Solar Trough Generation - The California Experience

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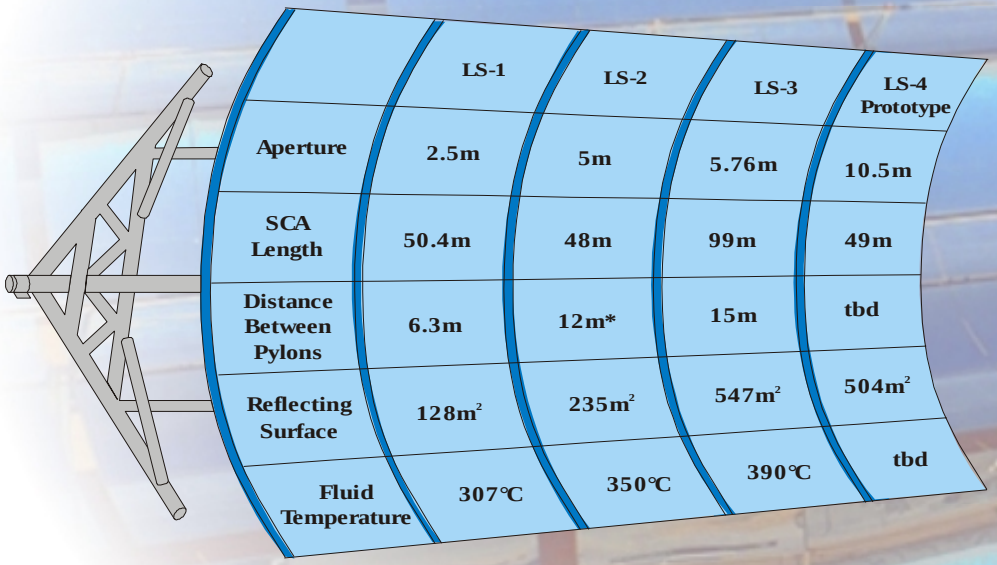
OVERVIEW

- **SEGS Background & Description**
- **Historic Performance Trends**
- **The Recent California Experience**
- **Summary / Concluding Remarks**

SEGS
Solar Electric Generating Systems



*At SEGS VI & VII, the distance was increased to 15m.

Nine Hybrid Solar Power Plants Currently Operating

SEGS I	14 MWe	since 1984
SEGS II	30 MWe	since 1985
SEGS III	30 MWe	since 1986
SEGS IV	30 MWe	since 1986
SEGS V	30 MWe	since 1987
SEGS VI	30 MWe	since 1988
SEGS VII	30 MWe	since 1988
SEGS VIII	80 MWe	since 1989
SEGS IX	80 MWe	since 1990

