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Vagelis Vossos

Optimizing Energy Savings with Direct DC in U.S. Residential Buildings

While alternating current is the dominating power form in the current electric distribution system, a recent interest in direct current (DC) power distribution has been spurred by a combination of factors, including the rapid increase in photovoltaic (PV) systems in the U.S. and the ongoing expansion of appliances that utilize DC power internally. This study investigates how to maximize residential energy savings by using DC generated by PV systems rather than converting it first to AC for distribution to house loads. A conceptual house model that uses DC-internal loads was developed and the efficiency losses within its power distribution system were compared for AC versus DC distribution. The model was implemented using hourly average residential load and PV output data for 14 U.S. cities. The thesis addresses implications of storage, load shifting and an electric vehicle and includes sensitivity analyses for the efficiencies of the house power system components and appliance converters. Savings of 6% ± 3 % were calculated for configurations without storage and 12% ± 3 % for configurations with storage. Load shifting did not have a significant positive effect on savings and the electric vehicle reduced savings compared to the same house configuration without it. The results were highly sensitive to the power system and appliance conversion efficiencies but were not significantly influenced by climate.

About Vagelis: I grew up in Greece where I completed my B.S. in physics. I came to the Bay Area in 2005 and since then have been working in the renewable energy and energy efficiency field, specializing in photovoltaics. I am currently working for the energy efficiency standards group at the Lawrence Berkeley National Laboratory. After my graduation, I intend to continue working in the energy field.