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# Numerical Analysis of the Adaptive Solar Façade

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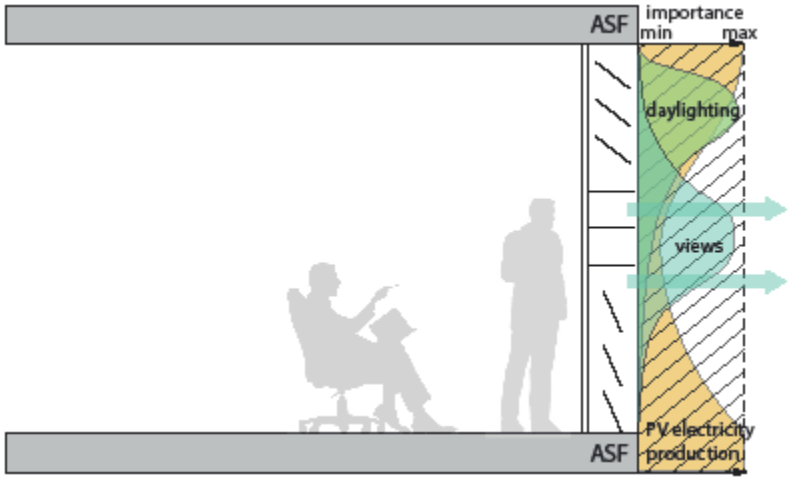
# The Adaptive Solar Façade (ASF)

- Individually Actuated Panels

- Combines Dynamic Shading with PV-Electricity Production




- Needs to be Optimized for Cooling, Heating, Lighting, Actuation and PV-Electricity Production

# Overview

- Introduction
- Problem Description
- Methodology
- Results and Discussion
- Conclusions and Outlook

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# Problem Description

## Optimization Problem

Minimize: $\mathrm{C} + H + L + A - PV$

$\mathrm{C} = Cooling\ Energy$
$\mathrm{H} = Heating\ Energy$
$L = Lighting\ Energy$
$A = Actuation\ Energy$
$PV = PV\ Electricity\ Production$

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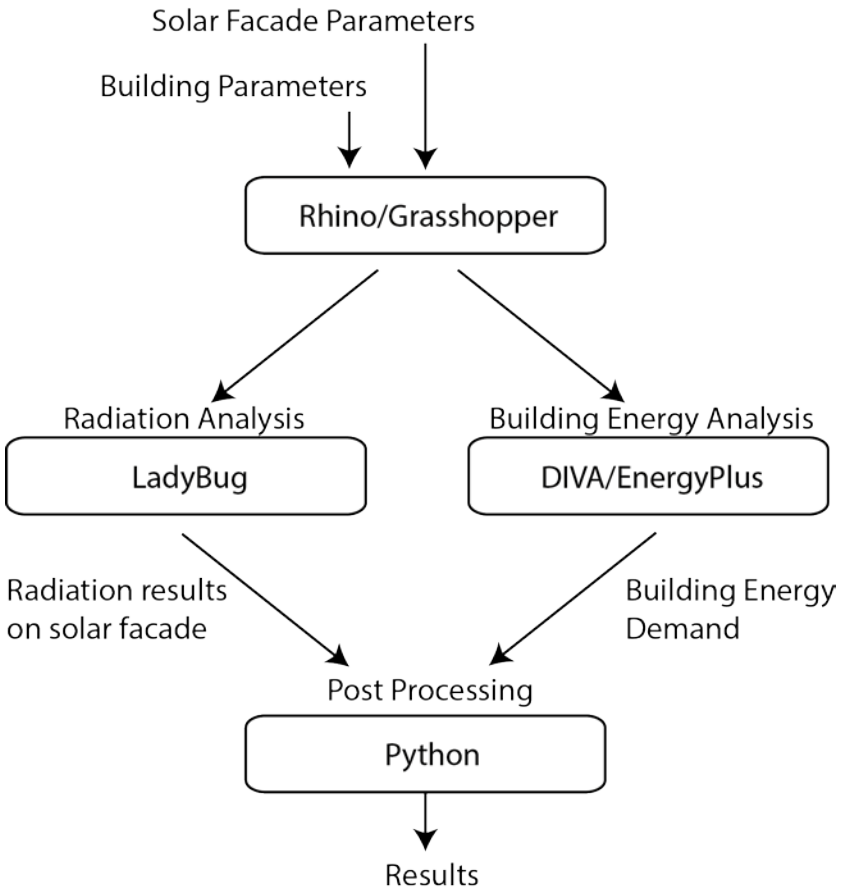
# Methodology