Total Capacity: 354 MWe

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Kramer Junction SEGS

- Five 30 MW Hybrid Power Plants
  - SEGS III-V: Dual Inlet Rankine Steam Cycle
  - SEGS VI-VII: Single Inlet Reheat Rankine Steam Cycle
- Annual Energy Input Entering Steam Turbine
  - 75% Solar Energy
  - 25% Natural Gas Boilers
- Typical 30 MW SEGS (VI) Characteristics
  - 800 LS2 SCAs
  - 188,000 m2 of Reflective Aperture Area
  - 96,000 Reflector Panels
  - 9,000 HCE Tubes

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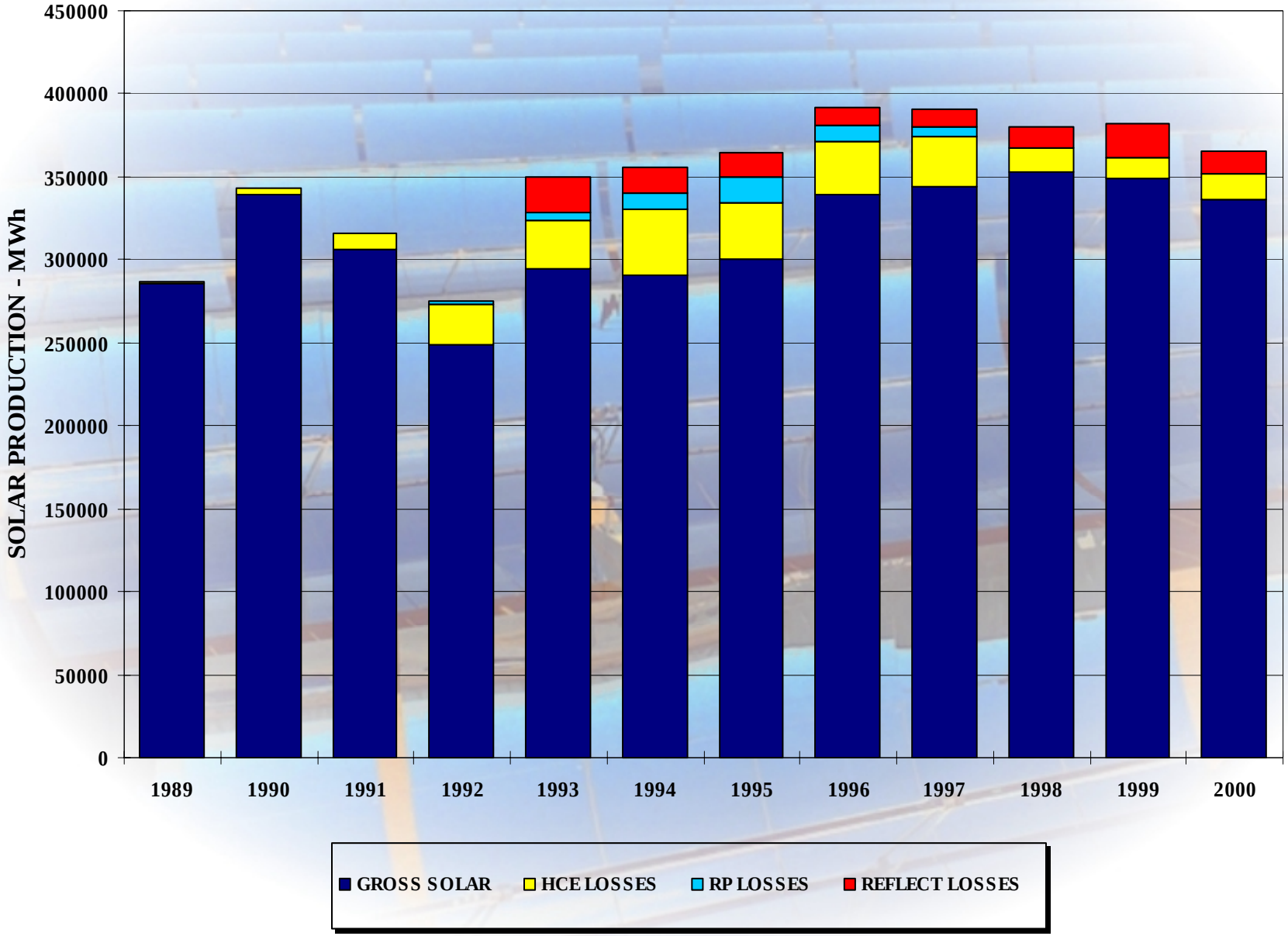
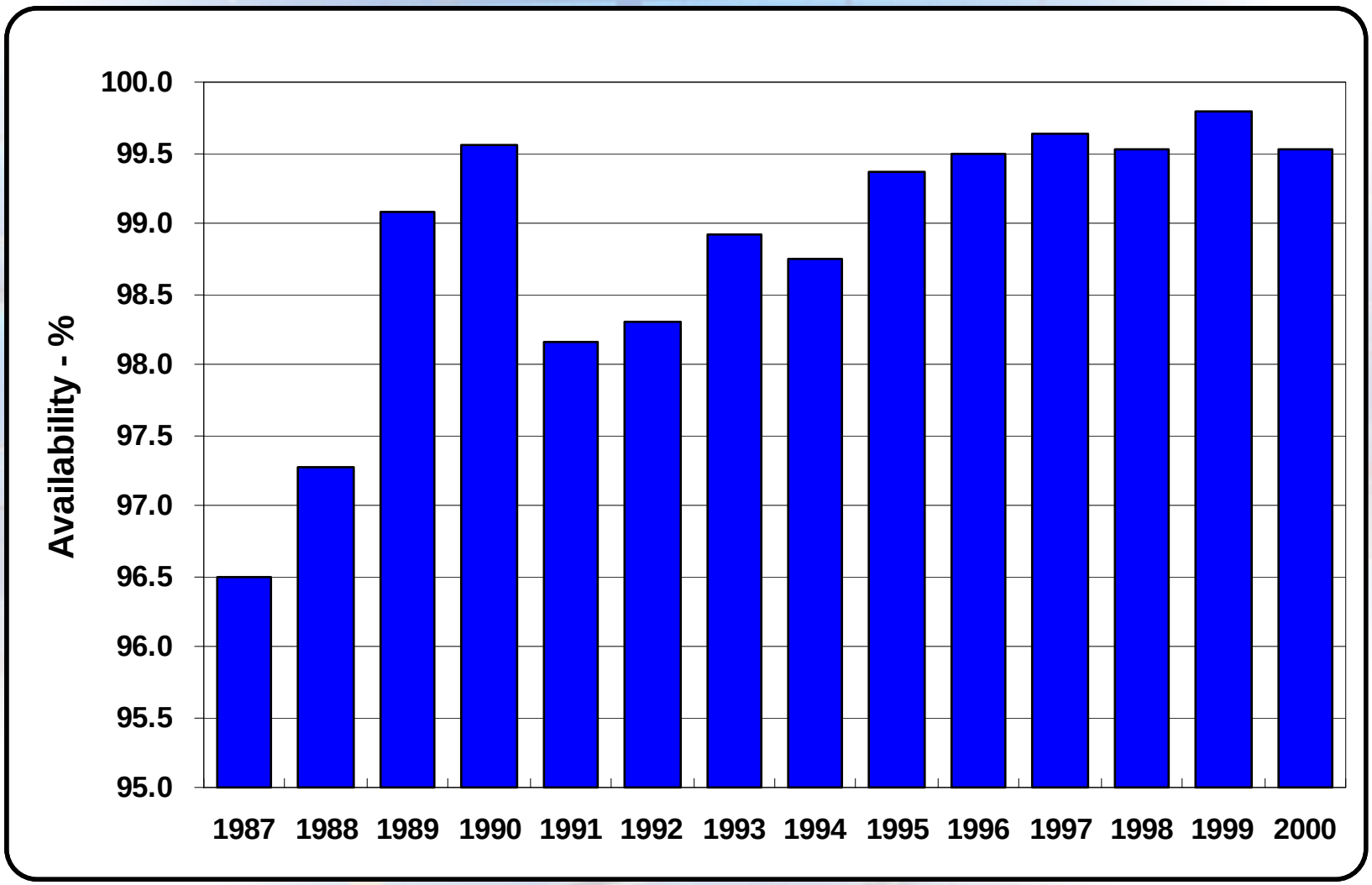
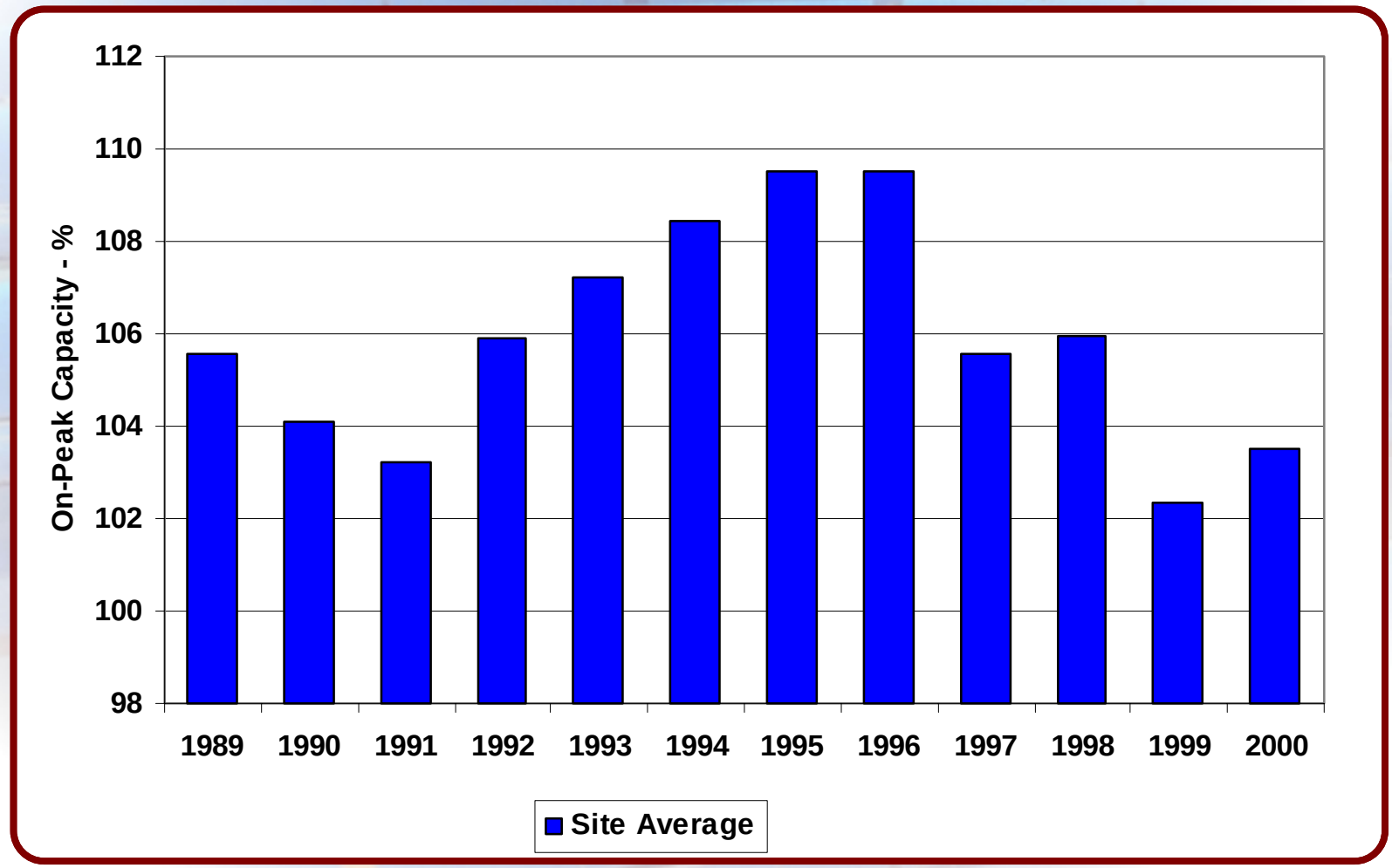
Gross Solar Production
SEGS III-VII



