Solar Advisor Model
Financial Impact Analysis for Utility Solar

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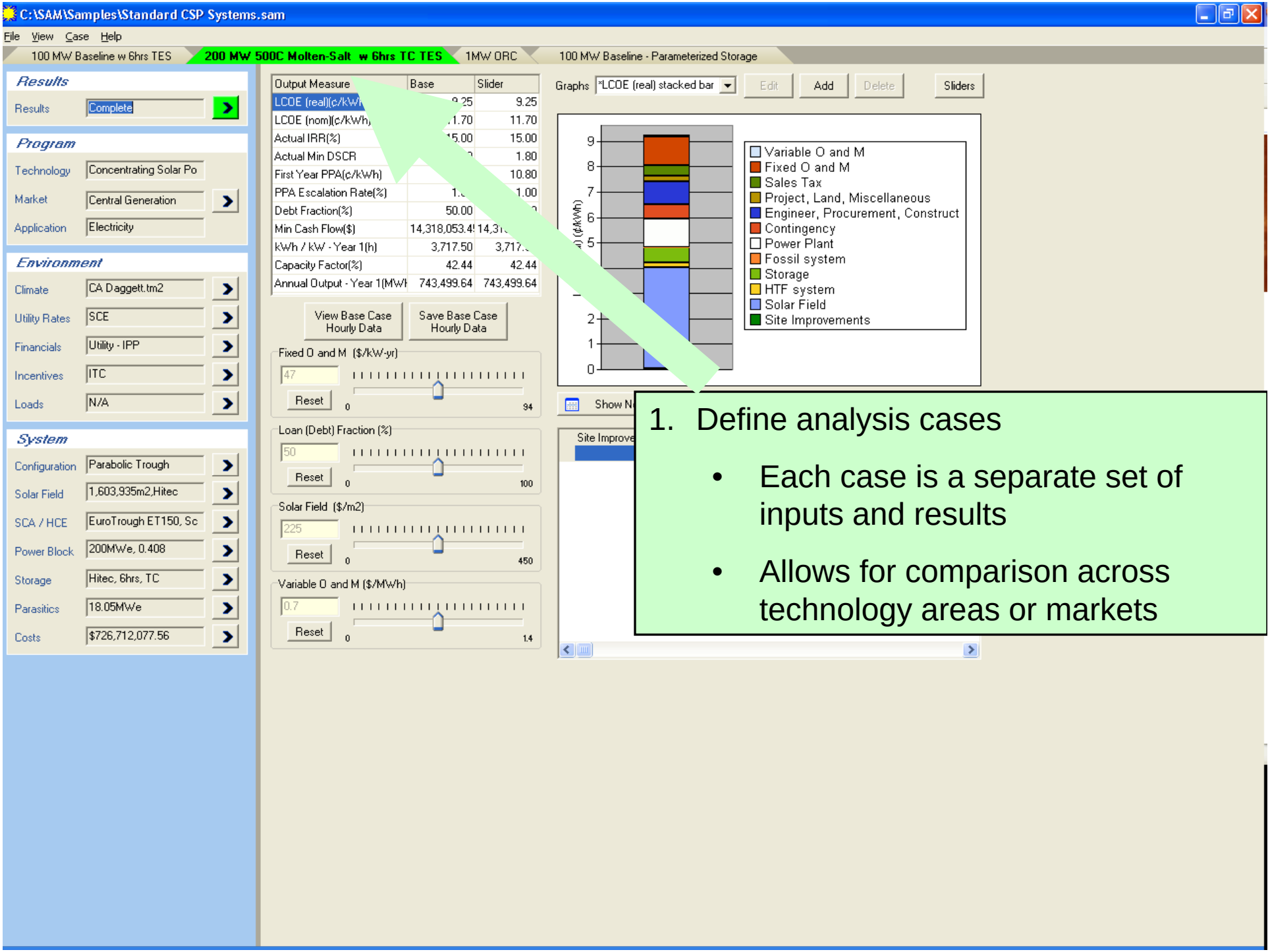
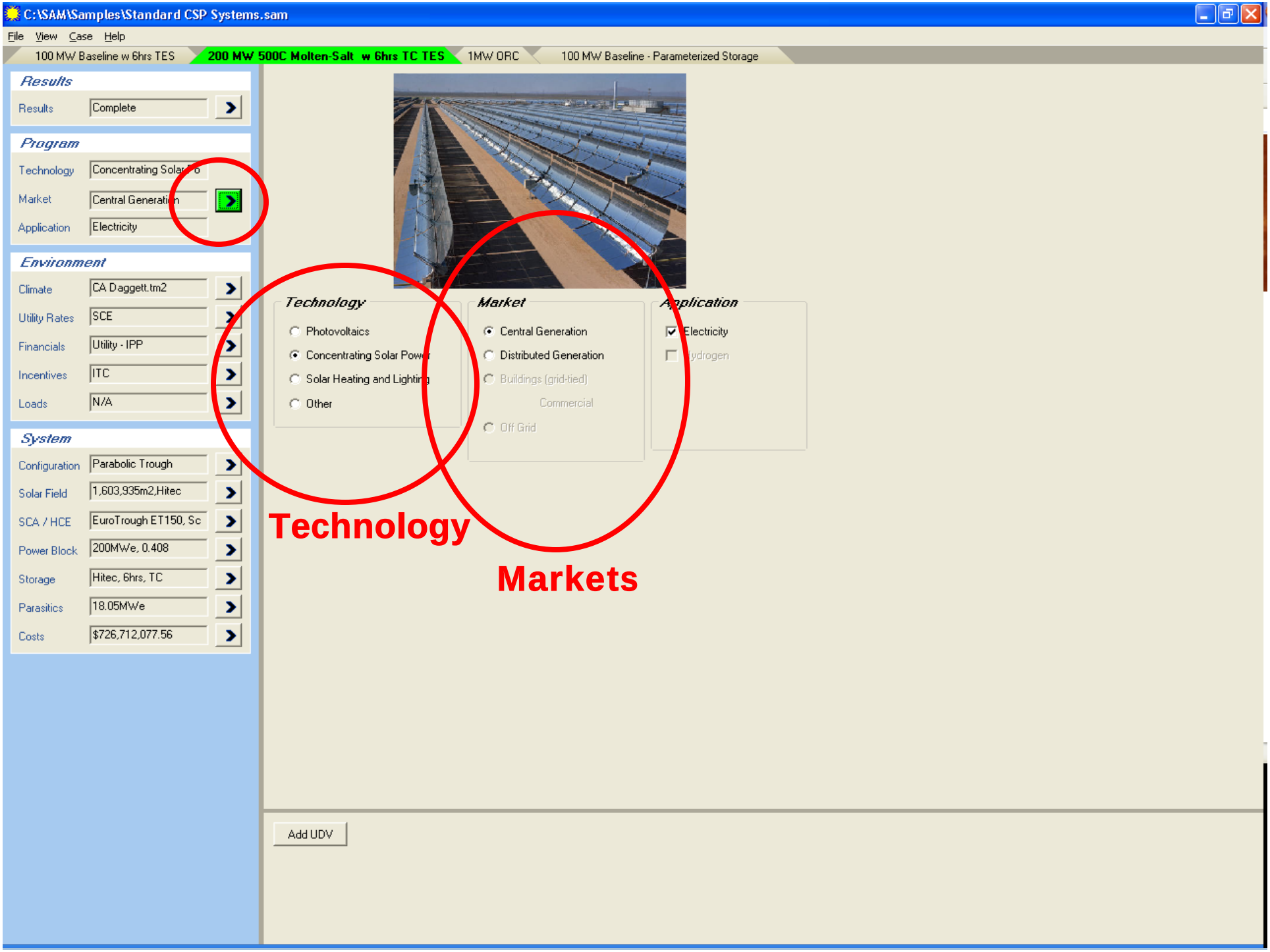
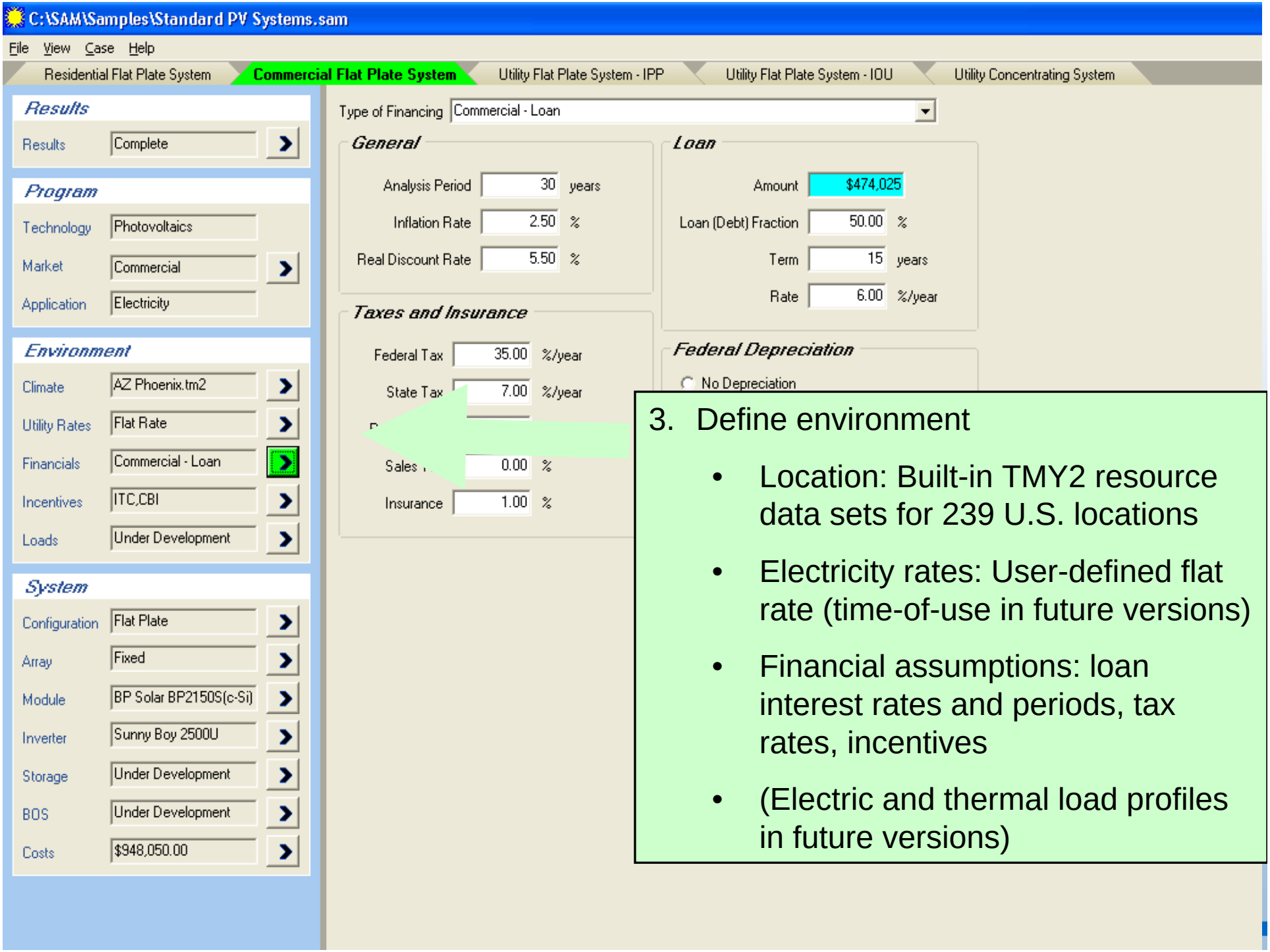
SAM (Solar Advisor Model) Concept

