## Impact Evaluation of Deemed Savings in Greenhouses: Heat Curtain and Infrared Films

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## **Overview and Purpose**

Heat curtain and infrared film technologies are installed in greenhouses to inhibit heat loss and excess heat gain. Vendors commonly advertise heating energy savings of 30% to 60% when heat curtains are installed and 10% to 20% when infrared films are installed. An impact evaluation was performed to determine the validity of program and vendor savings claims for these measures. Engineers collected characteristic data from a sample of sites and used an automated process to determine measure impacts using the eQUEST simulation software. Intensive metering and model calibration was performed on a subset of sites to validate the methodology and determine the model parameters that were most important to accurately model the measures under evaluation. The automated process employed greatly reduced the labor and budget required to evaluate measure impacts, resulting in improved evaluation efficiency. Additionally, evaluation results largely validated vendor percentage savings claims for both heat curtain and infrared film measures.

## Methodology

Engineers employed an automated process to model the pre- and post measure conditions at 39 greenhouse sites with the eQUEST energy simulation software. Engineers performed site visits and input collected data into a text-based pre-processor to generate an eQUEST simulation of each evaluated greenhouse. These automated models were reviewed to verify that the generated model correctly reflected the site, and parametric runs were made to determine measure impacts. This evaluation procedure was validated against measured data from 6 sites and subsequently applied to the remaining 33 sites under evaluation. The calibration exercise identified key model inputs to be collected during site visits and largely validated the use of the eQUEST simulation software to evaluate the impact of heat curtain and infrared film measures in greenhouses.

## Results

The study found that energy savings of 22% to 43% could be achieved when greenhouses were retrofit with heat curtains and savings of 3% to 27% could be achieved when greenhouses were retrofit with infrared films. Overall, heat curtain and infrared film measures were shown to result in significant energy savings across climate zones. The level of energy savings was found to be dependent on three key greenhouse characteristics: (1) heating system type, (2) heating temperature setpoints, and (3) climate zone. This poster details the evaluation methodology and results, calibration procedure, key modeling assumptions and uncertainties (as they apply to greenhouse simulation) associated with the evaluation procedure employed.