

# SolOpt: A Novel Approach to Solar Rooftop Optimization



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**What type of solar system  
should be installed on a  
facility rooftop?**

# Solar Power System Objectives

Space utilization optimization function:

- Maximize net present value
- Maximize energy savings
- Minimize carbon footprint
- Minimize payback period
- Minimize levelized cost of energy



*Image NREL PIX Library #14164*

# Technologies Considered

## Photovoltaic (PV)



Takes building information, electrical usage, electrical rates, weather data files, and runs hourly production and financial calculation

## Solar Hot Water (SHW)



Takes building information, domestic hot water system, fuel costs, weather data files and runs hourly production and financial calculation

**Finds the best mix of the two technologies**

100% PV



100% SHW

**Area allocation for each technology**

# Unique SolOpt Attributes

## Auto sizing features

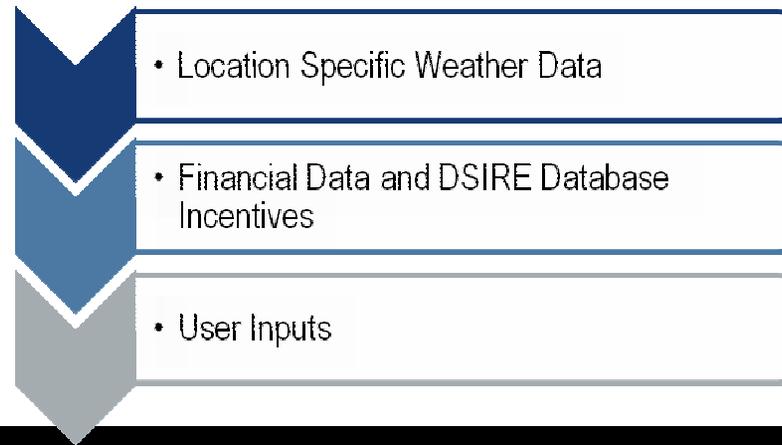
- Panel Spacing
- Pump sizes
- Pipe sizes
- Tank Size
- Flow rates



## Usability features

- Reduced number of inputs
- Built-in building specific hot water draw profiles and hot water usage
- PV/SHW system interaction plots
- Can run an analysis with limited building/system information
- Capability to input more advanced inputs