- Combine all solar technologies in one modeling environment
  - **concentrating solar power (CSP)**
  - **photovoltaics (PV)**
  - **solar heating (primarily solar residential hot water) [on hold currently]**
  - **solar hybrid lighting [on hold currently]**
- Model performance, costs and financing consistently across technologies for appropriate comparisons.
- Calculate impact of technology improvements on LCOE, NPV, etc. in various markets.
- Extensive sensitivity analysis and output/ plotting capabilities
- Do not reinvent the wheel (existing models when possible)
- Originally for DOE/lab analyst user base for Multi-year planning
- Now, visioning additionally as a robust simulation tool that industry will use and they (especially CSP) are starting to.

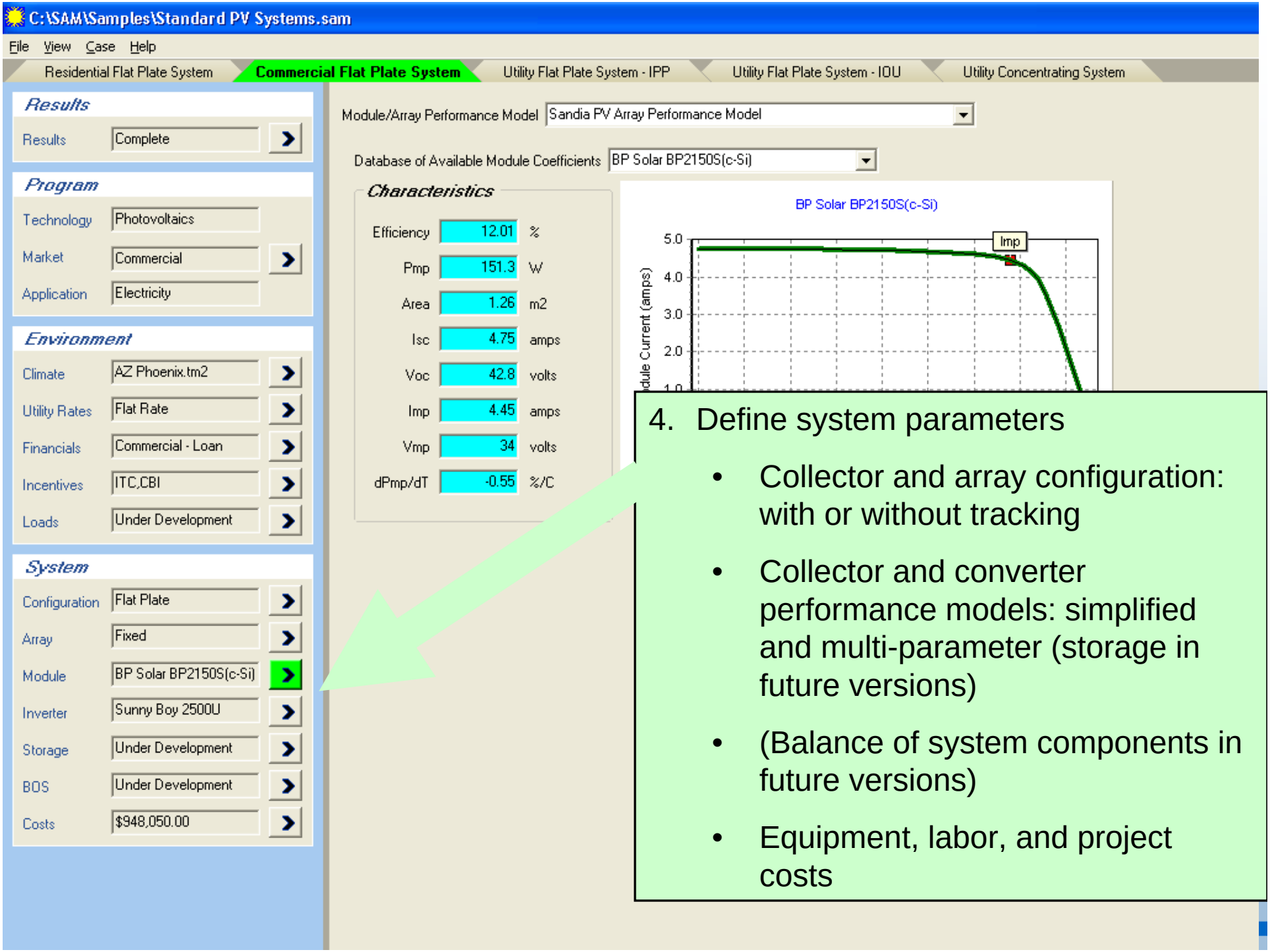


1. Define analysis cases
   - Each case is a separate set of inputs and results
   - Allows for comparison across technology areas or markets


C:\SAM\Samples\Standard CSP Systems.sam
File View Case Help
100 MW Baseline w 6hrs TES
200 MW 500C Molten-Salt w 6hrs TC TES
1MW ORC
100 MW Baseline - Parameterized Storage
Results
Results Complete
Program
Technology Concentrating Solar Po
Market Central Generation
Application Electricity
Environment
Climate CA Daggett.tm2
Utility Rates SCE
Financials Utility - IPP
Incentives ITC
Loads N/A
System
Configuration Parabolic Trough
Solar Field 1,603,935m2,Hitec
SCA / HCE EuroTrough ET150, Sc
Power Block 200MWe, 0.408
Storage Hitec, 6hrs, TC
Parasitics 18.05MWe
Costs $726,712,077.56
Technology
Photovoltaics
Concentrating Solar Power
Solar Heating and Lighting
Other
Market
Central Generation
Distributed Generation
Buildings (grid-tied)
Commercial
Off Grid
Application
Electricity
Hydrogen
Technology
Markets
Add UDV