## Combination Of Different Tools To Achieve Optimal Results



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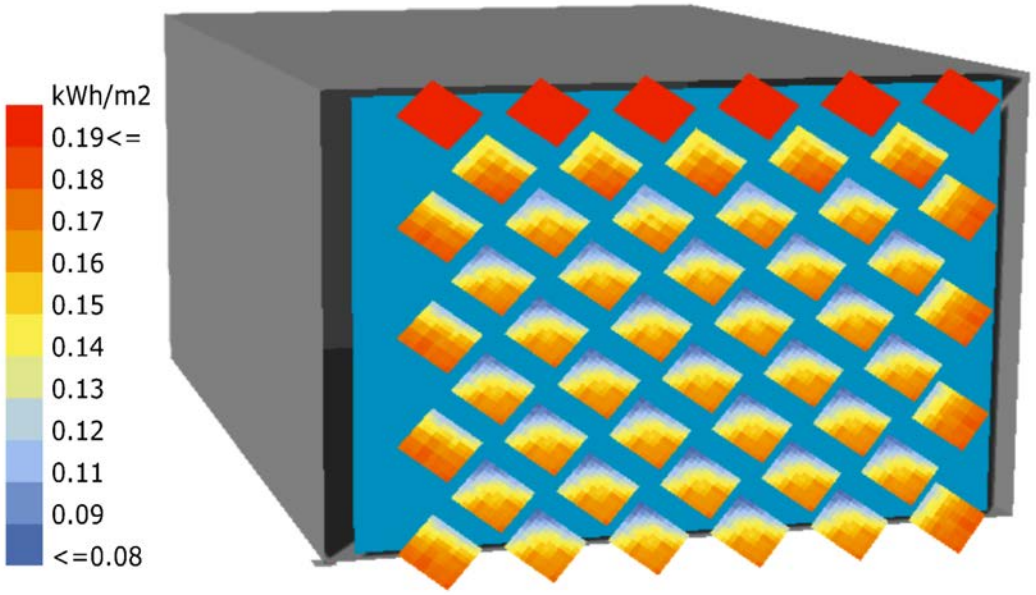
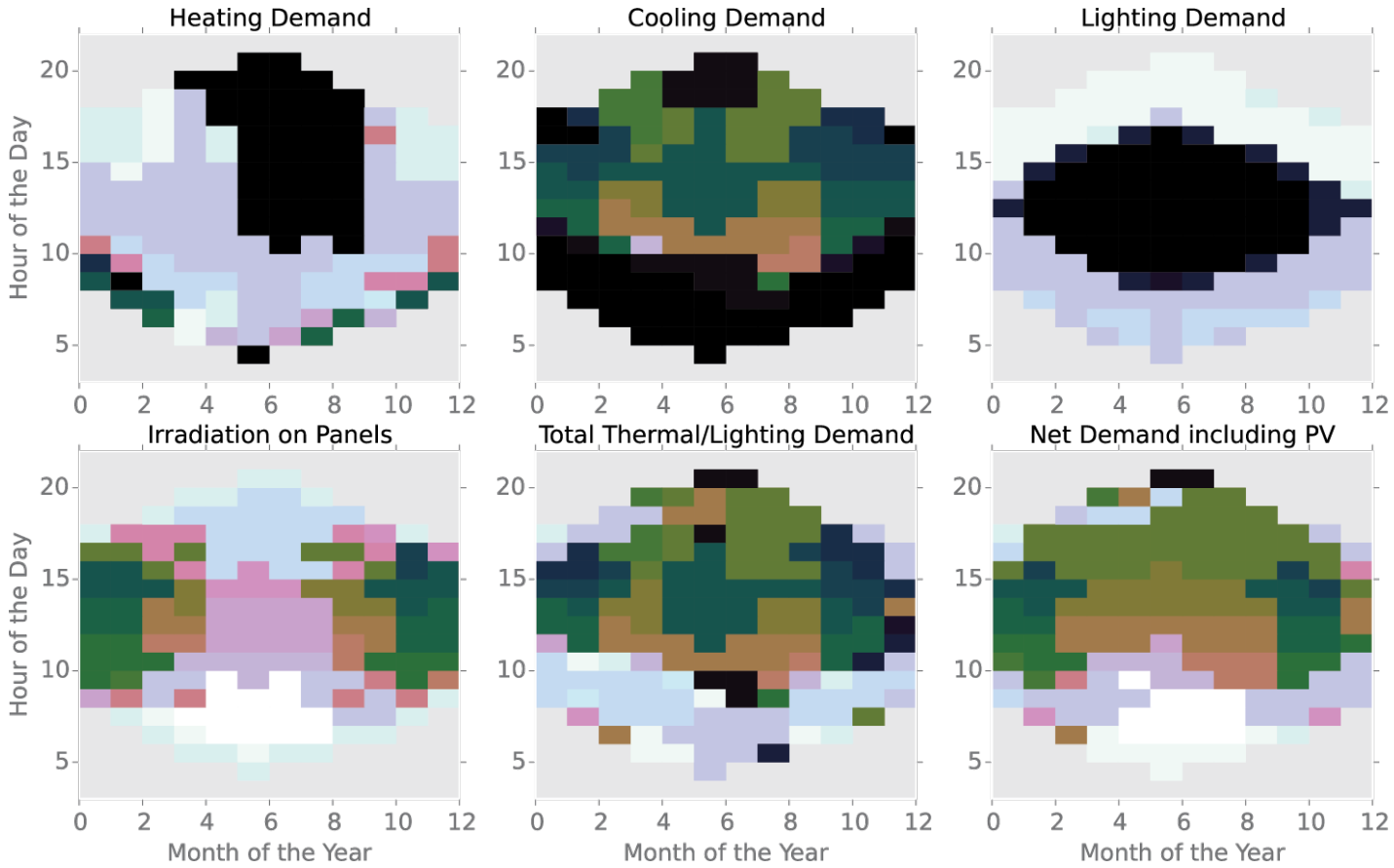
# Radiation on Panels