# Calculation Methodology

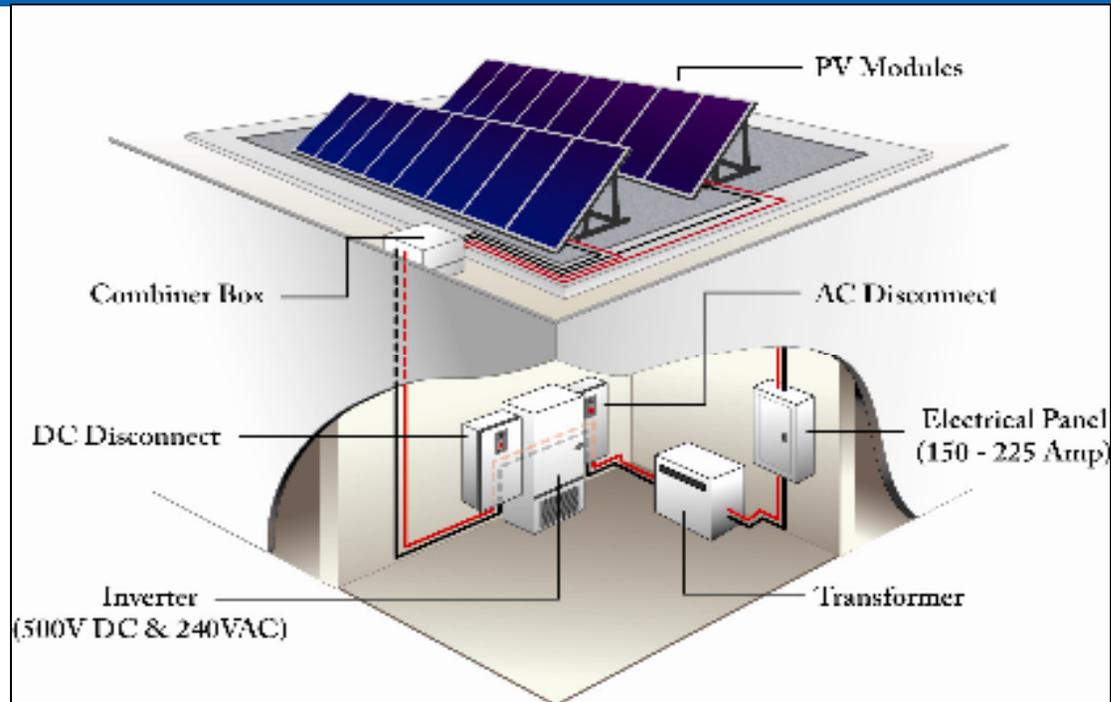


## Hourly Production Calculation

### Outputs

- System Size (SHW & PV)
  - System Production
  - Cost Savings
  - Net Present Value
  - Simple Payback
  - Discounted Payback
  - Savings to Investment Ratio
  - Internal Rate of Return
  - System Area Requirement
  - Greenhouse Gas Reduction
- Plots:
- Net Present Value
  - Discounted Payback
  - Energy Production
  - CO<sub>2</sub> Reduction
  - LCOE
  - SHW Energy
  - PV Energy

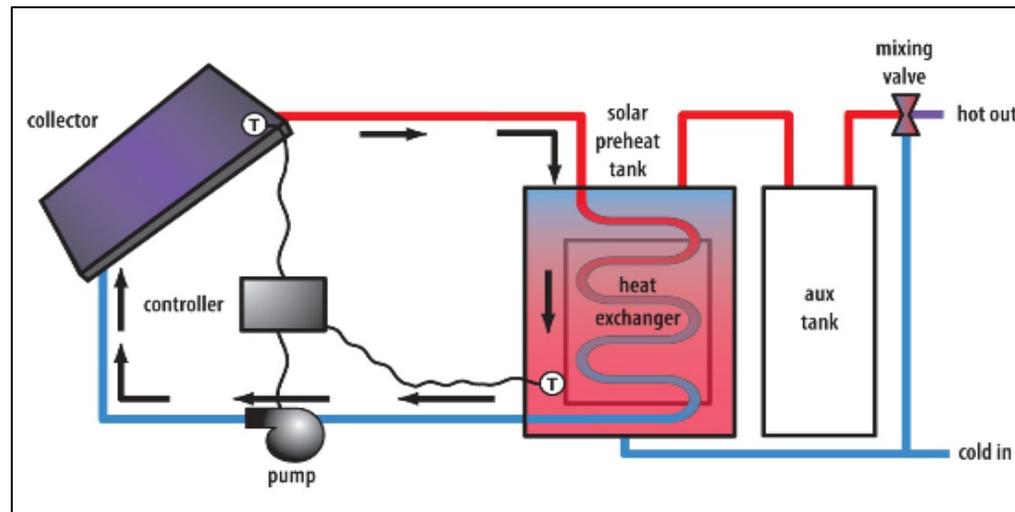
# PV Calculation



Simplified efficiency model, hourly simulation

- Select from database of commercially available panels
- Inverter efficiency curve
- Takes into account row spacing due to shadow effects
- Considers all optical effects including ground reflection surface
- System capital cost regression based on cost database