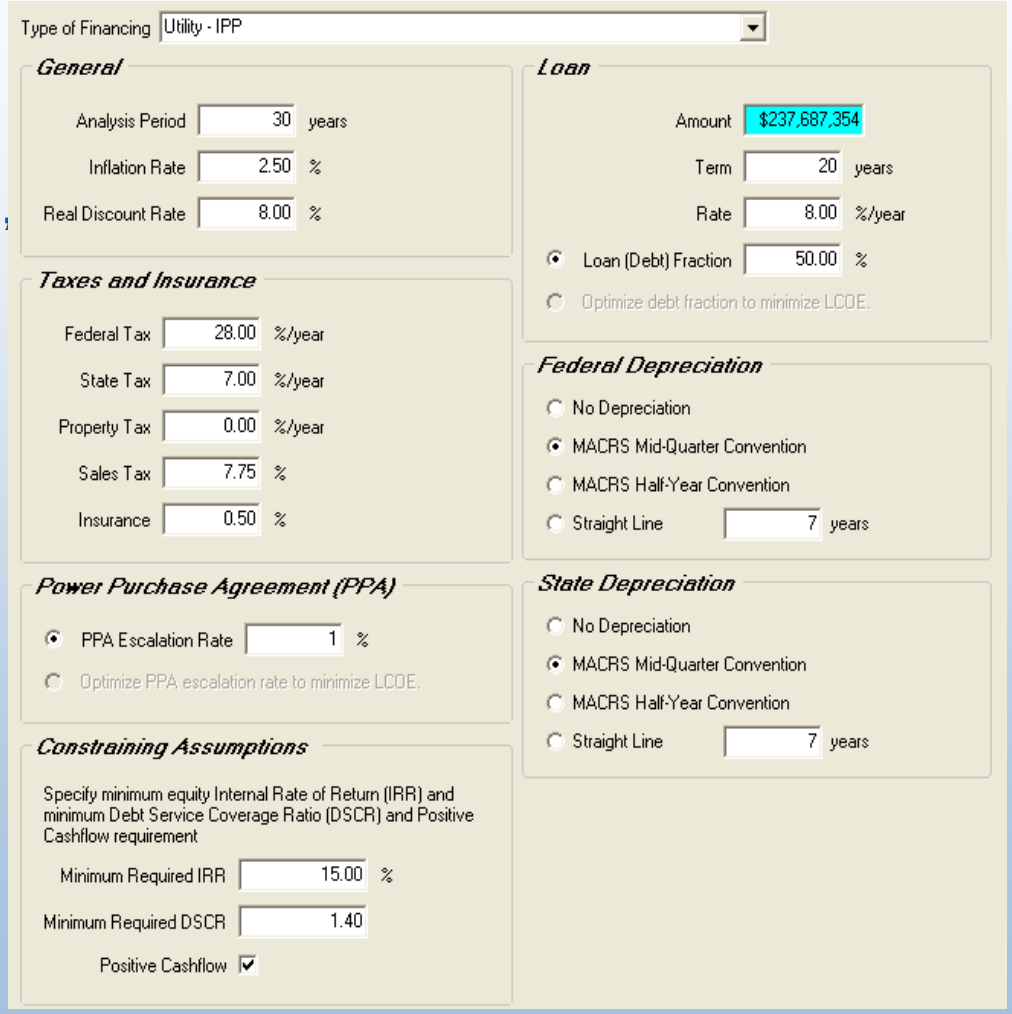
3. Define environment
   - Location: Built-in TMY2 resource data sets for 239 U.S. locations
   - Electricity rates: User-defined flat rate (time-of-use in future versions)
   - Financial assumptions: loan interest rates and periods, tax rates, incentives
   - (Electric and thermal load profiles in future versions)



4. Define system parameters
   - Collector and array configuration: with or without tracking
   - Collector and converter performance models: simplified and multi-parameter (storage in future versions)
   - (Balance of system components in future versions)
   - Equipment, labor, and project costs