- Radiation Analysis with Ladybug
- Includes Self-Shading




Insolation from 11:00-12:00 on June 16

# Optimum Orientation of Panels

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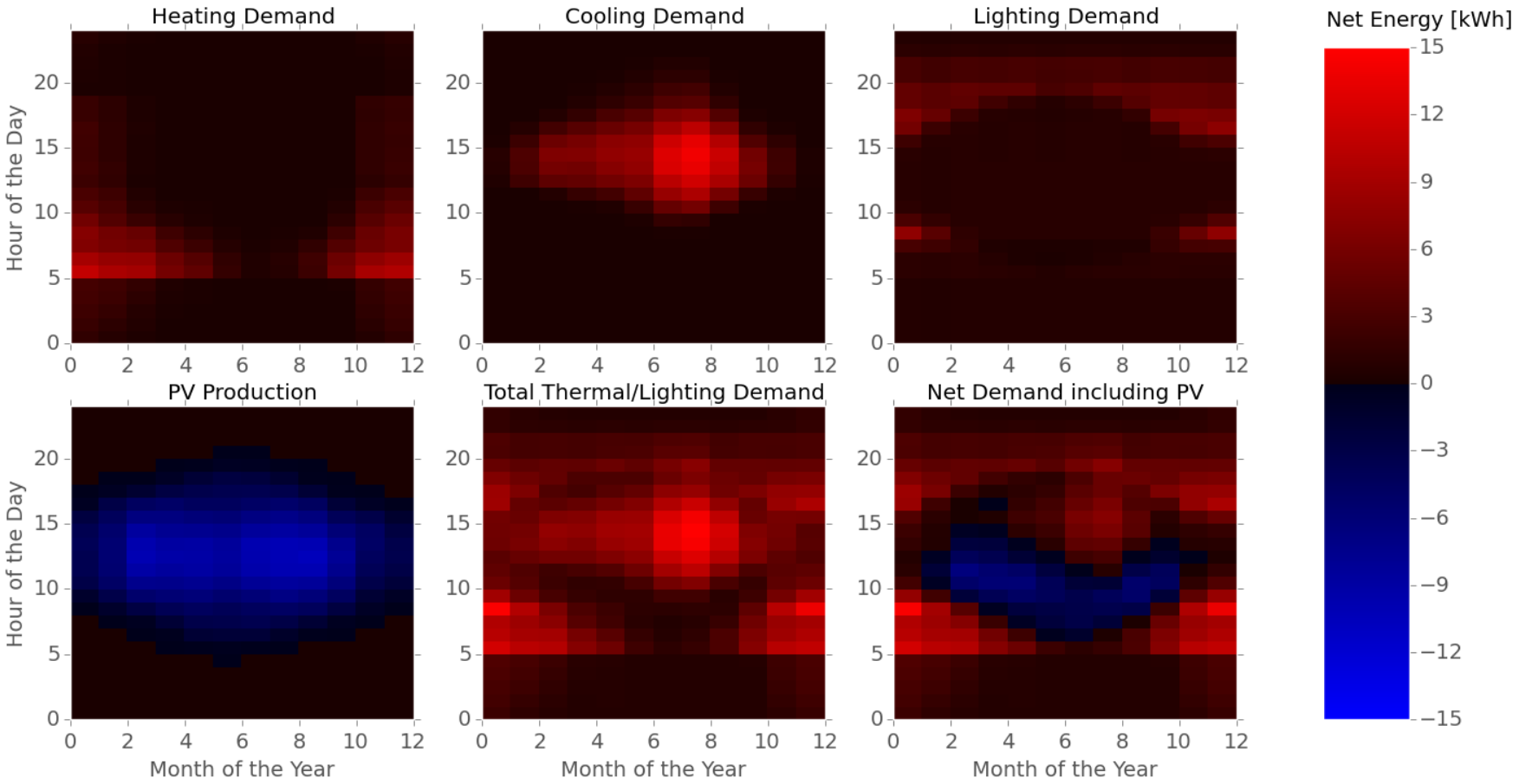
# Net Energy Demand at Optimum Orientation

