplying heat to various high temperature applications, such as drive heat engines or promote thermo-chemical reactions. Jointly with another colleague, Karni also pioneered a novel concentrated photovoltaic system. Prof. Karni and his research group are now working on a new method for using solar energy to produce non-polluting fuels. A common denominator among the aforementioned processes is the endeavor to maximize the energy conversion efficiency of the process. Three industry-led commercialization programs based on concepts developed by the Karni Group and are currently underway.

Host: Prof. A. Steinfeld, www.pre.ethz.ch