

# **PRODUCTION MODELING & MODELS**

## **A PROJECT DEVELOPERS PERSPECTIVE**

**TARN YATES & BRADLEY HIBBERD**

**BORREGO SOLAR SYSTEMS INC.**

## WHO WE ARE

### **BORREGO SOLAR**

- BUSINESS – 25 YEARS
- 70 EMPLOYEES – SOCAL, NORCAL, NEW ENGLAND
- COMMERCIAL/INDUSTRIAL/UTILITY PROJECTS
- INSTALLATIONS TO DATE: 25MW APPROXIMATELY
- INSTALLATIONS IN 2010: 15MW PROJECTED

### **BRADLEY HIBBERD**

- DIRECTOR OF TECHNOLOGY
- 7 YEARS INDUSTRY EXPERIENCE

### **TARN YATES**

- APPLICATIONS ENGINEER
- 5 YEARS INDUSTRY EXPERIENCE

# INTRODUCTION

## IMPORTANCE AND CHALLENGES - BRADLEY HIBBERD

- IMPORTANCE OF PRODUCTION MODELING
- REALITY OF MODELING SOLAR PROJECTS
- ADDITIONAL CHALLENGES

## THE TOOLS/WHAT IS NEEDED - TARN YATES

- TOOLS
- FUNDAMENTALS
- SHADING