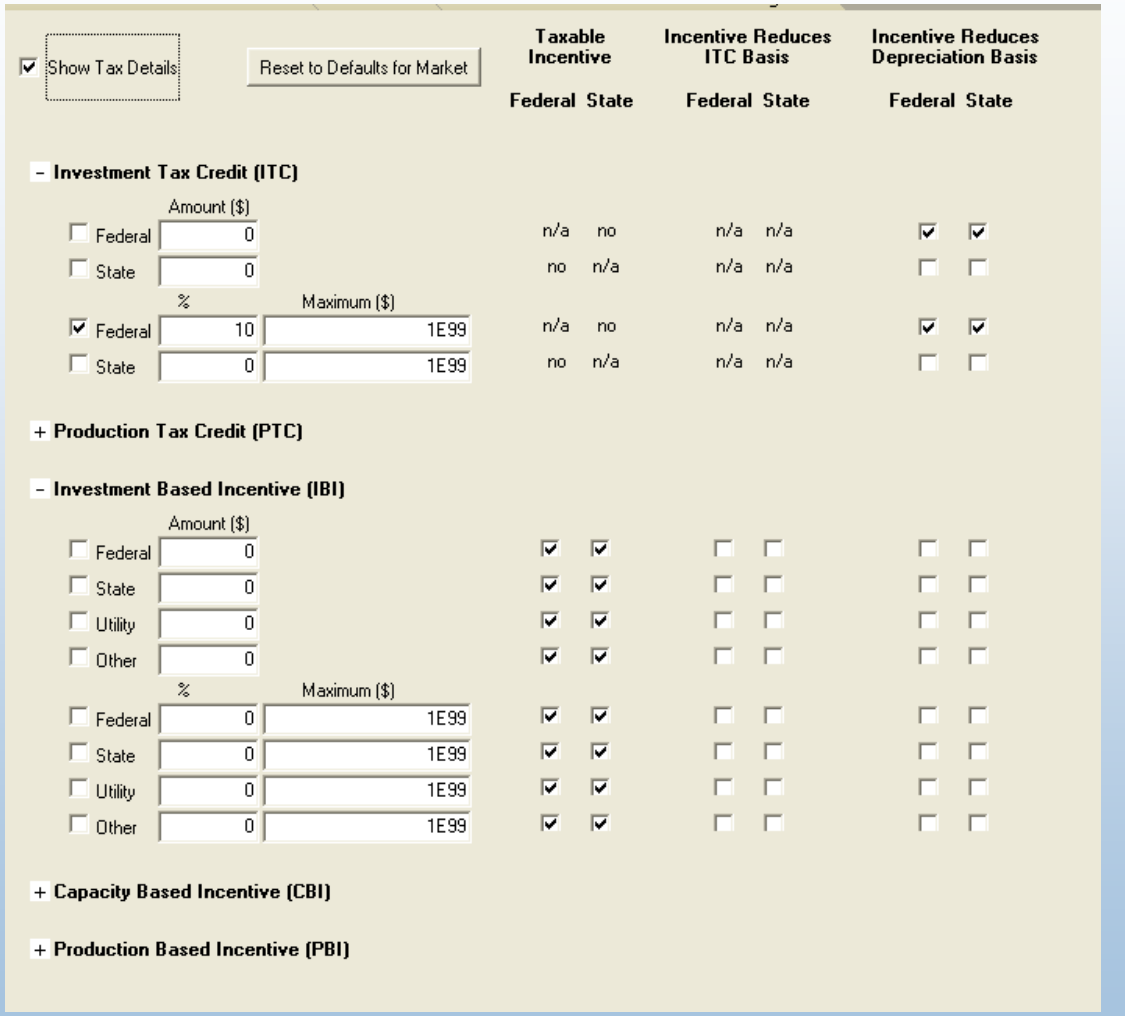
Finance Model

- Detailed Cashflow model
- Output
  - LCOE, NPV, IRR, Revenue, Taxes, etc.
- Residential
  - Cash, Loan or Mortgage
- Commercial
  - Cash or Loan
- Utility Scale
  - IPP (at right) or Utility



Financial Incentives

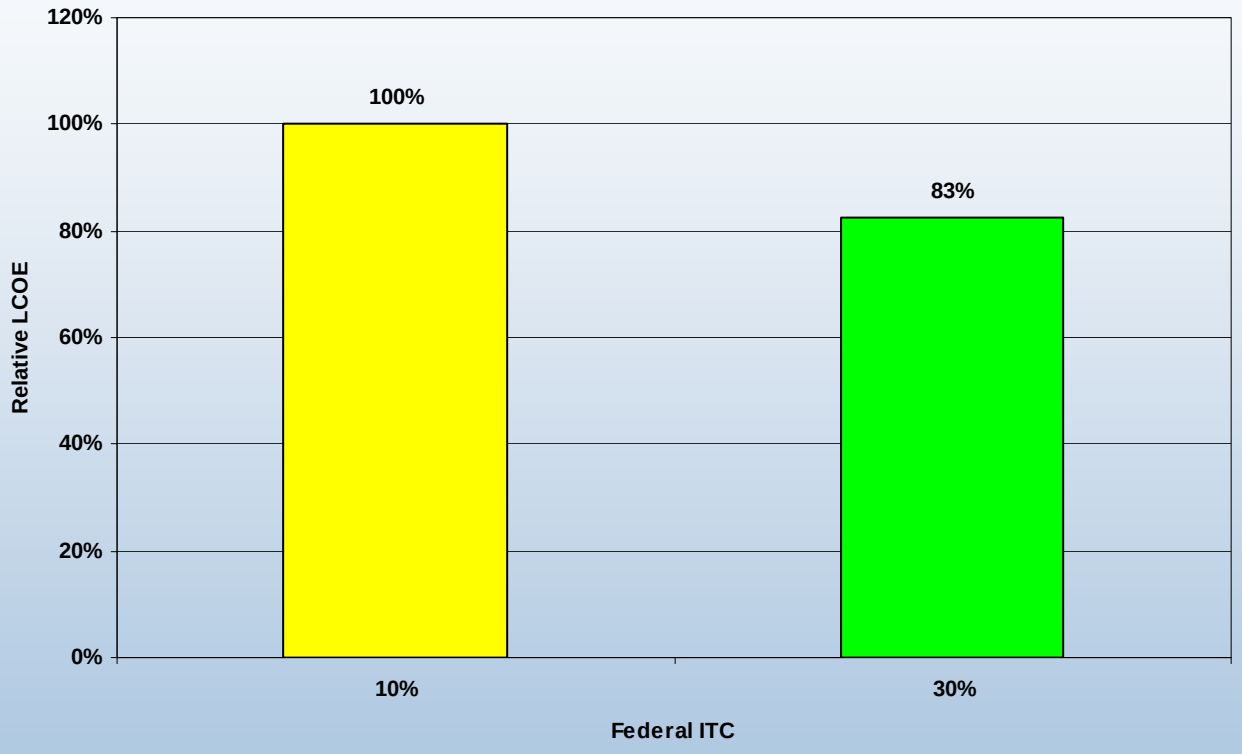
- Detailed Incentives available
- Separate possible entries
  - Federal
  - State
  - Utility
  - Other
- Variable Tax Implications
- Incentives
  - Tax Credits
    - Investment
    - Production
  - Investment Based Incentives (Buy-Downs)
  - Capacity Based Incentive
  - Production Based Incentive



