Modeling of Performance, Cost, and Financing of Concentrating Solar, Photovoltaic, and Solar Heat Systems

INTRODUCTION

The Department of Energy (DOE) Solar Program has adopted a "systems driven approach" (SDA) to program planning across all solar technologies. This approach has several advantages including a clear connection between market requirements and R&D activities, a consistent approach and metrics across technologies, consistent assumptions for cross-technology comparisons, and data and metrics that provide a credible story about R&D efforts. NREL has spent the past few years working on a tool to enable and enforce the SDA.

SOLAR ADVISOR MODEL CONCEPT

- Combine all solar technologies in one modeling environment
  - concentrating solar power (CSP)
  - photovoltaics (PV)
  - solar heating (primarily solar residential hot water)
  - solar hybrid lighting
- Model performance, costs, and financing consistently across technologies for appropriate comparisons.
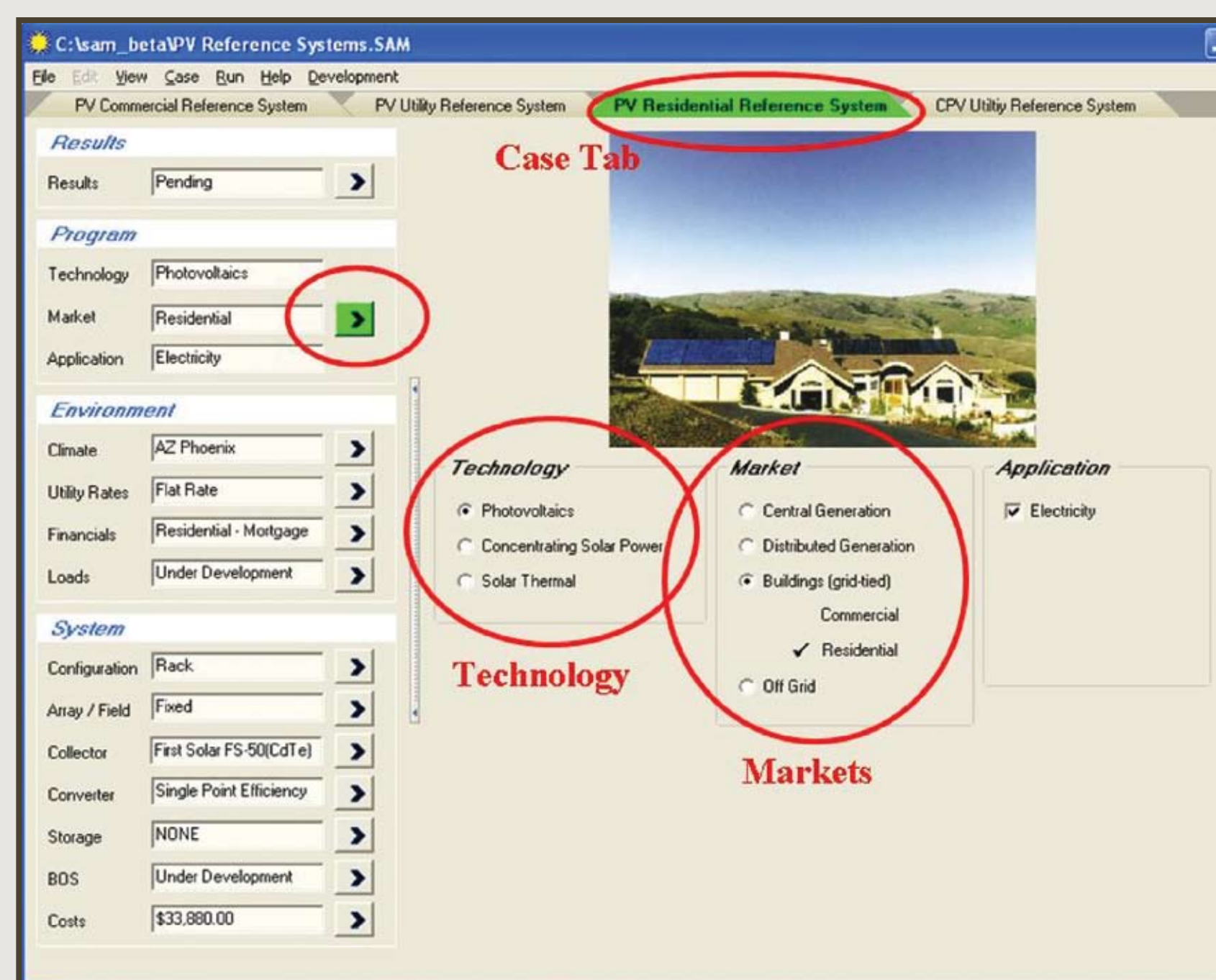
- Calculate impact of technology improvements on LCOE, NPV, etc. in various markets.
- Provide extensive sensitivity analysis and output/ plotting capabilities
- Do not reinvent the wheel (existing models when possible)
- Potentially become a robust simulation tool that industry will use but as a secondary goal.