Kramer Junction SEGS Collector Availability

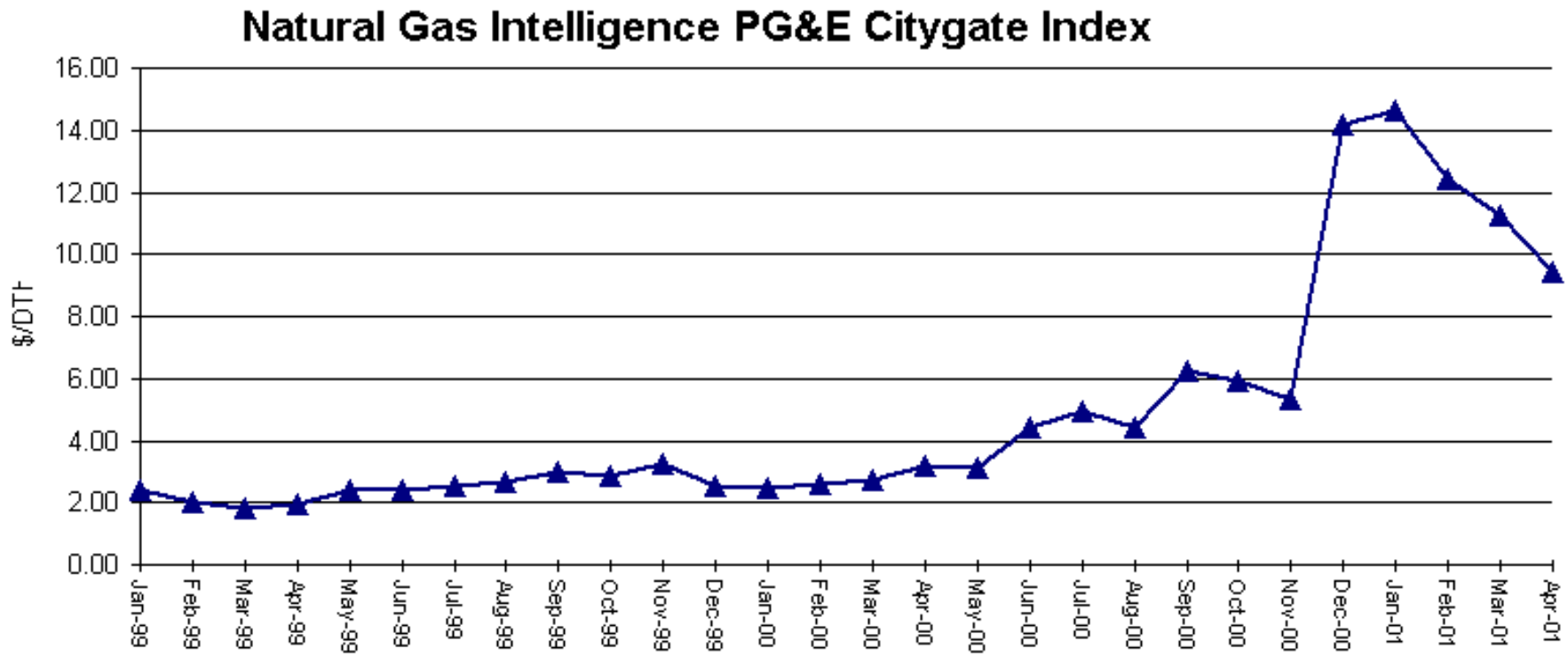


Kramer Junction SEGS Peak Capacity



The California Experience

- Gas Prices Increased!
  - El Paso gas awarded capacity away from California
  - Pipeline explosion in New Mexico
    - Repairs and inspections to many other pipelines
  - Storage reserves low due to high usage in summer


Natural Gas Intelligence PG&E Citygate Index
$/DTh
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Jan-99
Feb-99
Mar-99
Apr-99
May-99
Jun-99
Jul-99
Aug-99
Sep-99
Oct-99
Nov-99
Dec-99
Jan-00
Feb-00
Mar-00
Apr-00
May-00
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01

December 01

- SRAC posting was based on $14 gas
- SCE petitioned to contest posted SRAC to CPUC
  - SCE has fixed pricing to consumer
- QF's (12,000 MW) offline
  - Planned Outages - Heavy summer ops
  - Forced Outages - Big losses?
  - Air Permits running out or gone
  - Uncertainty
- STAGE 3 EMERGENCIES DAILY!!!!!