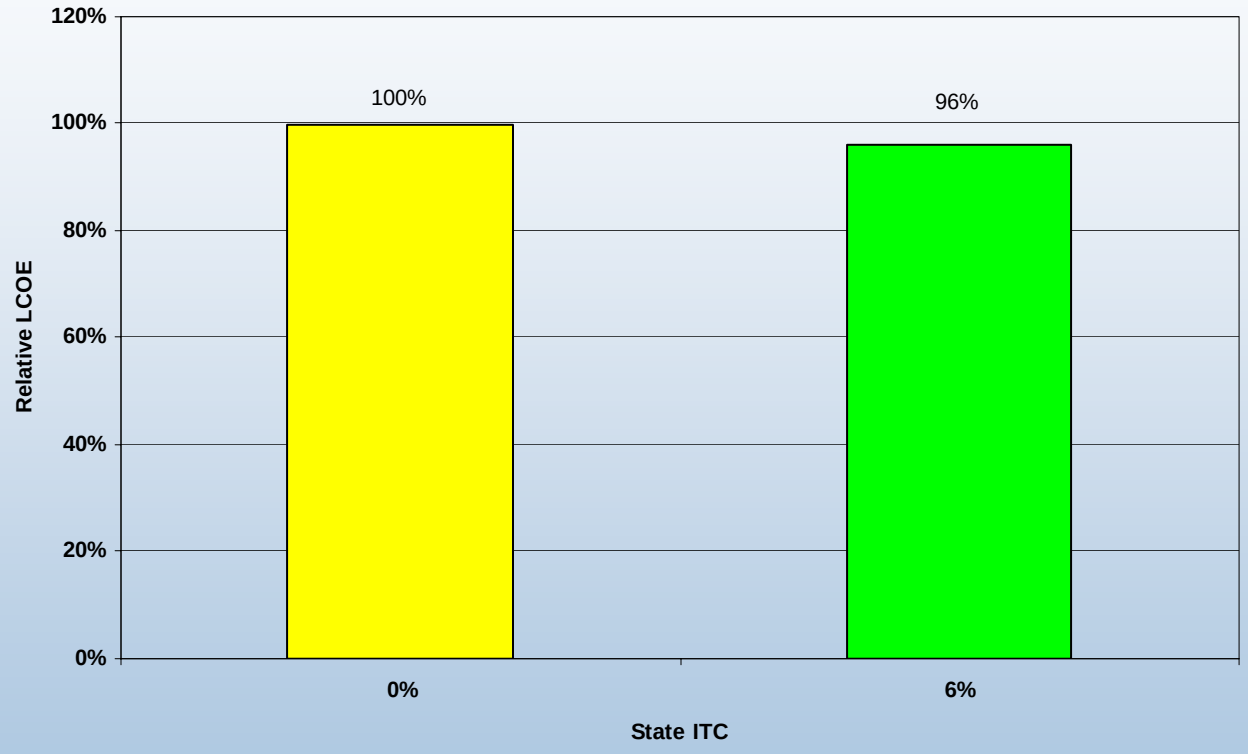
Policy Impact Analysis For Utility Scale Solar

- Federal Policies
  - Federal Investment Tax Credit (ITC)
  - Federal Loan Guarantee
- State Policies
  - State ITC
  - State Production Tax Credit (PTC)
  - Sales Tax Exemption
  - Property Tax Exemption