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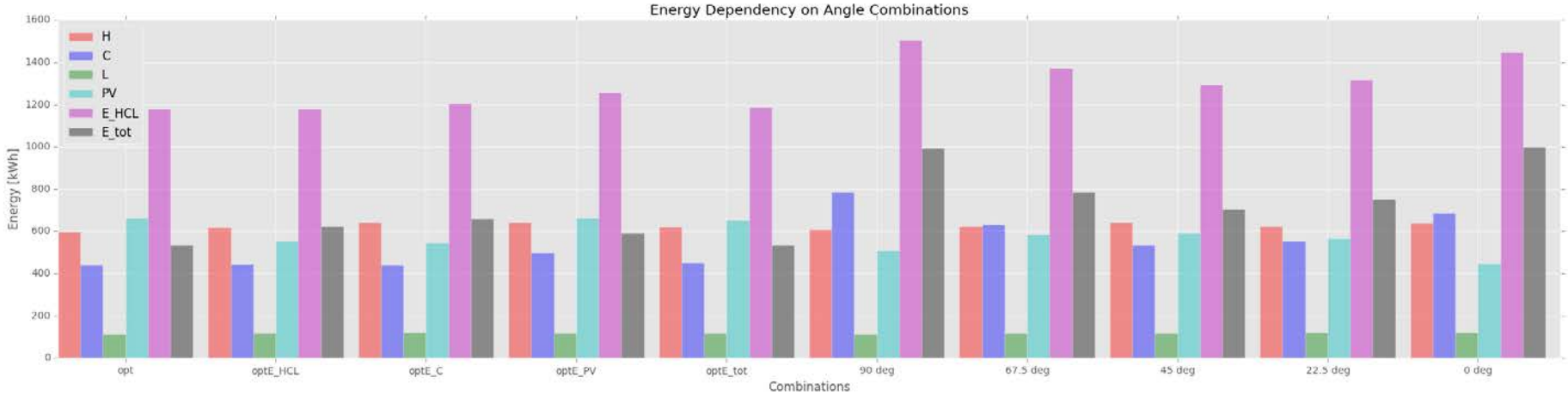
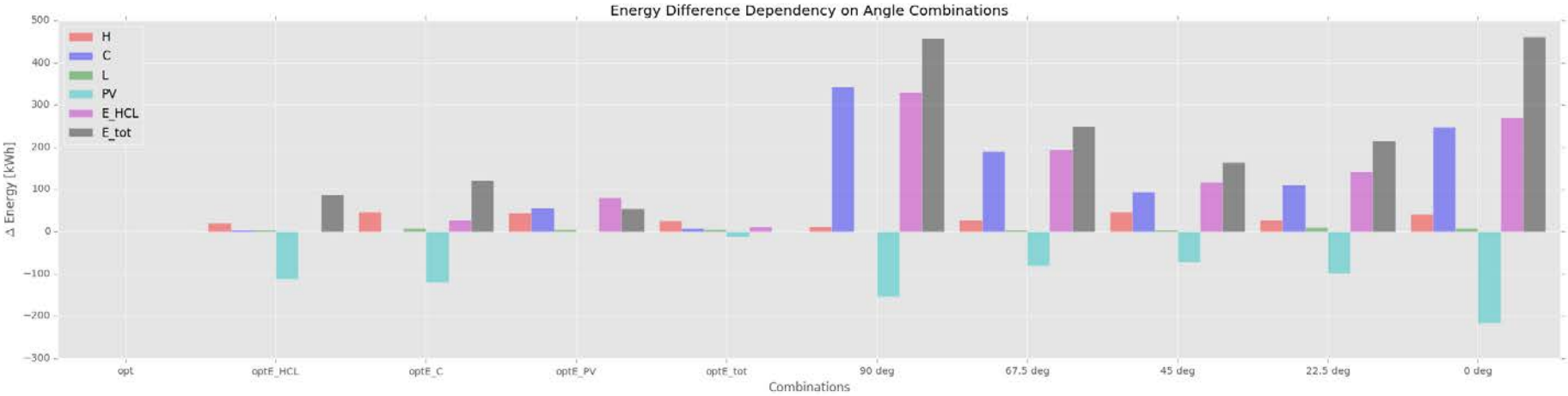
# Conclusions

- Developed Simulation Framework for the ASF
- Possibility to Include PV-Electricity Production
- Optimal Angles for Single Cluster Found