December 01 (Cont)

- KJ SEGS ran solar only mostly
  - Used gas up to 25% FERC
  - Used extra gas in November
- FERC lifted 25% limitation
  - KJ SEGS could not operate at loss
  - KJ made attempts with SCE to produce with revenue based on gas prices
  - SCE petitioning CPUC to do away with 25% to 0% earlier in year

January

- SRAC posted - SCE protest
  - KJ ran with gas until 1/12
  - No November payment (QF's)!!!!!
    - Planned Outages
    - Forced Outages
    - No Payment no Power
- KJ SEGS ran solar only
  - Came out of 2 planned outages early
  - Postponed 2 planned outages

February - March

- Legislature, QF's, Utilities in Sacramento
- CPUC ordered CDWR to buy (loan) power to SCE
  - SCE continues to receive monies from consumers
- SCE must pay back "loan" but could limit cost recovery and financial stability
  - Concerned about ability to pay QF's
- CPUC adopted rate increase - 4.8 billion/yr

February - March (cont)

- CDWR entered into MOU for sale of transmission system - 2.8 billion
  - SCE debt on 1/31/01 - 3.5 billion
- SRAC Formula Basically Unchanged
  - Gas Increase?
- KJC OC Paid For April 01 on April 17
  - New Billing Structure
- No Word on $11 Million Back Payments

Summary & Conclusion

The SEGS Plants are Reliable

Over 100 years of Operational Experience

SEGS Plants Have Ability to Stabilize Production Emergencies.

The California Experience - Why Didn't it Get Fixed?

February - March (cont)

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- CPUC ordered CDWR to buy (loan) power to SCE
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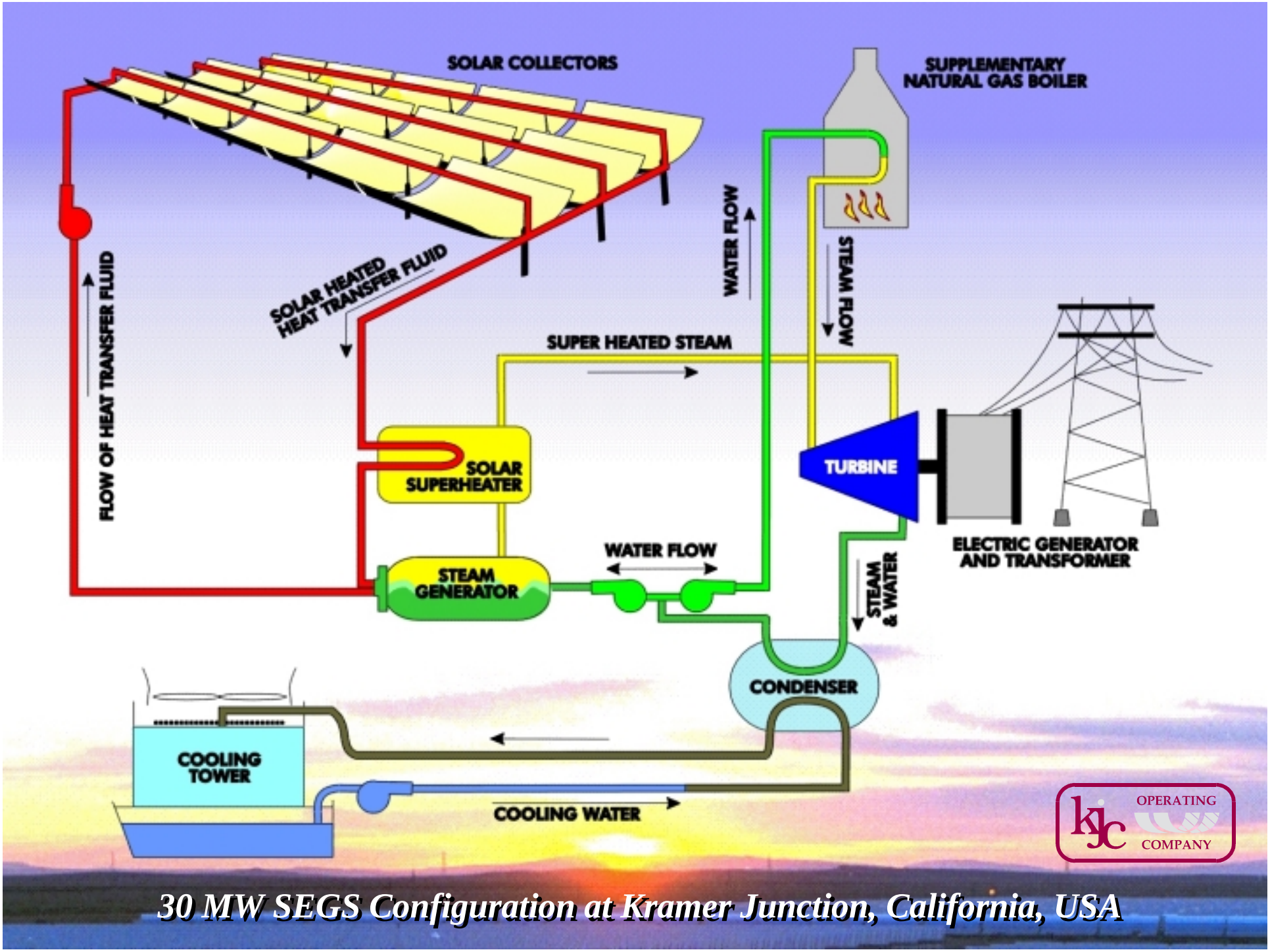
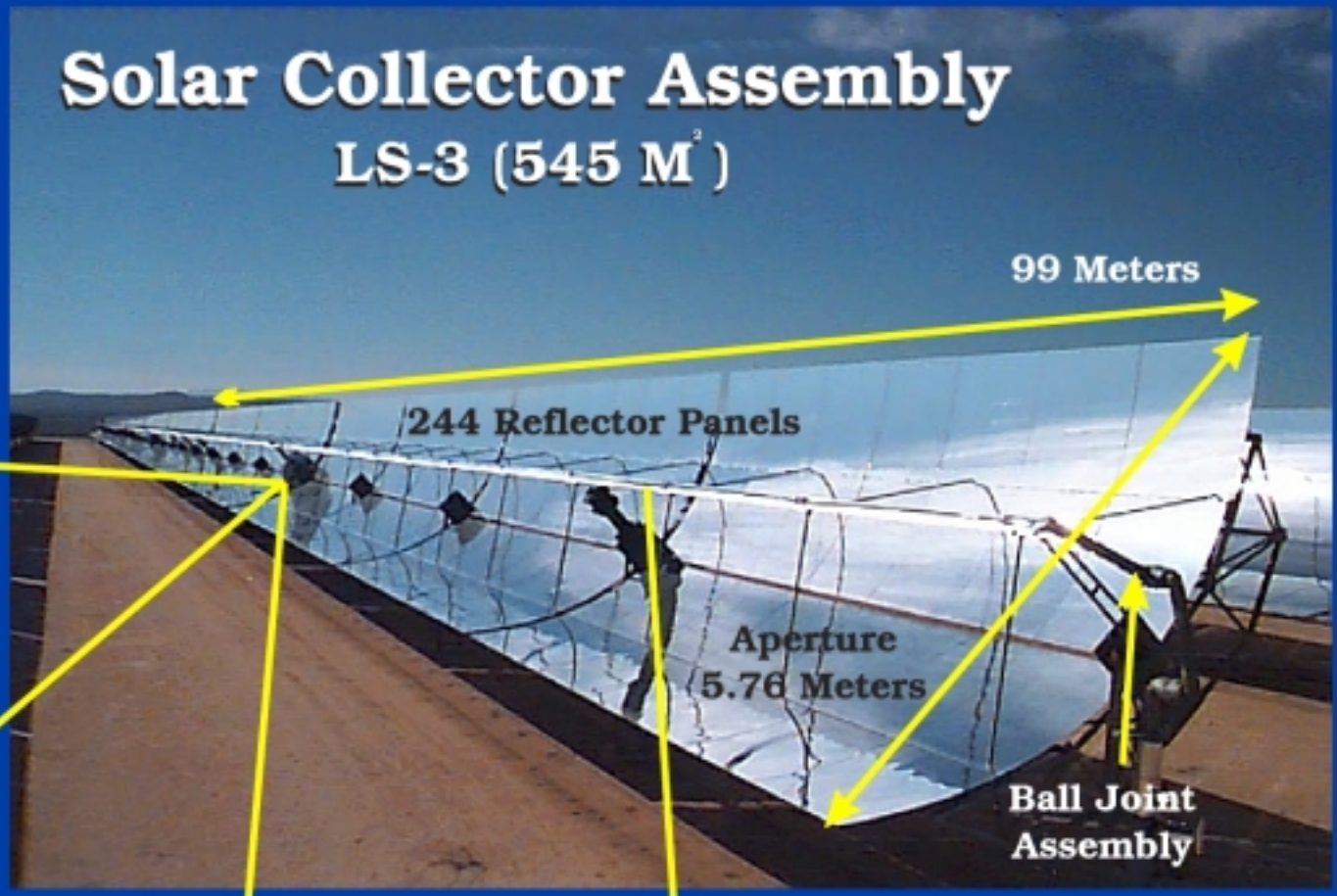


30 MW SEGS Configuration at Kramer Junction, California, USA

Solar Collector Assembly

LS-3 (545 M²)