Policy Impacts
Federal Investment Tax Credit

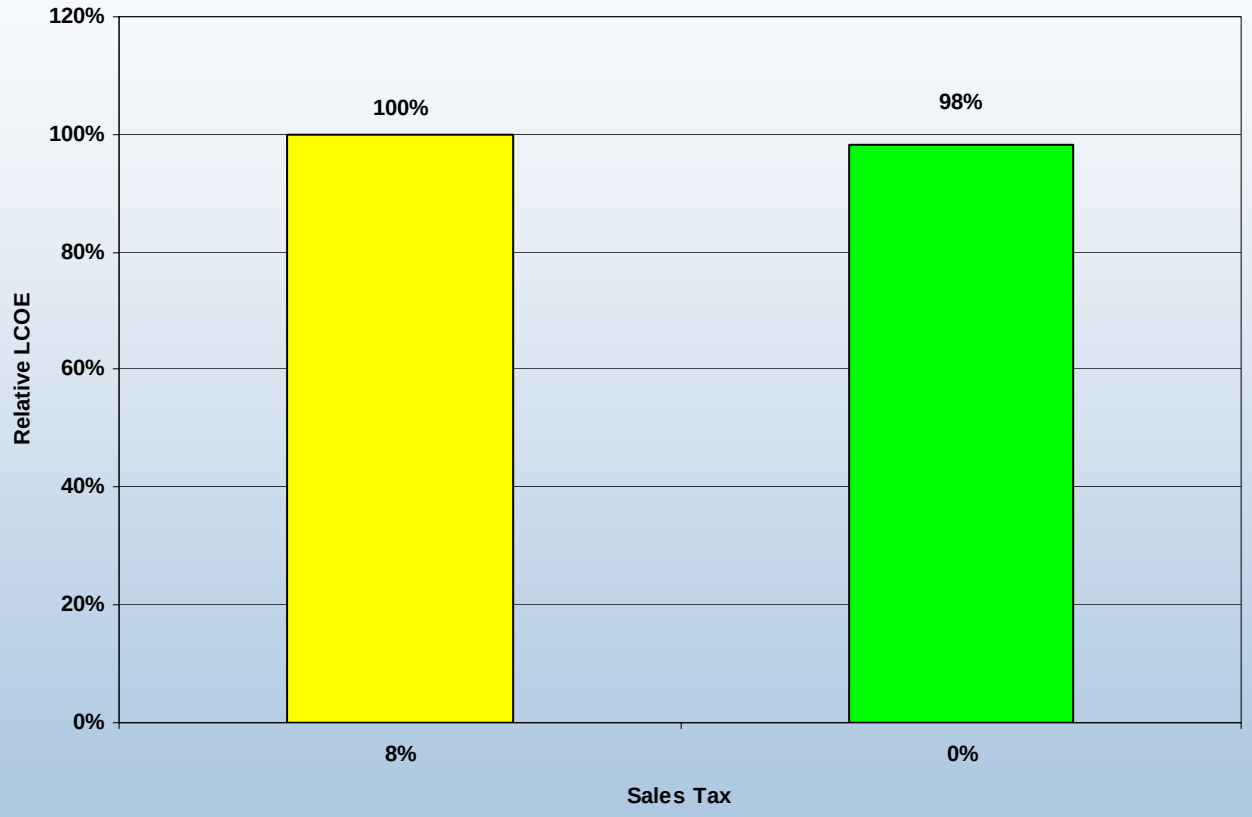


Policy Impacts
State Investment Tax Credit



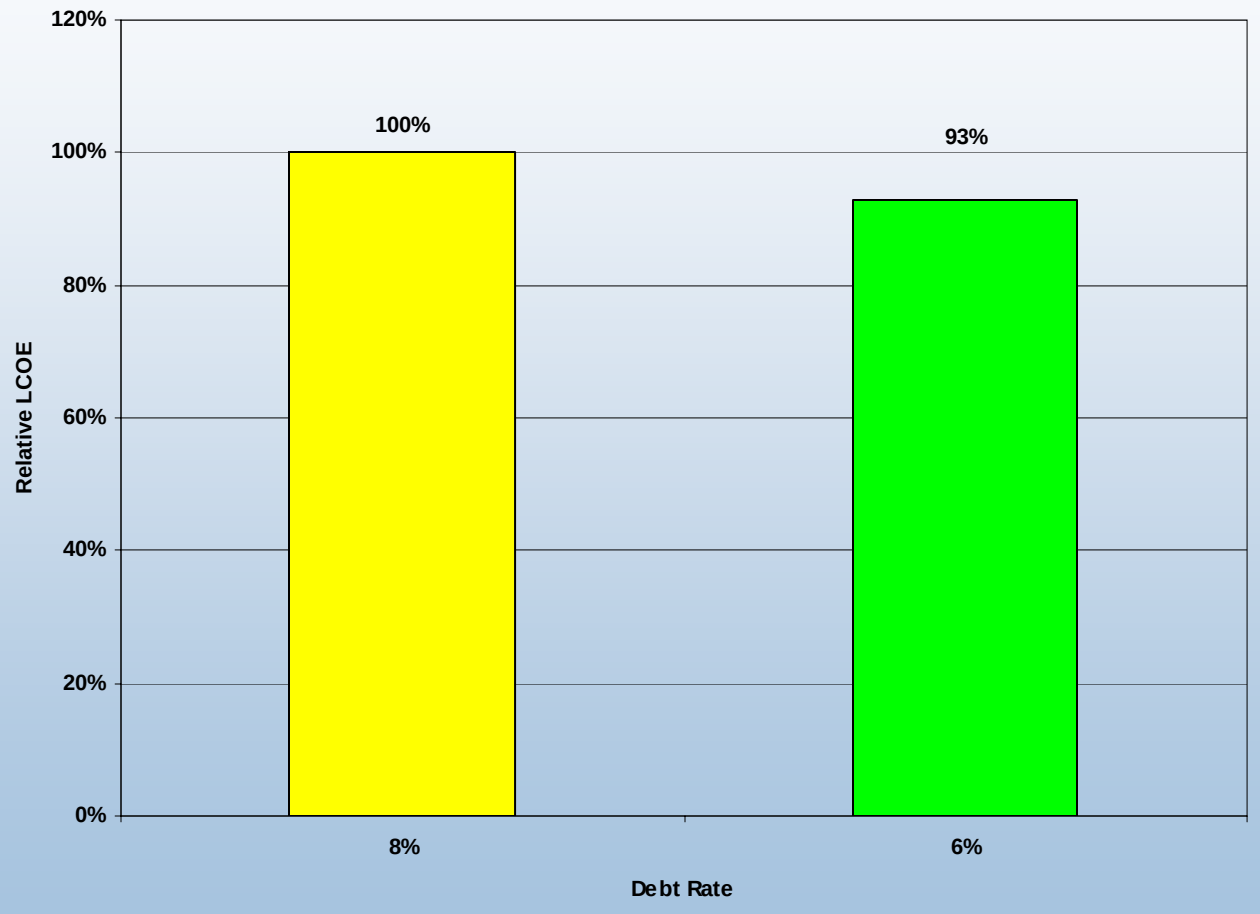
Policy Impacts
State Production Tax Credit