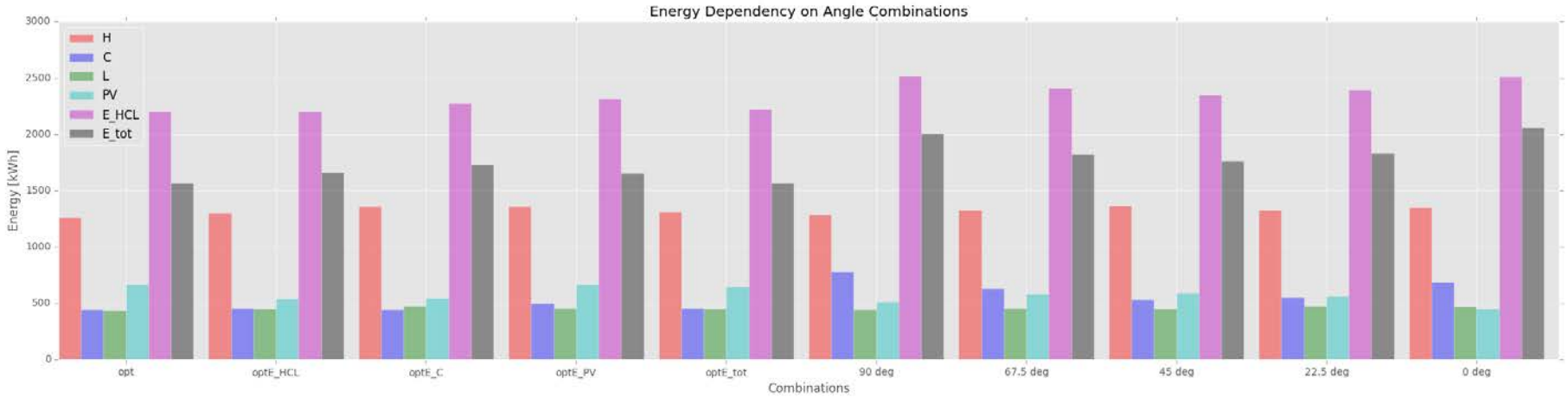
# Outlook

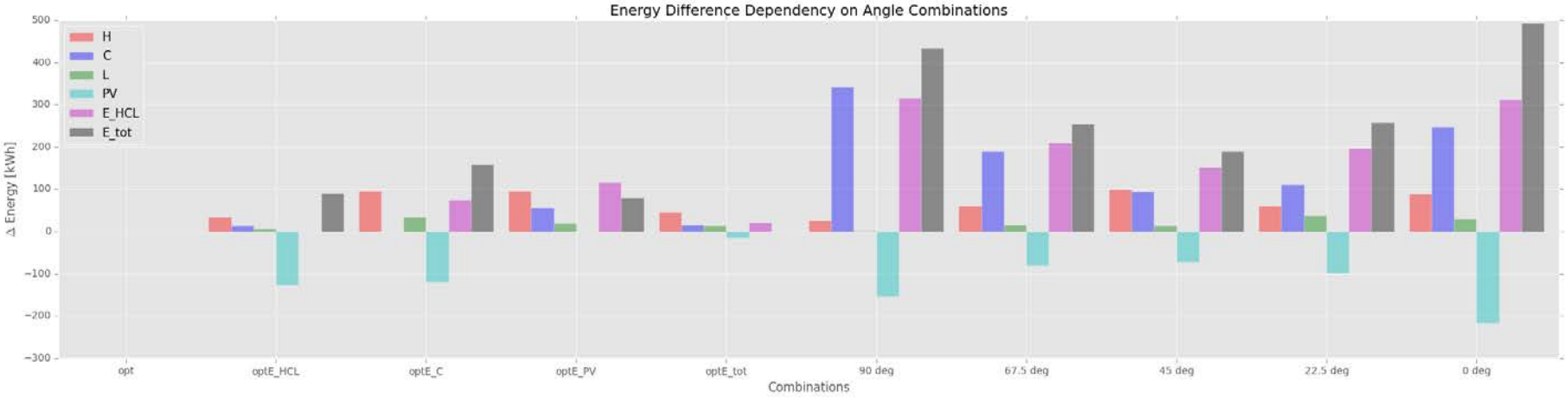
- Development of Building Energy Simulation Tool
- More In-Depth Analysis of PV-Electricity Production
- Include Energy-Use for Actuation in Simulation
- Use Multiple Clusters of PV-Panels