Drive System

Sun Sensor

Local
Controller

24 Heat Collection Elements

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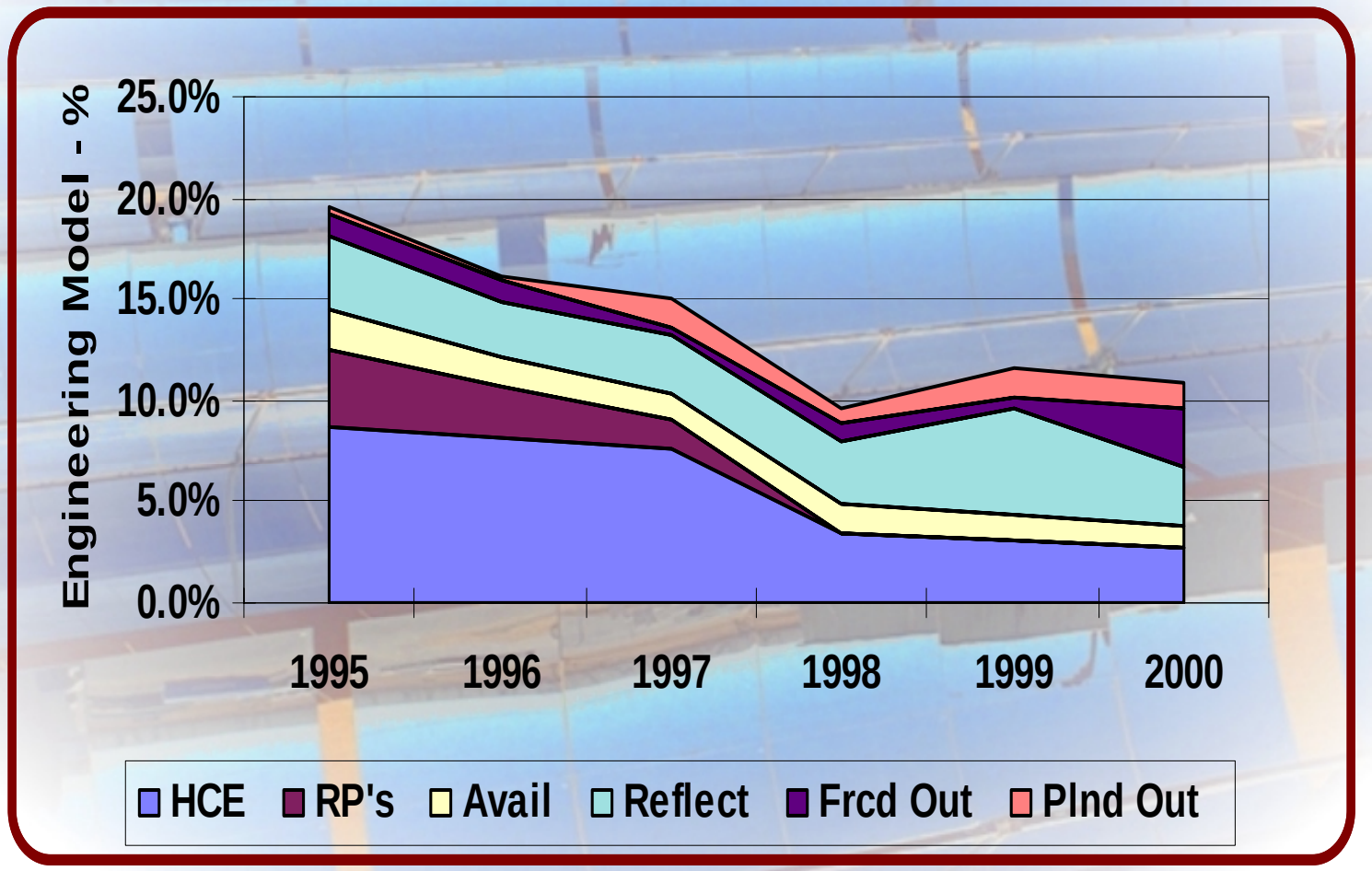
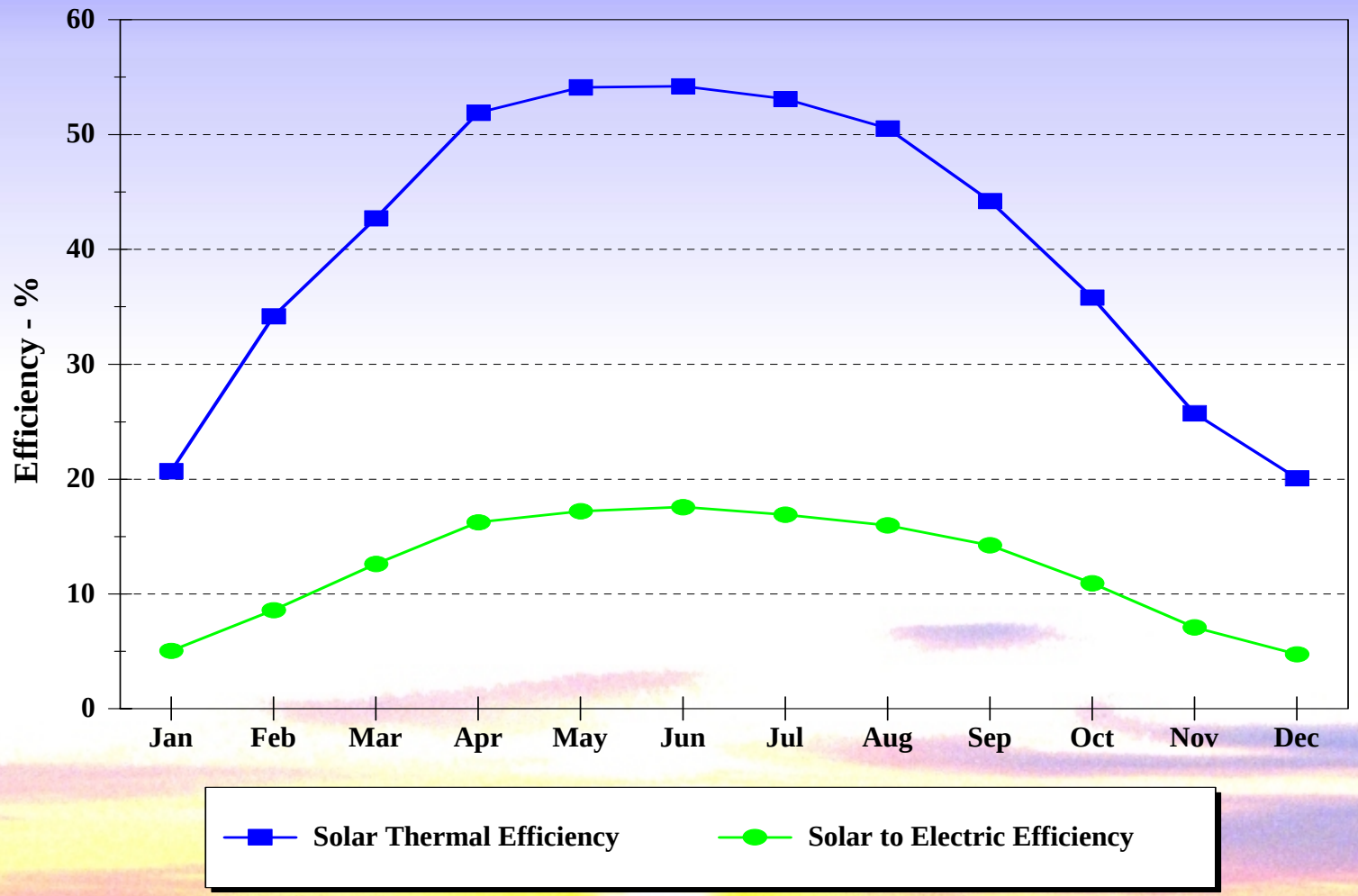
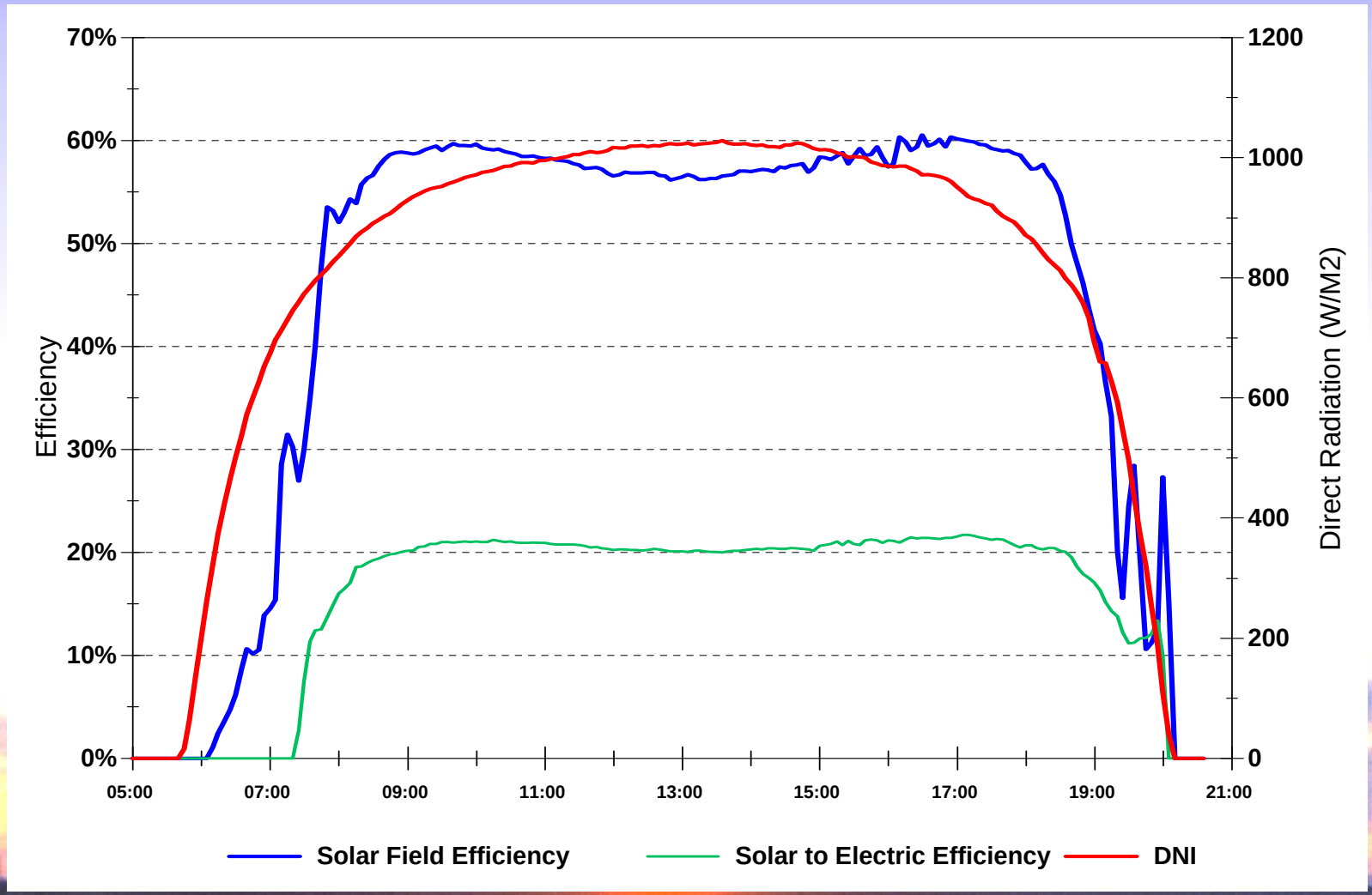
SOLAR PRODUCTION LOSSES
% of Engineering Model, SEGS III-VII