Policy Impacts
Sales Tax Exemption



Policy Impacts
Property Tax Exemption

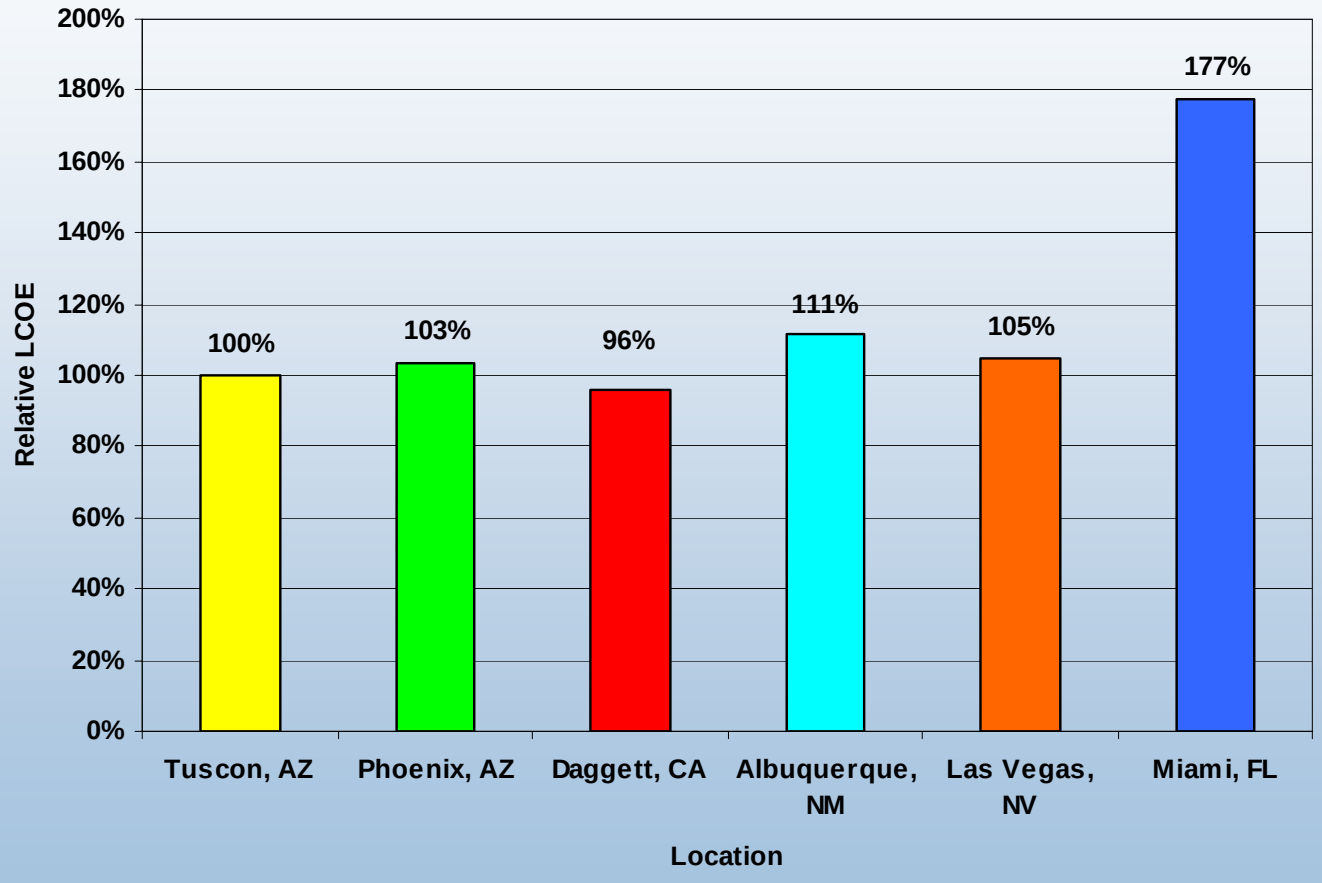
Policy Impacts
Loan Guarantee



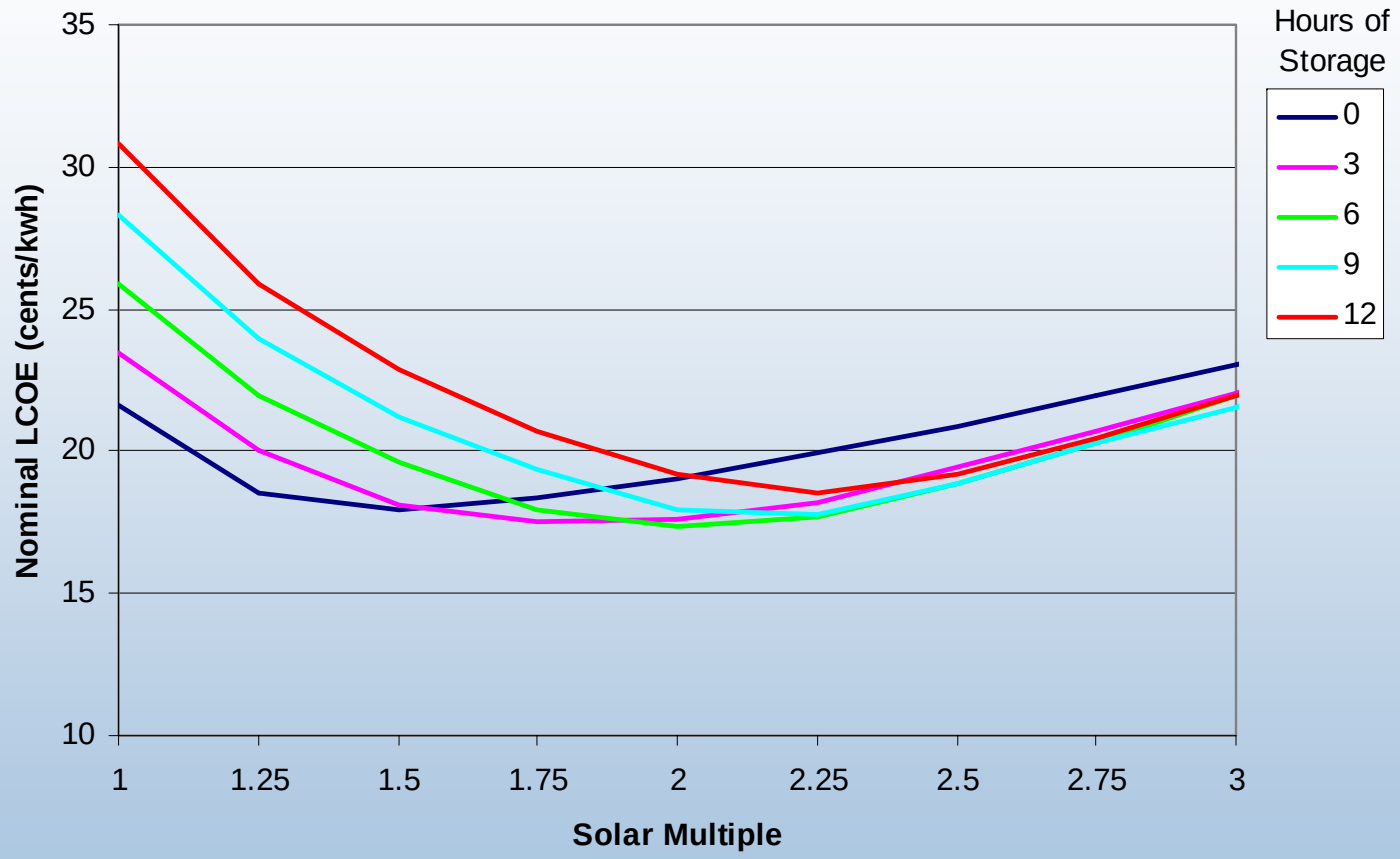
Technology Impacts

- Solar Resource
- Storage Capacity/Cost
- Plant Size

Impact of Solar Resource for Typical CSP Trough Plant



CSP Plant with Thermal Storage Optimized to Minimize LCOE



- Solar Multiple is non-dimensional solar field term (1 = solar-only design point)
- 6-hours TES and solar multiple of 2.0 results in minimum LCOE
- With current cost of storage, LCOE not highly impacted by TES
- TES provides additional benefits beyond lowering LCOE

Conclusion

- SAM is a good tool for integrated performance, financial and cost analysis for PV and CSP systems.
- Easy-to-use GUI interface
- SAM is the only good tool for parabolic trough analysis in the U.S. (one of several for PV systems).
- We have a lot of improvements still under development for CSP and PV especially.
- We are transitioning from a tool for DOE/Lab R&D planning to a tool for use by the PV and CSP industries