- ADVANCED FEATURES
- OUTPUT
- ADDITIONAL FEATURES

# PROJECTS DEPEND ON REVENUE

## IRR/ROI/SIMPLE PAYBACK/OTHER METRIC

### ENERGY PRODUCED = REVENUE

- PRODUCTION MODELING DETERMINES THIS
- FEASIBILITY OF PROJECT RELIES ON THE MODELING
  - INVESTORS RELY ON THE MODELING



### ACCURACY

- INVESTORS NEED CONFIDENCE

### CONSISTENT/REPRODUCEABLE

- INDEPENDENT ENGINEERING REVIEWS





**BORREGO SOLAR**

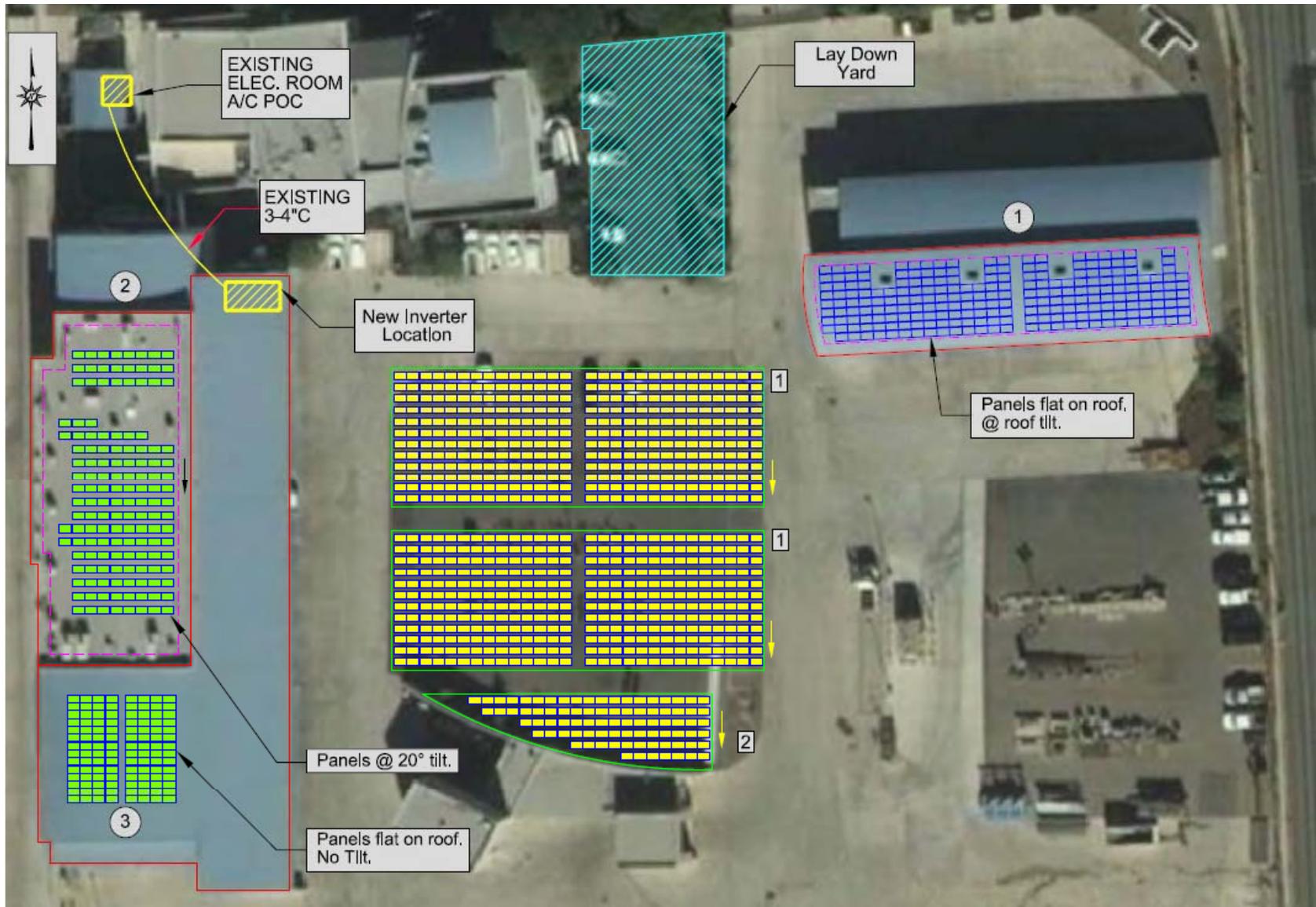
# REALITY OF SOLAR PROJECTS



# REALITY OF SOLAR PROJECTS



# REALITY OF SOLAR PROJECTS



# COMPLEXITIES OF MODELING

## **SITE DETAILS**

- MULTIPLE ARRAYS
- MULTIPLE MOUNTING STRUCTURES
- SHADING

## **ADDITIONAL COMPLEXITY**

- CHOSING WEATHER DATA
- SOILING - SNOW & DIRT
- NEW PRODUCTS