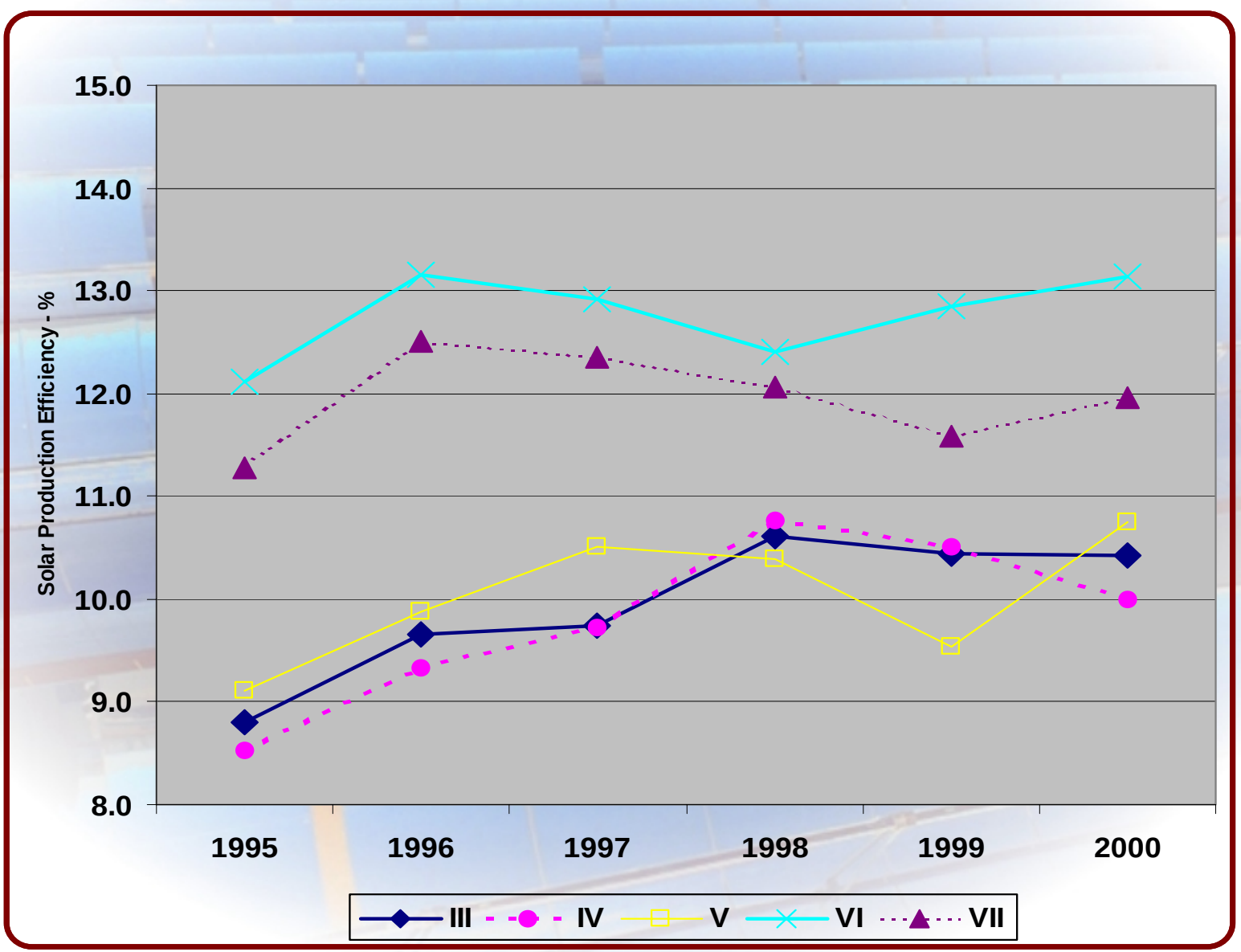
SEGS VI
Annual Solar Efficiency



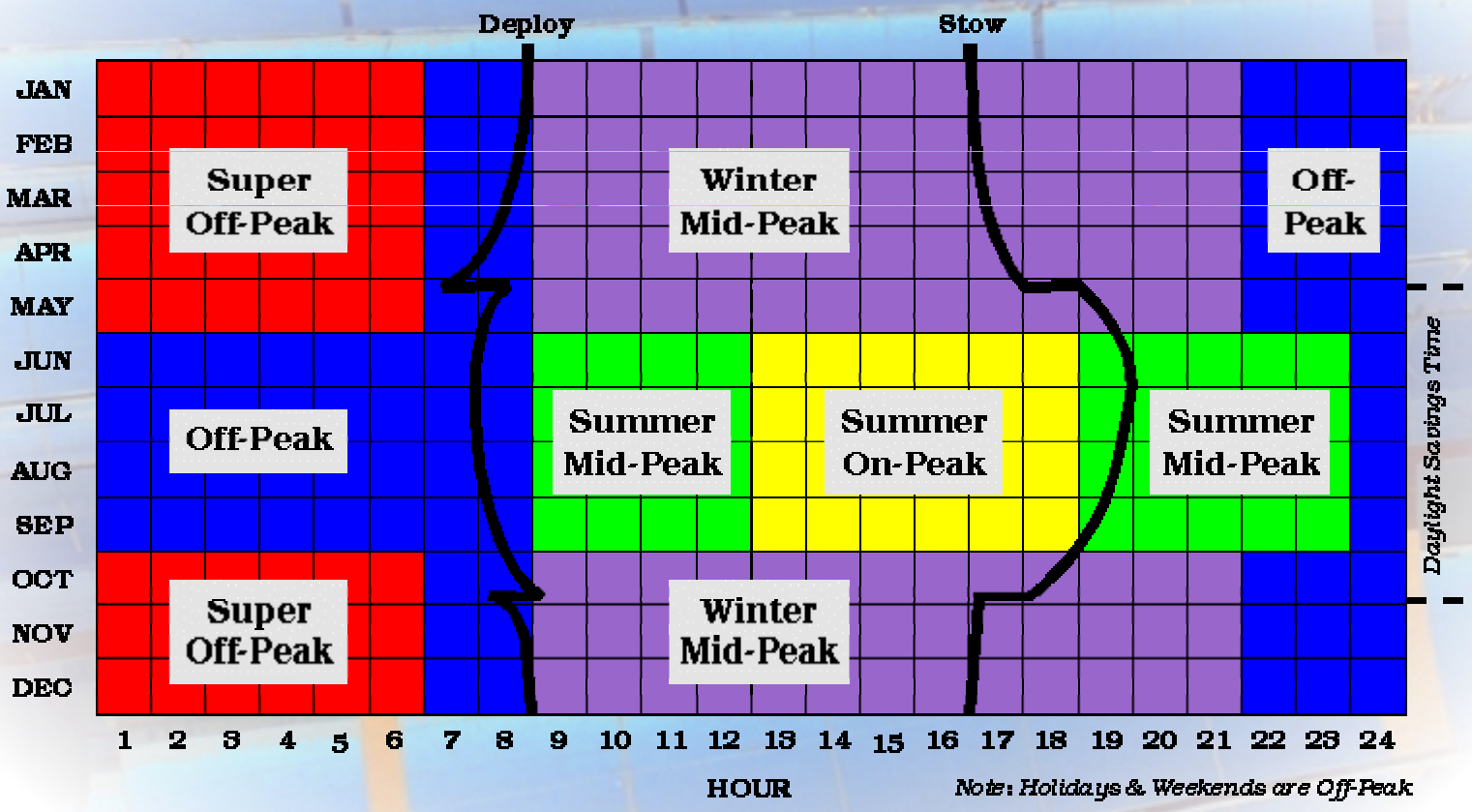
SEGS VI
Solar Efficiencies - Peak Day



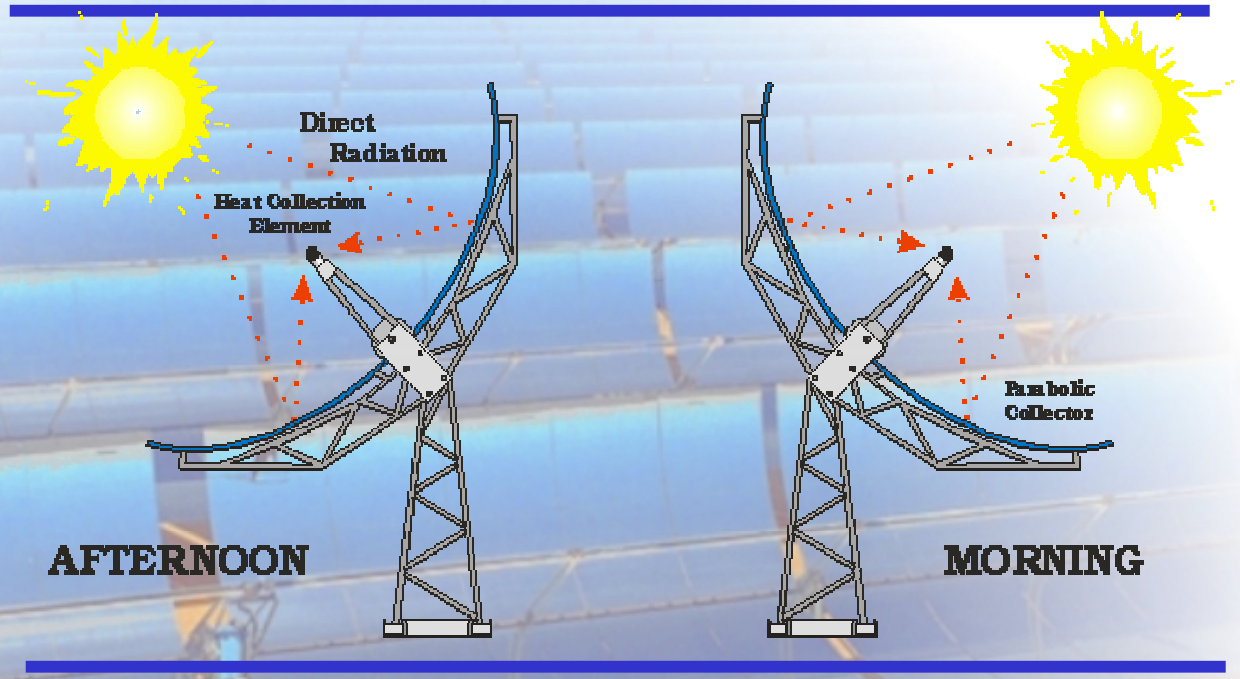
Kramer Junction SEGS Efficiency



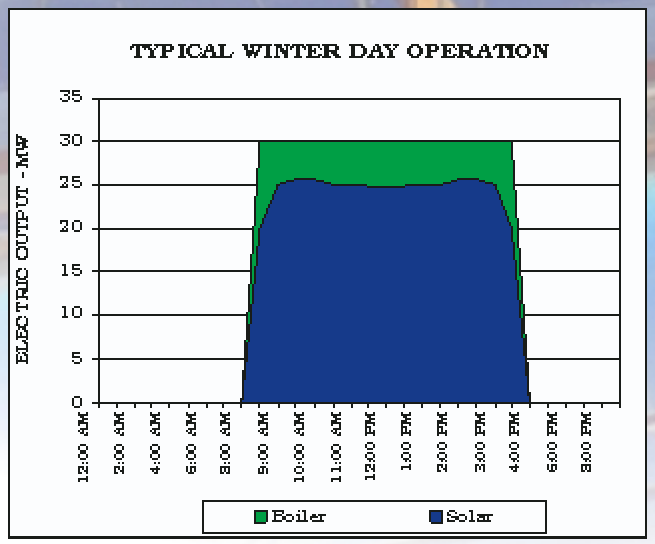
SCE Time of Use (TOU) Rate Periods
SEGS III-VII

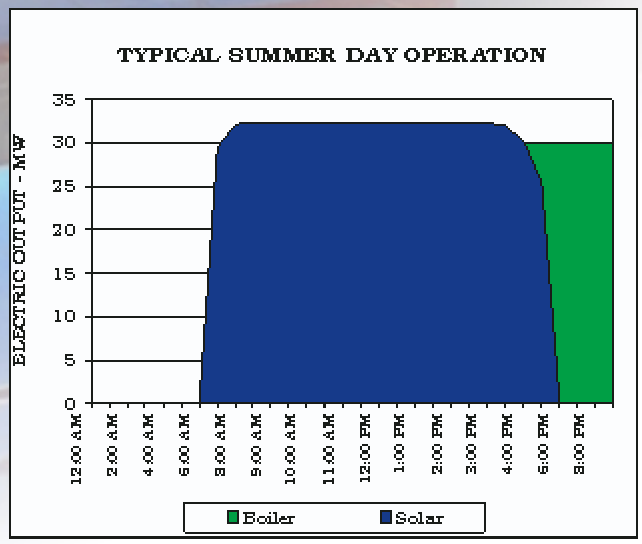


Simple Schematic of Parabolic Trough Operation (North-South Axis)