PERFORMANCE MODELS

TRaNsient SYstem Simulation Program (TRNSYS) Engine for all technologies
- Existing content for all technologies
- Large user community

Photovoltaics
- King Database Performance Map Model
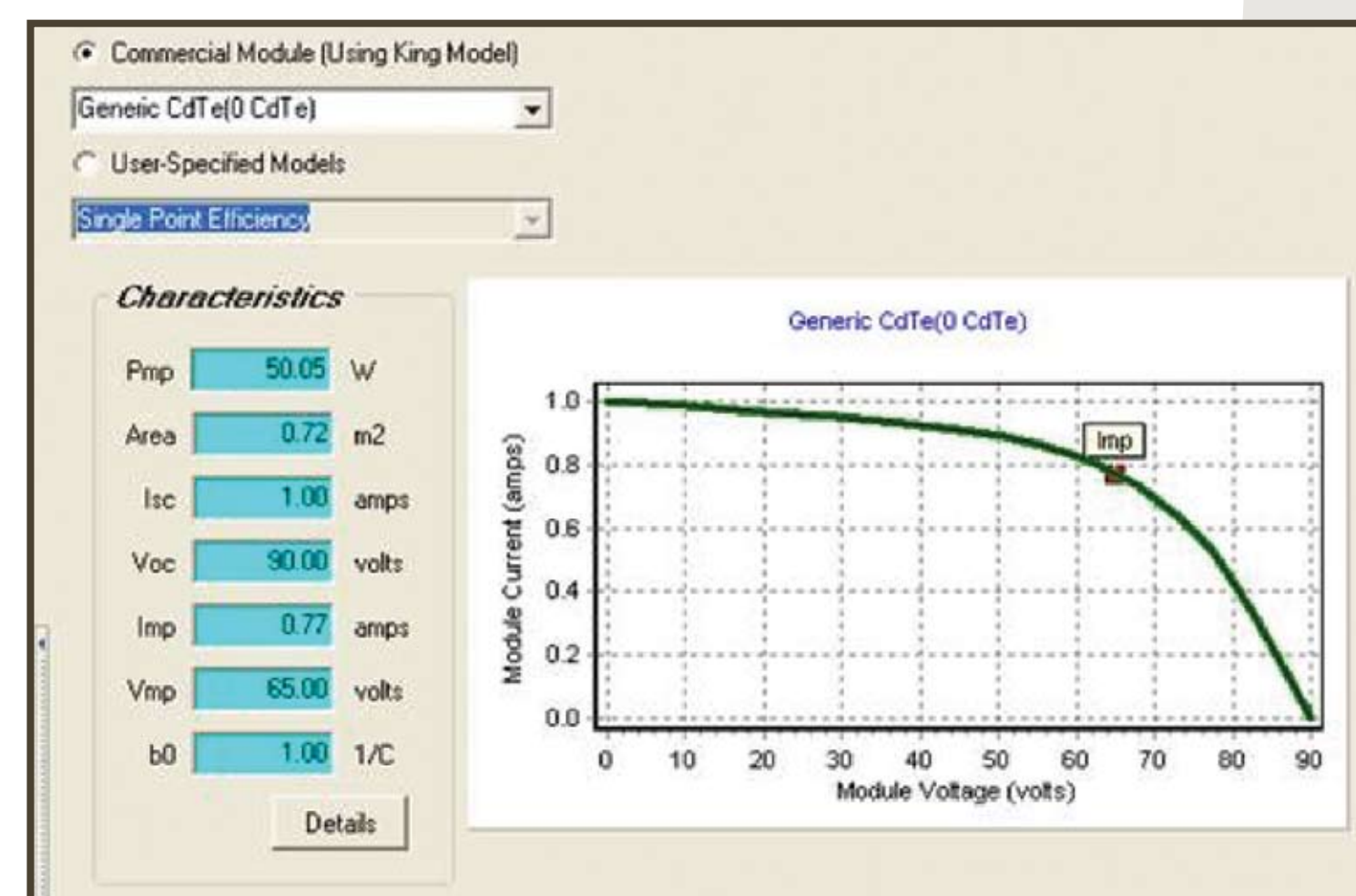- Simple Single-Pt Efficiency with Temp. Correction