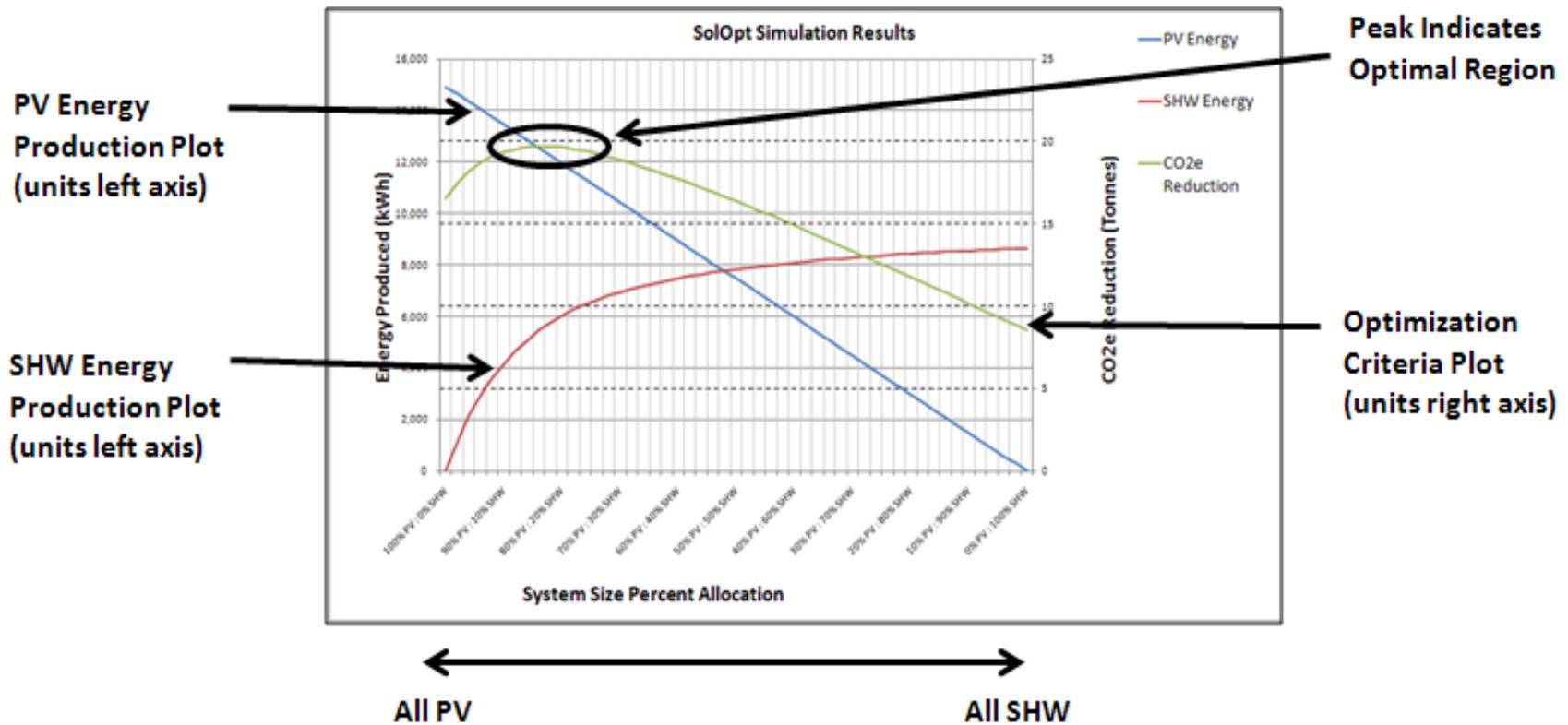
# SHW Calculation



## Implicit iterative calculation method, hourly simulation

- Modified plug flow tank temperature calculation
- User-specified panel characteristics
- Hourly heat exchanger effectiveness calculation
- Existing system efficiency calculation
- DHW draw profiles and hot water usage calculation for 10 building types
- Hourly mains temperature calculation
- Pipe loss calculation
- System capital cost regression based on cost database

# Optimization Methodology



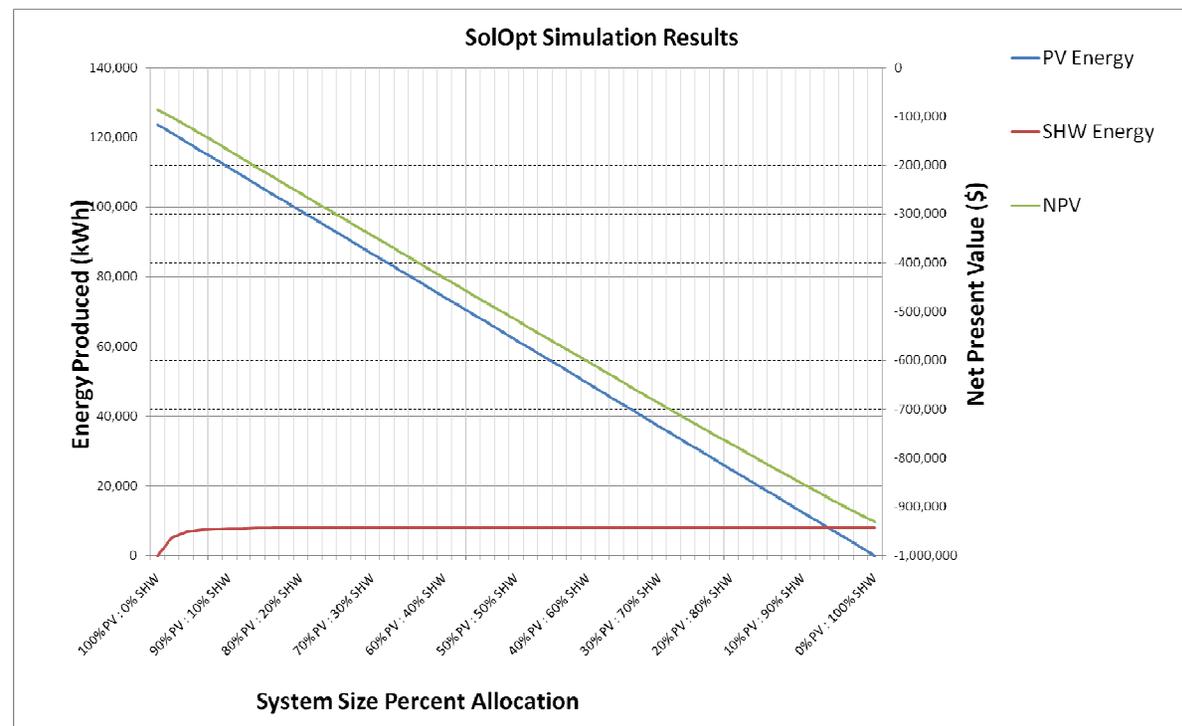
# Case Study 1: City of Denver

## Background

- 118 Buildings
- Building Types Include
  - Recreation Center
  - Fire Stations
  - Office Buildings
  - Police Stations
  - Prisons
  - Warehouses
  - Libraries
- Optimization Criteria
  - Maximize NPV