Modes of Operation





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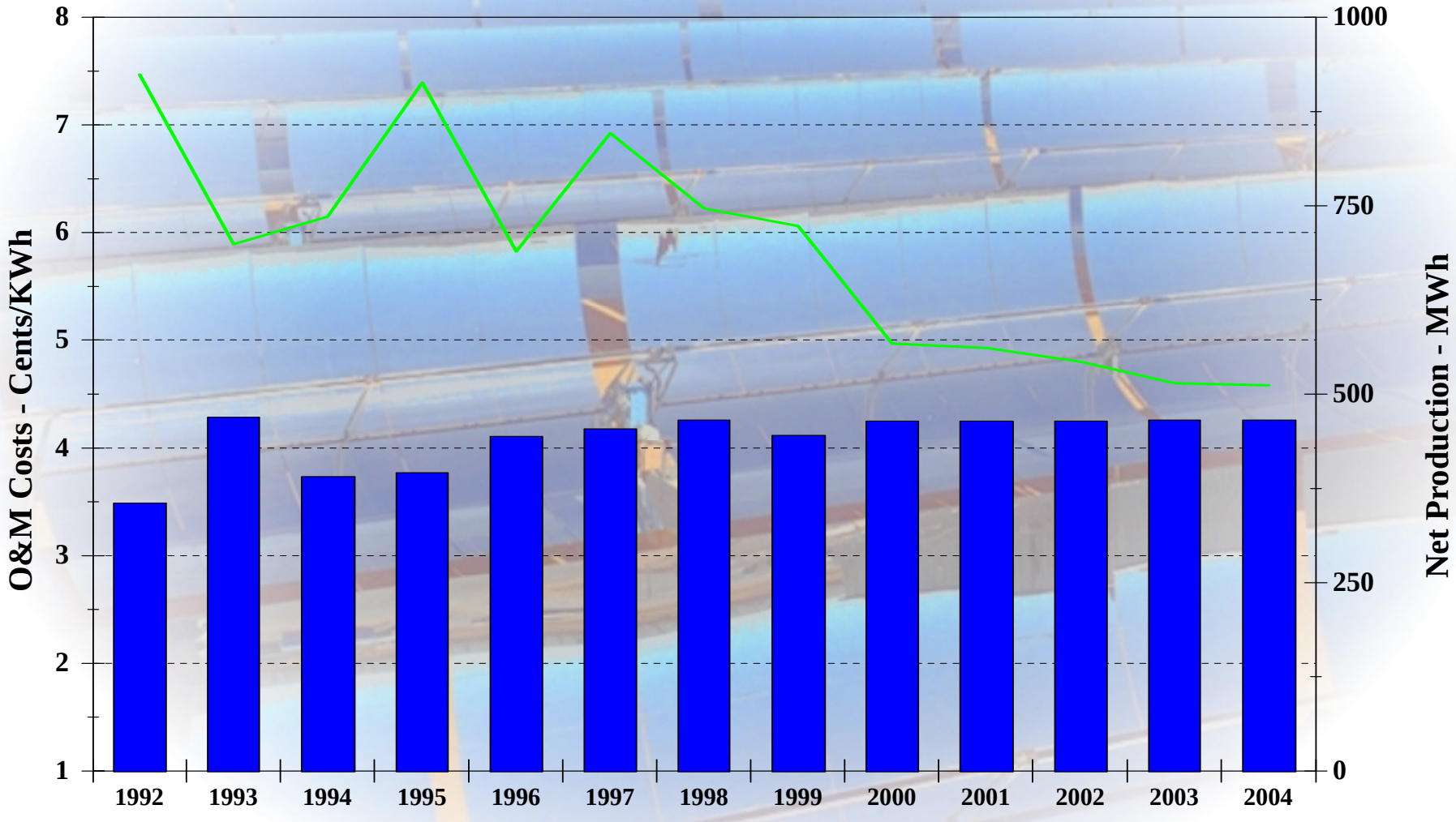
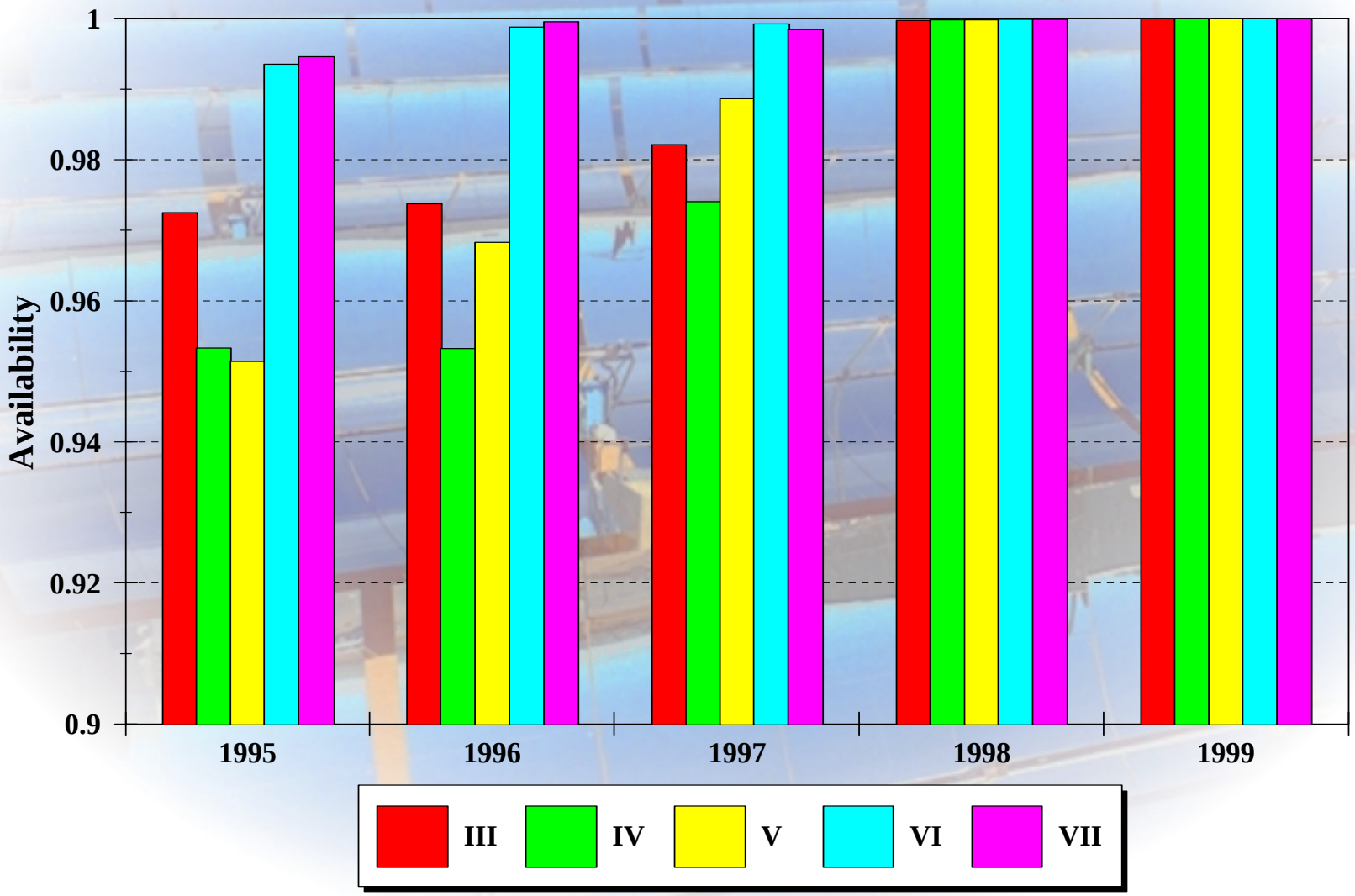
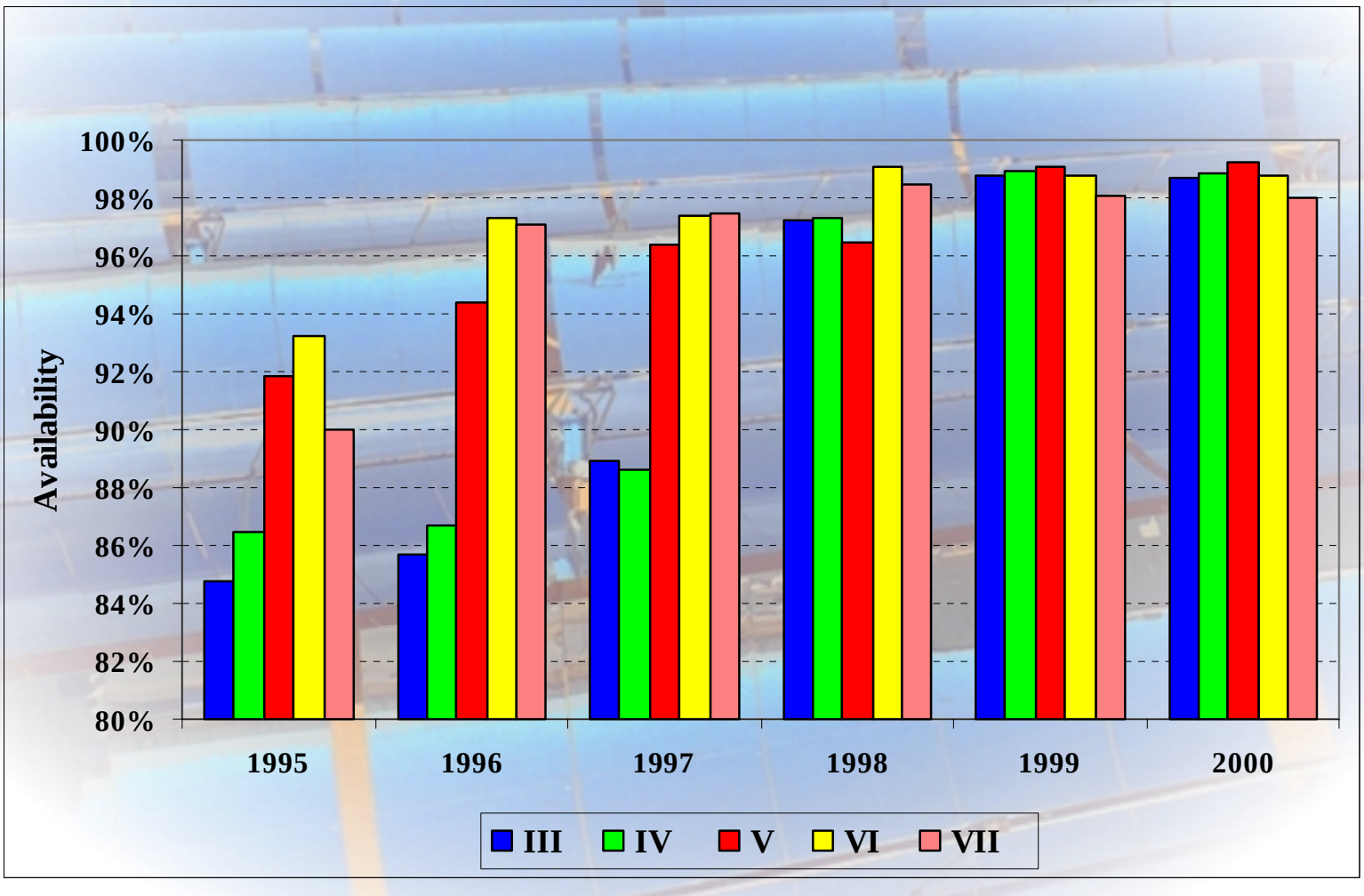
Total O&M Costs