Concentrating Solar Power
- SolarPaces library
- Developing new power-plant models with UW-SEL

Active Solar
- Using existing, validated models and systems

Outputs
- Annual Energy Output
- Energy Output by Hour

PROJECT FINANCING OPTIONS

- Based on an existing, validated NREL finance tool
- Based on a detailed cash-flow model
- Output
  - LCOE, NPV, IRR, revenue, taxes, etc.
- Residential
  - Cash, loan, or mortgage
- Commercial
  - Cash or loan
- Utility Scale
  - IPP or utility

OUTPUTS AND APPLICATIONS

- Financial outputs include levelized cost of energy, net present value of the project, rate of return
- Performance outputs include solar efficiency, annual total output, hourly output, and value
- Cost outputs include the detailed yearly cash flows
- Solar Advisor is currently used to provide analysis support to the DOE Solar Program Multiyear Planning Process
- Applicants for the DOE's Solar Advanced Initiative (worth $140 million) need to use Solar Advisor to quantify their R&D impacts on the total system cost of energy.
- Future improvements will broaden the uses and the user groups for Solar Advisor across all technologies.
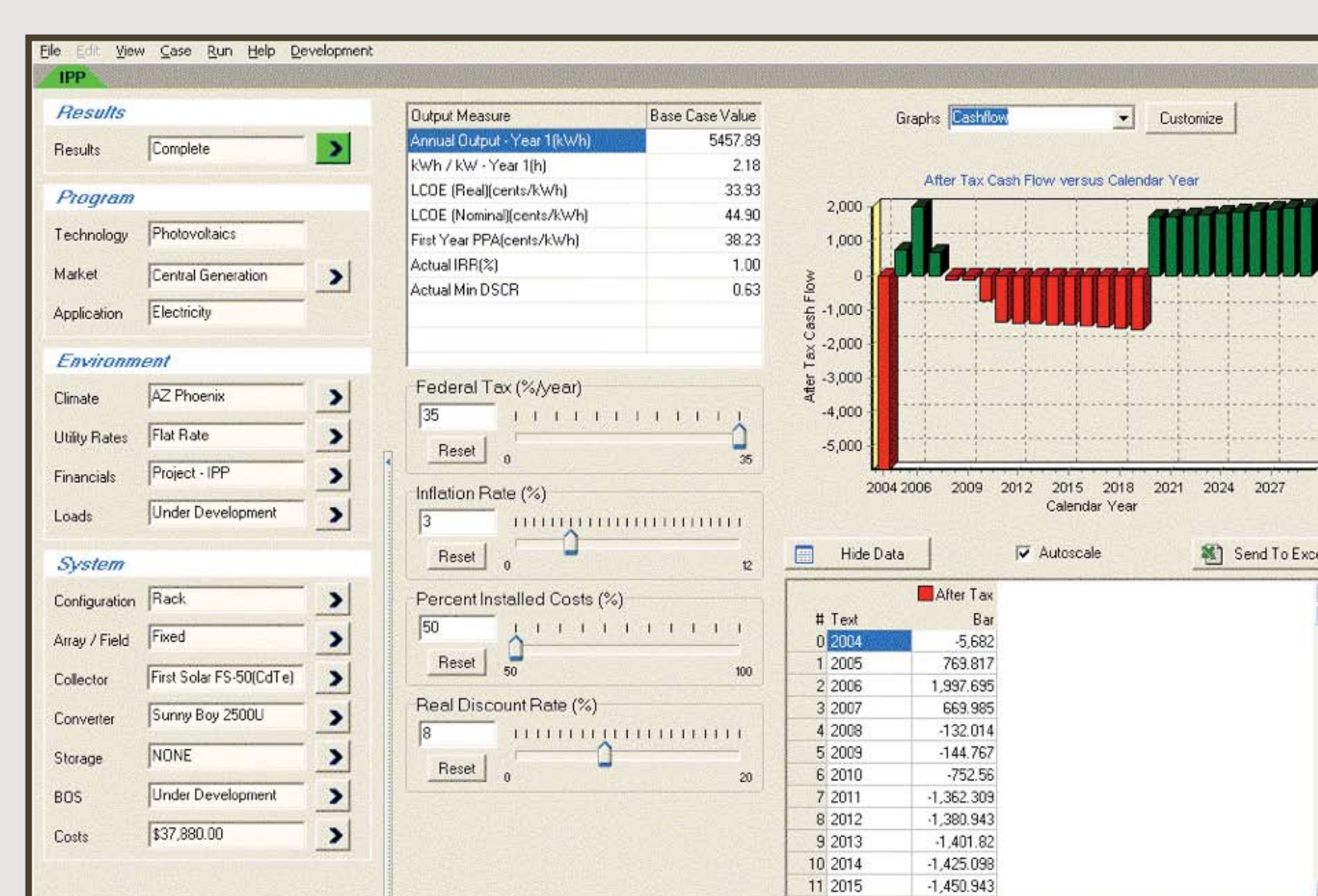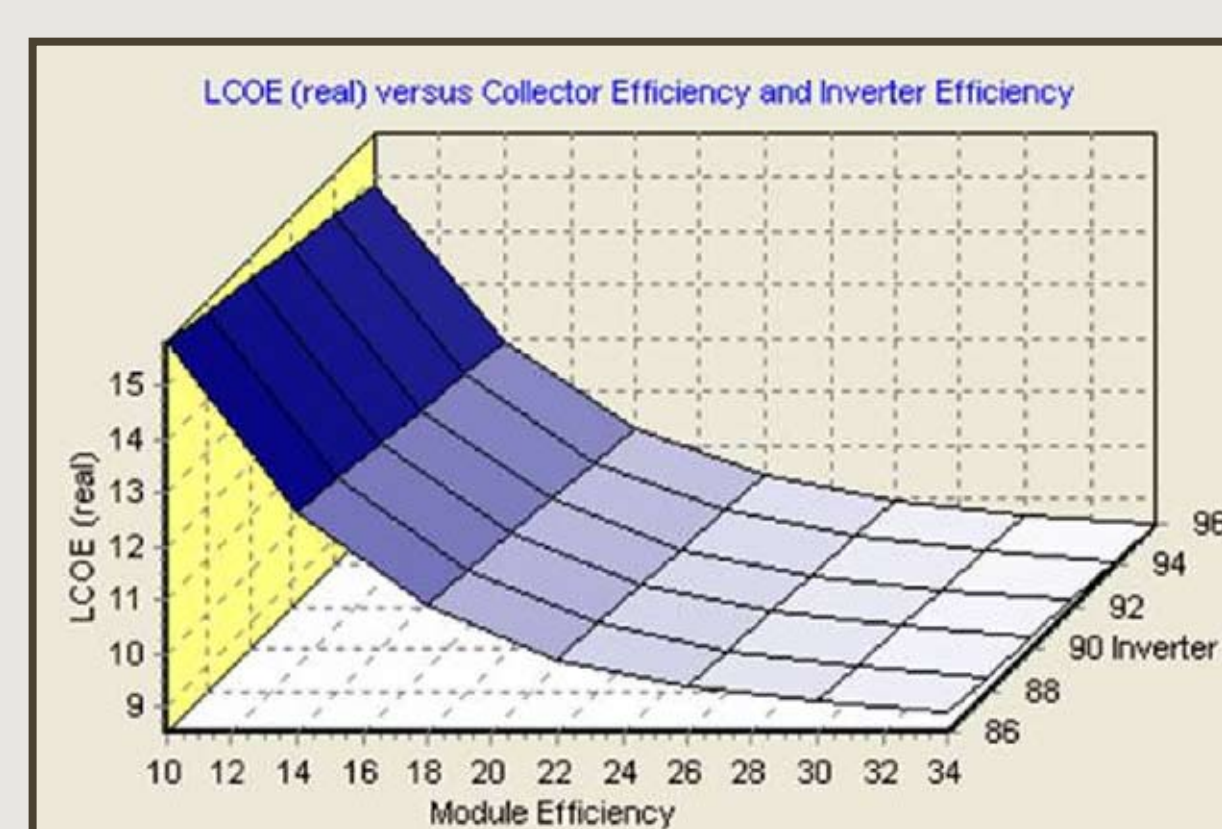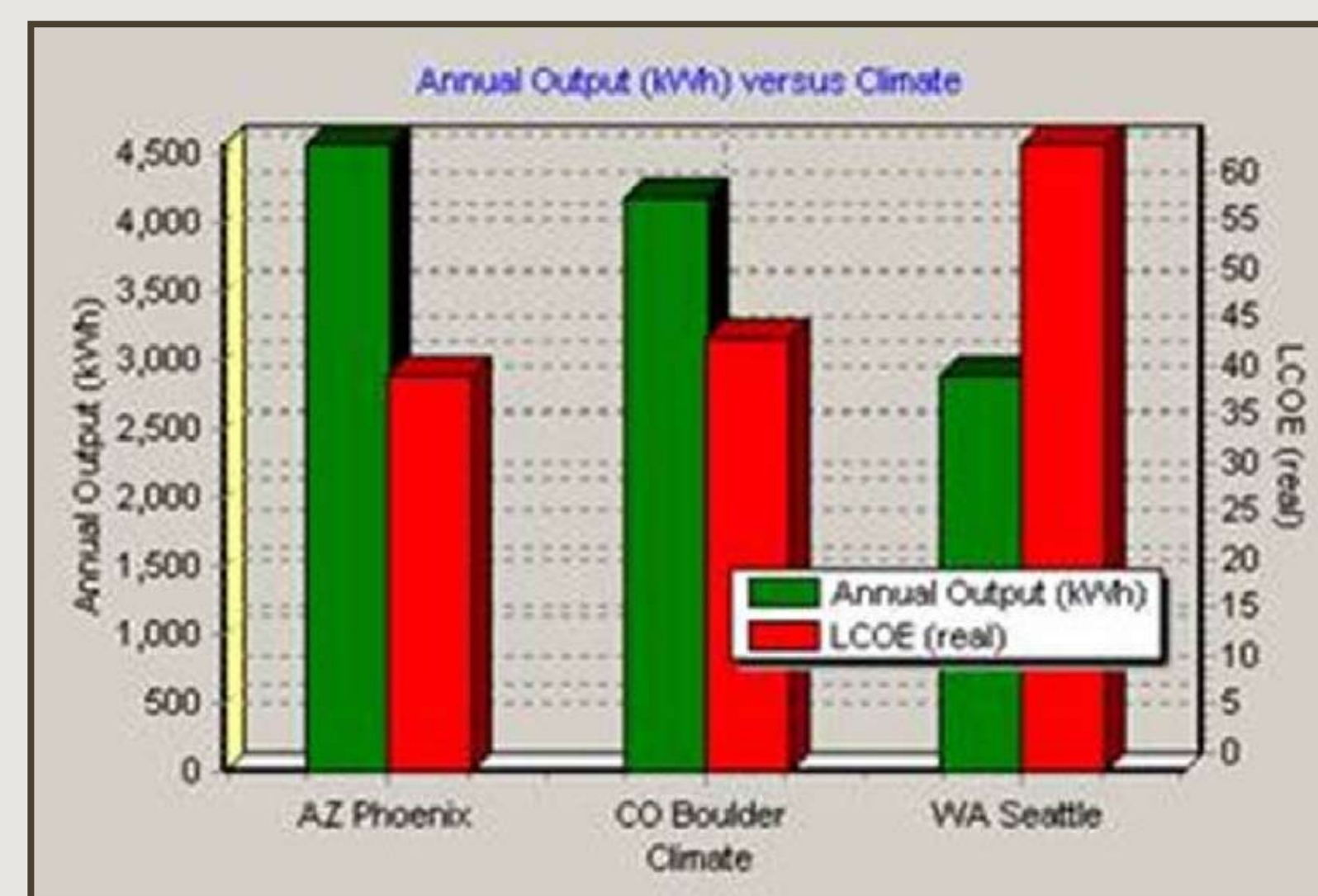
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