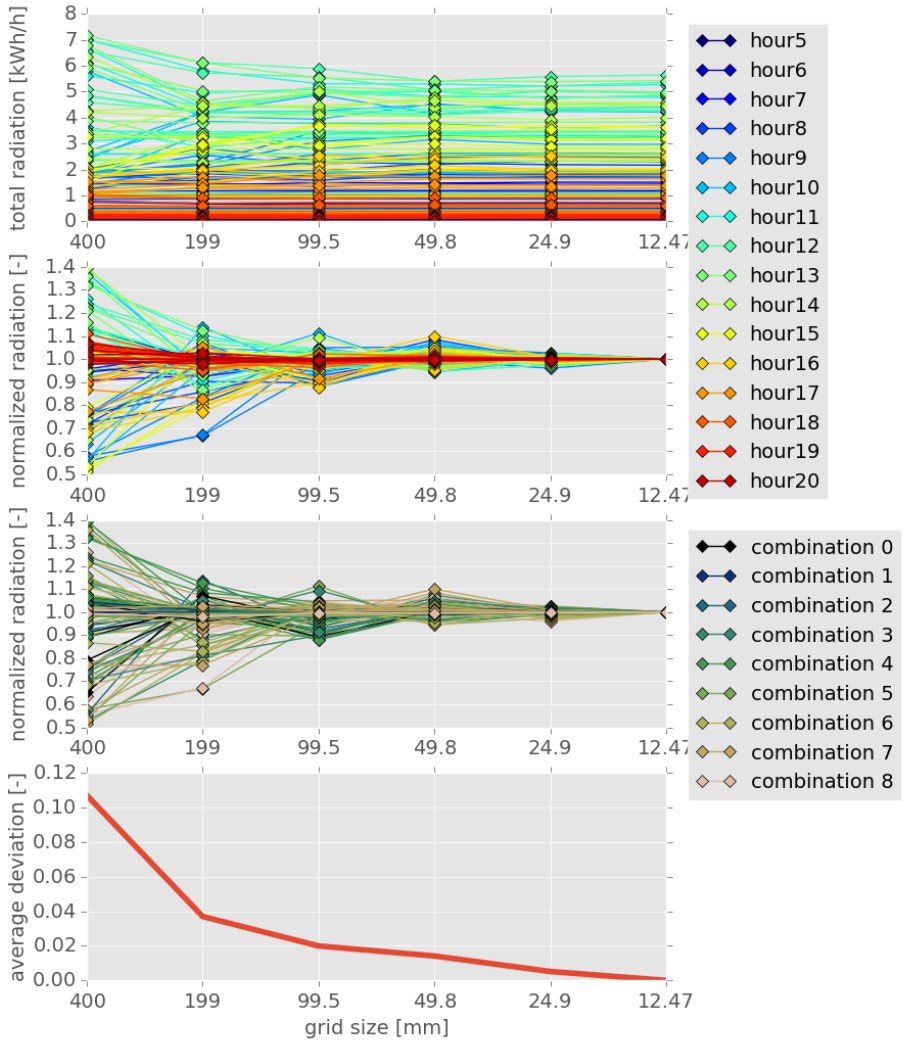

Heating COP = 3 Cooling COP = 3 Lighting = 3 W/m2 PV-efficiency = 0.072

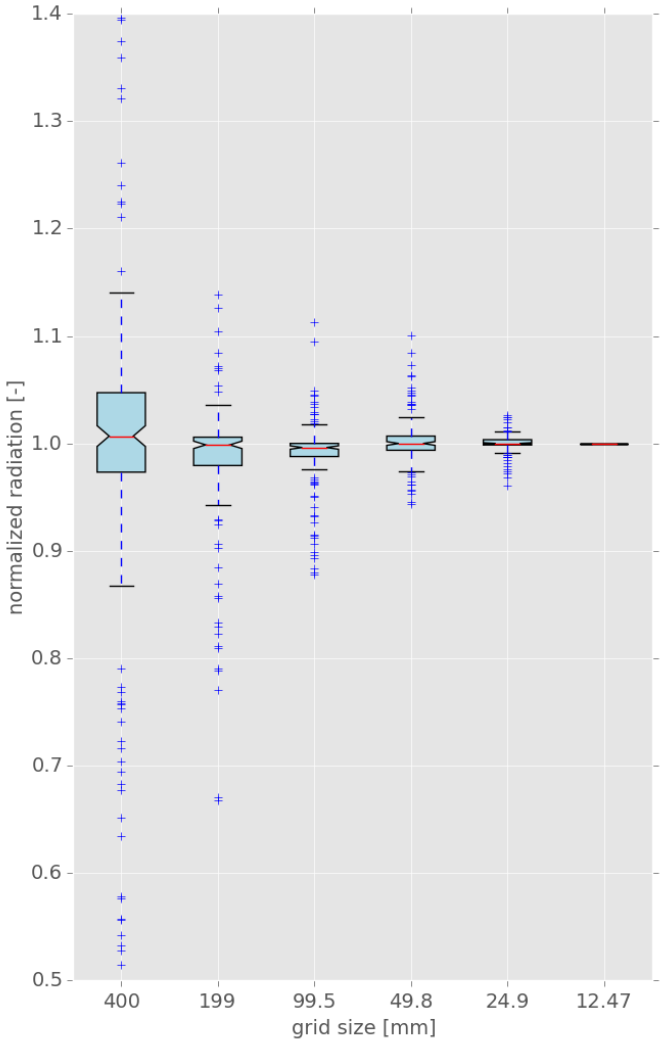