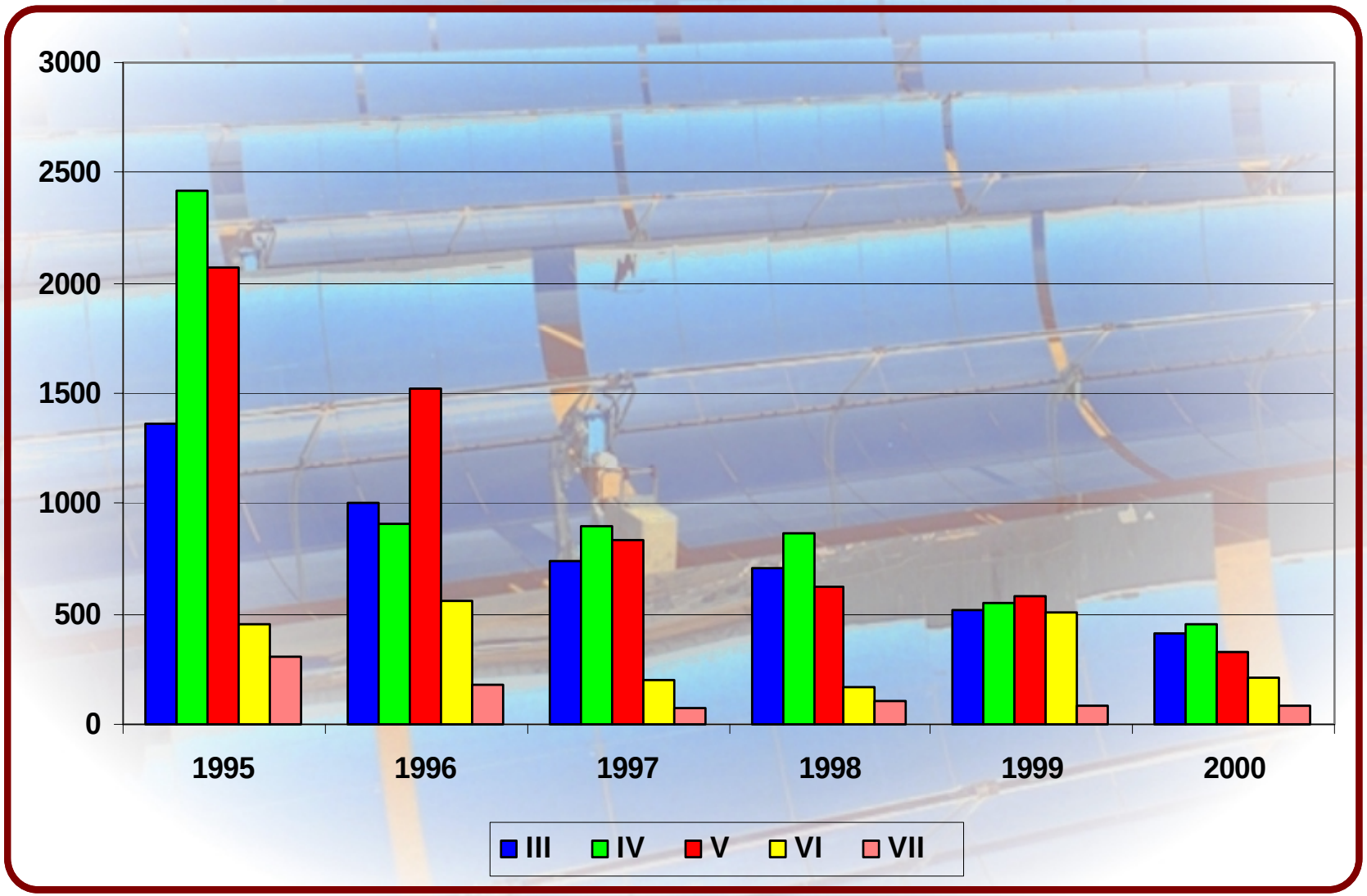
LS-2 RP AVAILABILITY
Actual & Projected



HCE AVAILABILITY
Actual



Kramer Junction SEGS LS-2 RP Breakage



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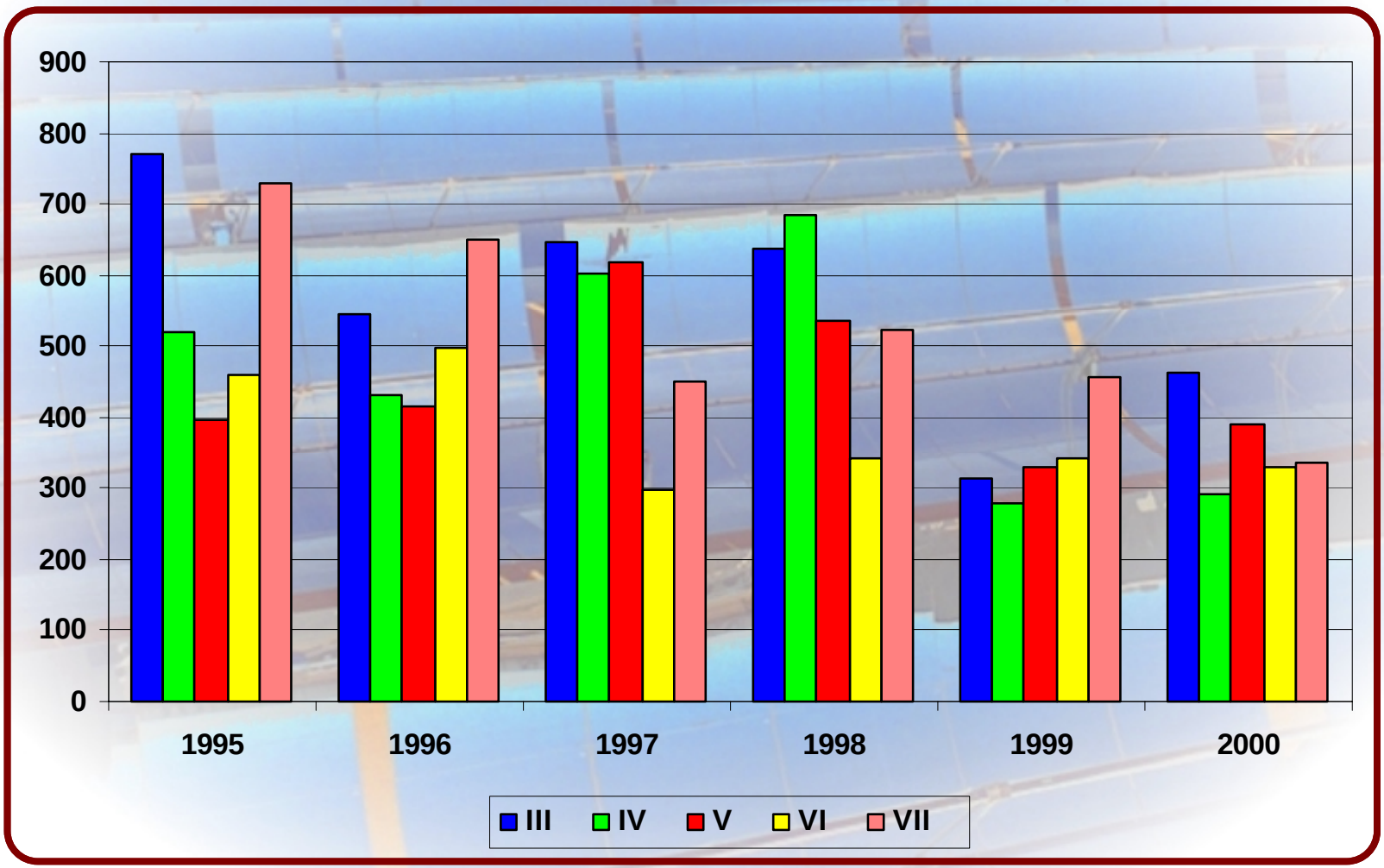
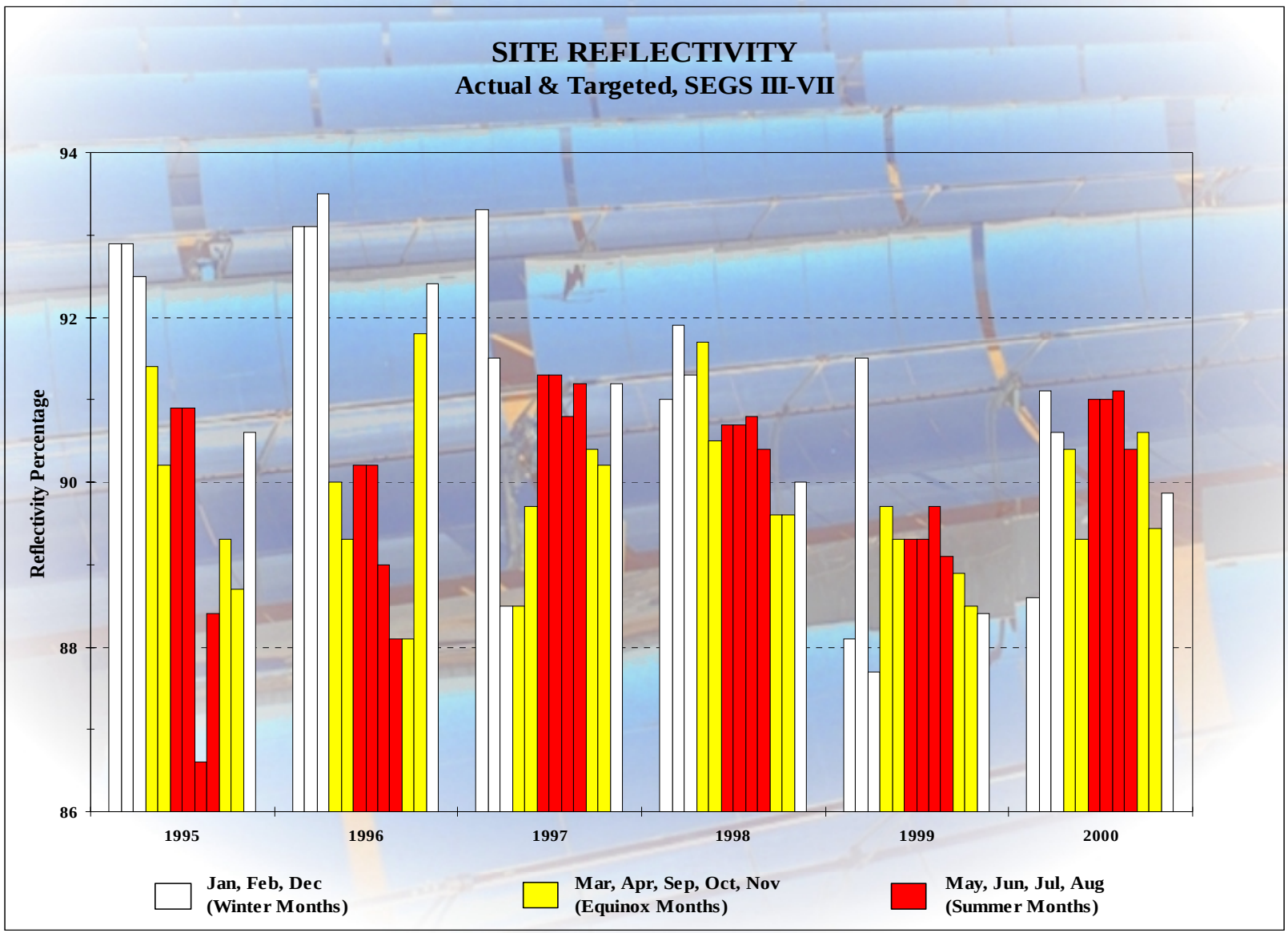
Kramer Junction SEGS HCE Glass Breakage



Kramer Junction SEGS Reflectivity