## Summary of Results

- 8.9 MW of PV and 14,000 ft<sup>2</sup> SHW
- LCOE of \$0.09 and 9,000 tons of GHG reduction



Office Building (15,000 ft<sup>2</sup> facility, 9,000 ft<sup>2</sup> roof)

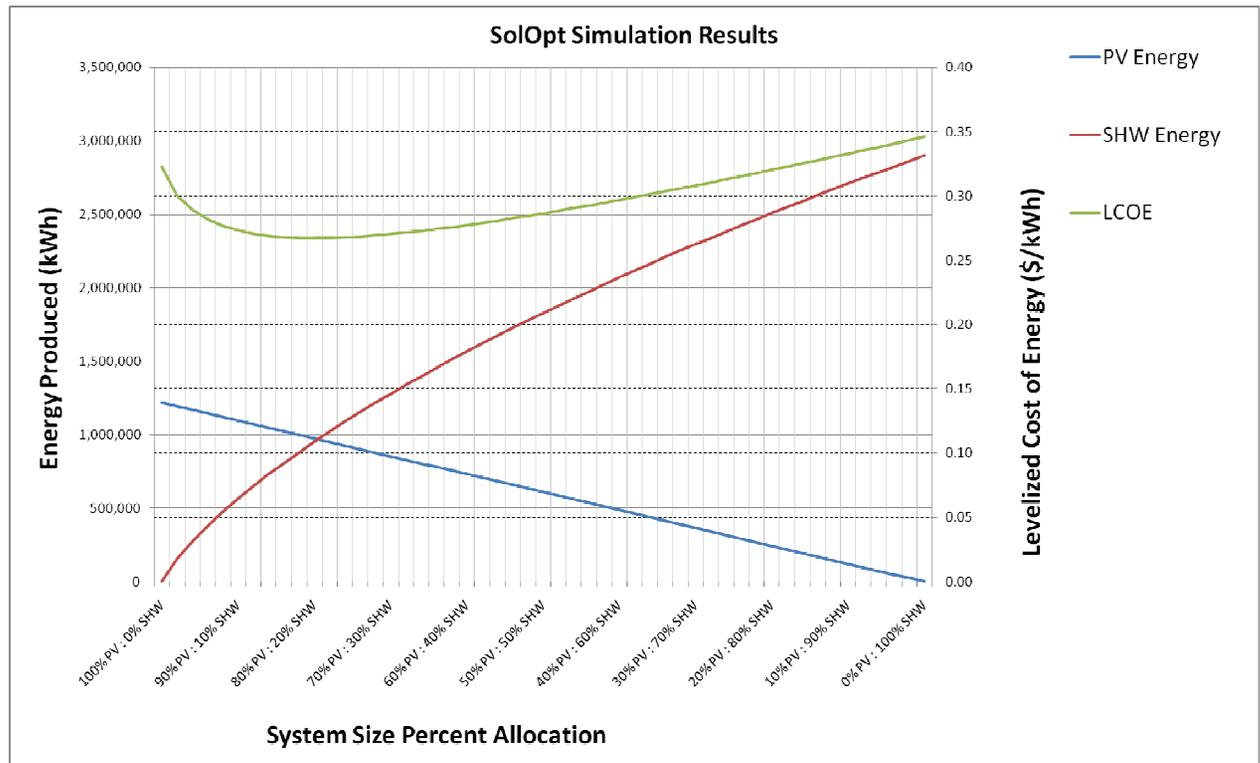
# Case Study 2: Manufacturing Plant, Idaho

## Background

- 250,000 ft<sup>2</sup> Plant
- Building
  - High hot water loads
  - High electrical loads
  - Large open roof area 116,800 ft<sup>2</sup>
  - Very low energy prices
  - No state incentives
- Optimization Criteria
  - Minimize LCOE

## Summary of Results

- Recommended system
  - 80% PV
  - 20% SHW
- LCOE of \$0.27



# SolOpt Download Instructions



SolOpt is freely available at the following website:

<http://solaramericacommunities.energy.gov/resources/publications/>

# SolOpt Contacts

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