## **DESIGN DECISIONS**

- MULTIPLE ARRAY'S – SINGLE INVERTER
- SHADING
- SOILING – TO CLEAN OR NOT TO CLEAN

# SUMMARY

## PRODUCTION MODELING

- IS CRITICAL TO PROJECT DEVELOPMENT
- CAN BE VERY COMPLEX TO MODEL

## ADDITIONALLY

- # OF PROPOSALS = 10 X # OF PROJECTS
- NUMBER OF PROJECTS REQUIRING MODELING IS LARGE
- TIME REQUIRED IS SIGNIFICANT

## TOOLS ARE NEEDED TO

- CREDIBLY PRODUCE RELIABLE PRODUCTION ESTIMATES
- MAKE APPROPRIATE DESIGN DECISIONS

# TOOLS

PVWATTS  
PV-DESIGNPRO  
PV\*SOL  
SAM  
PVSYST





**BORREGO SOLAR**

**WHAT DO WE NEED?**

# FUNDAMENTALS

## WEATHER DATA

- ACCURATE
- SITE SPECIFIC

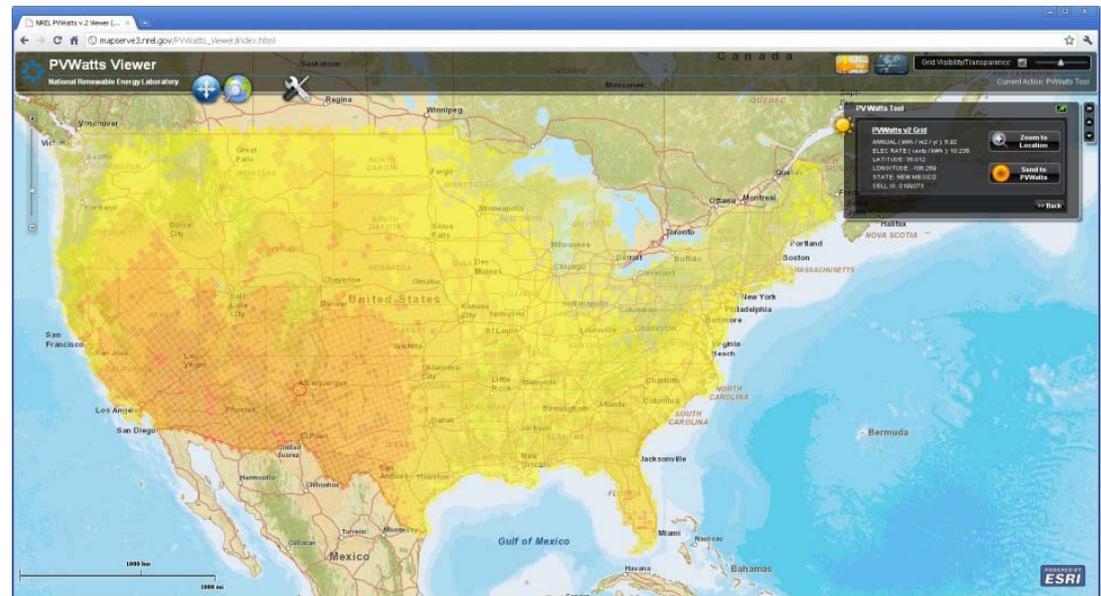
## VERIFIED MODELS

- IRRADIANCE
- TEMPERATURE
- PRODUCTION

## COMPONENT DATABASE

- FREQUENTLY UPDATED
- CREATED FROM INDEPENDENTLY TESTED DATA