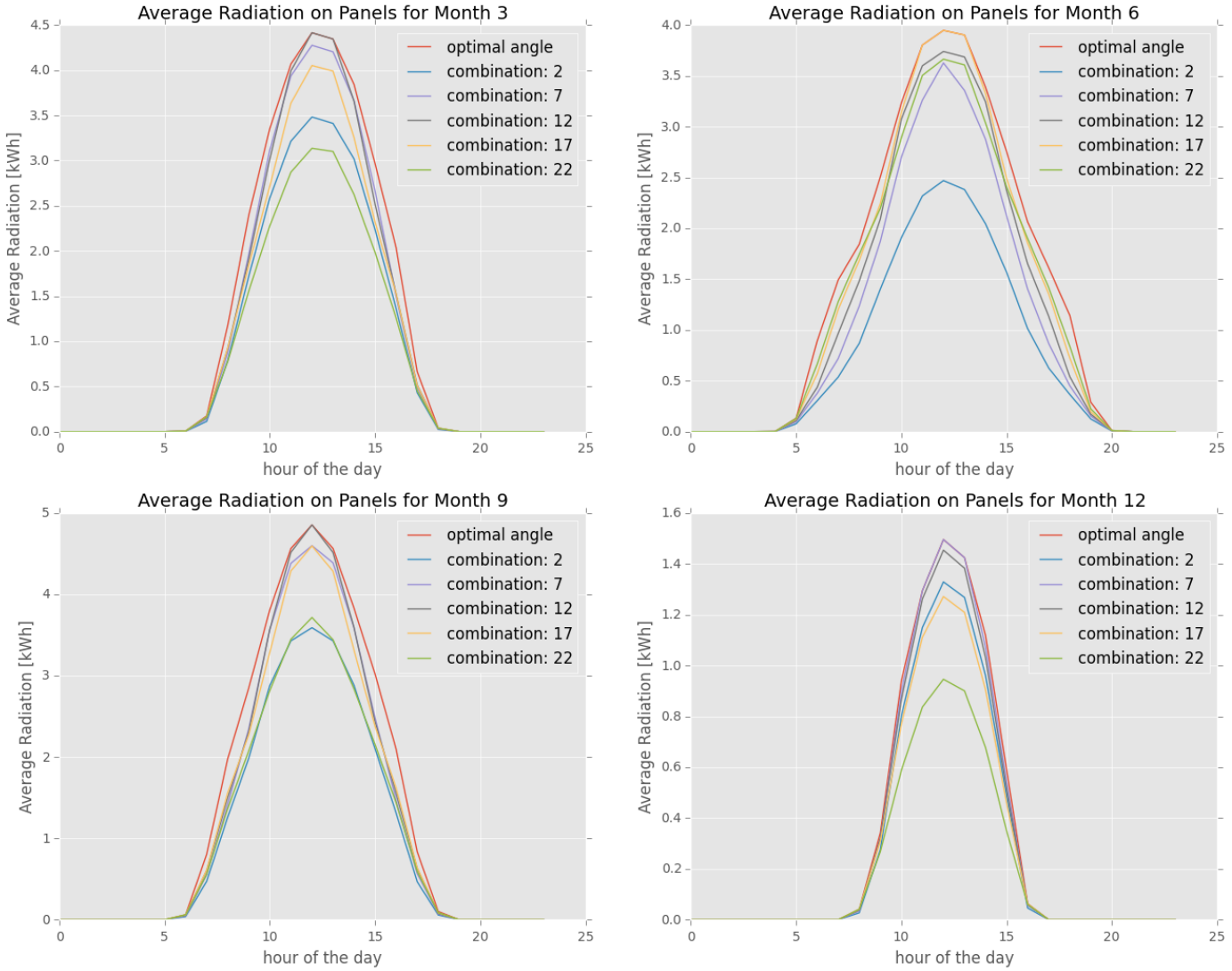

Heating COP = 0.85 Cooling COP = 3 Lighting = 11.74 W/m2 PV-efficiency = 0.072

Grid Convergence



Average Radiation on Panels



Total Radiation on Panels