## DETAILED CONTROL OF SYSTEM LOSS FACTORS



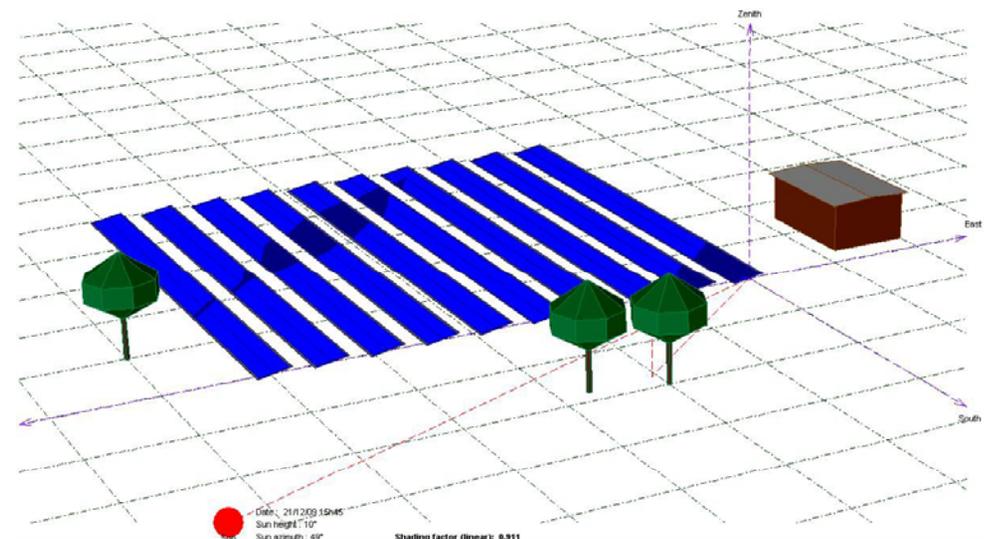
# SHADING

## GLOBAL SHADE PROFILE

## LOCAL SHADE

- 3D SHADE MODEL
  - INTERFACE WITH AUTOCAD

## INTER-ROW SHADING TOOL



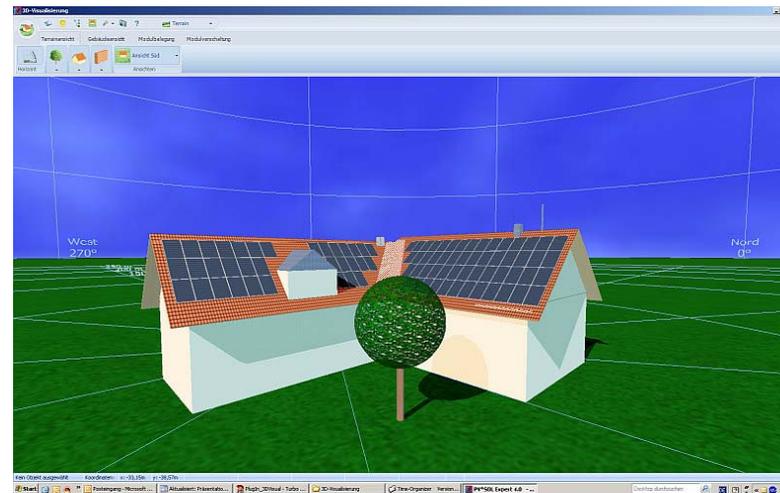
# ADVANCED

**MONTHLY SOILING LOSSES**

**HORIZONTAL SINGLE AXIS TRACKER**

**MULTIPLE ARRAYS & INVERTERS**

**HETEROGENEOUS ARRAYS**

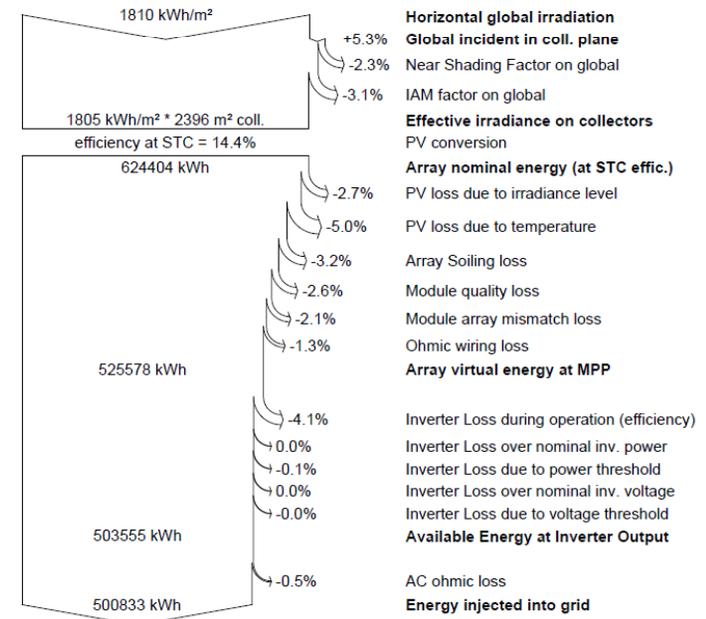


# OUTPUT

## REPORT DOCUMENTING MODEL INPUTS AND SYSTEM LOSSES

### 8760 REPORT

Loss diagram over the whole year



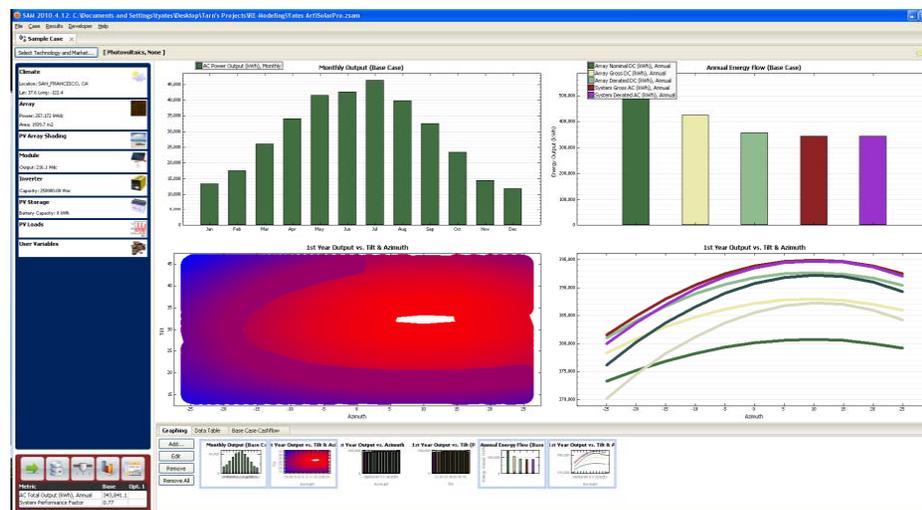
# ADDITIONAL FEATURES

PARAMETRIC AND OPTIMIZATION TOOLS

TOU/TOD TOOL

FINANCIAL ANALYSIS

THOROUGH HELP FILE AND USER GUIDE



**THANK YOU**

**QUESTIONS?**