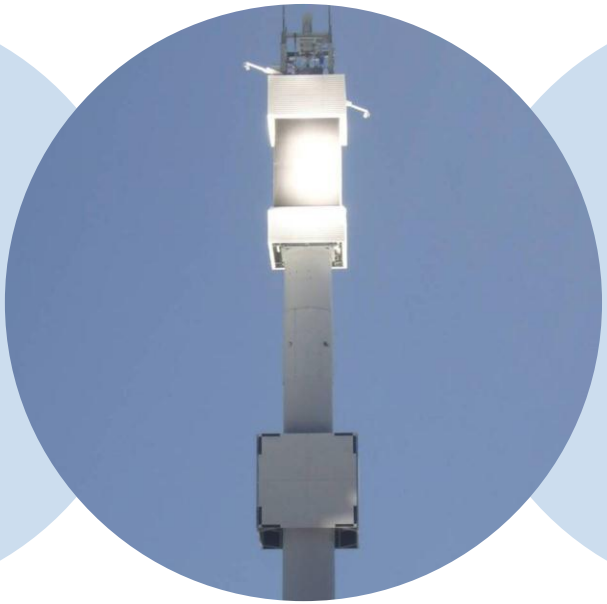
# Solar boilers

## Evolving issues with an evolving technology



May 14, 2012

Tim Zoltowski

Zurich Services Corporation

**Risk Engineering**

Zurich HelpPoint

# Introduction

- How is Concentrated Solar Power (CSP) used today
- What are the newest advances in CSP
- What are the emerging operational and code compliance issues associated with CSP

# Introduction to CSP

- Concentrated solar power
  - Heliostats concentrate solar thermal energy onto a relatively small area
    - Parabolic trough
    - Linear reflector
    - Parabolic dish
    - Power tower
  - Power tower
    - Higher output capacities
    - Higher peak operating temperature
    - Greater efficiency

# Design

- A typical power tower arrangement consists of
  - Field(s) of heliostats
  - Tower mounted receiver (adaptation of water tube boiler design)
  - Steam turbine, for power producers

# Design

- A typical power tower arrangement consists of
  - Field(s) of heliostats
    - Arrangement of mirrors automatically controlled to track the sun and focus the thermal energy on a point in space

# Design

- A typical power tower arrangement consists of
  - Field(s) of heliostats
    - Arrangement of mirrors automatically controlled to track the sun and focus the thermal energy on a point in space
  - Tower mounted receiver
    - Weight: 65 tons; height: 165 feet or higher
    - Adaptation of typical water tube boiler design

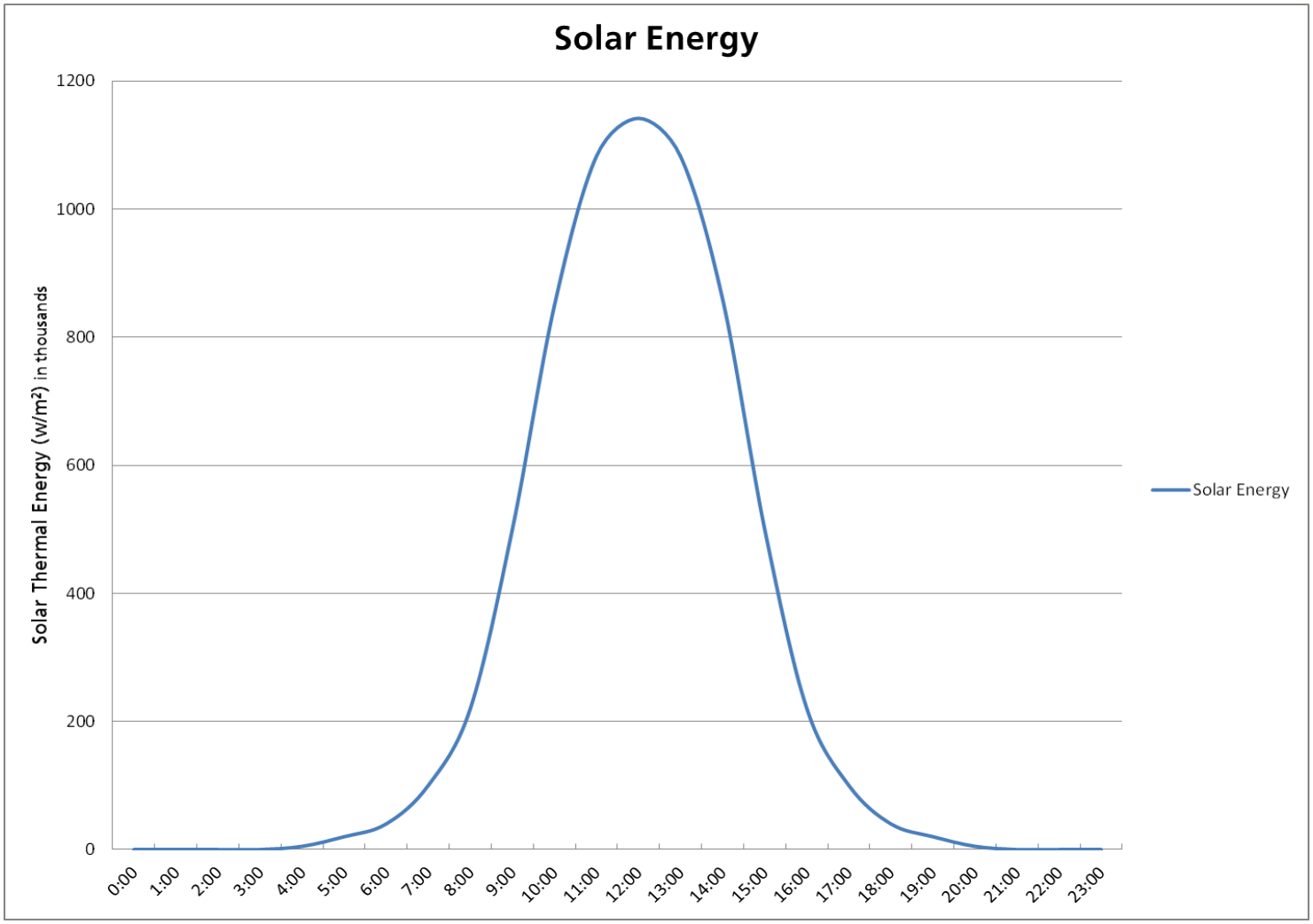
# Return on investment

- Start-up capital is three times that of conventional power plant
- Operating costs are roughly equal
- No fuel costs

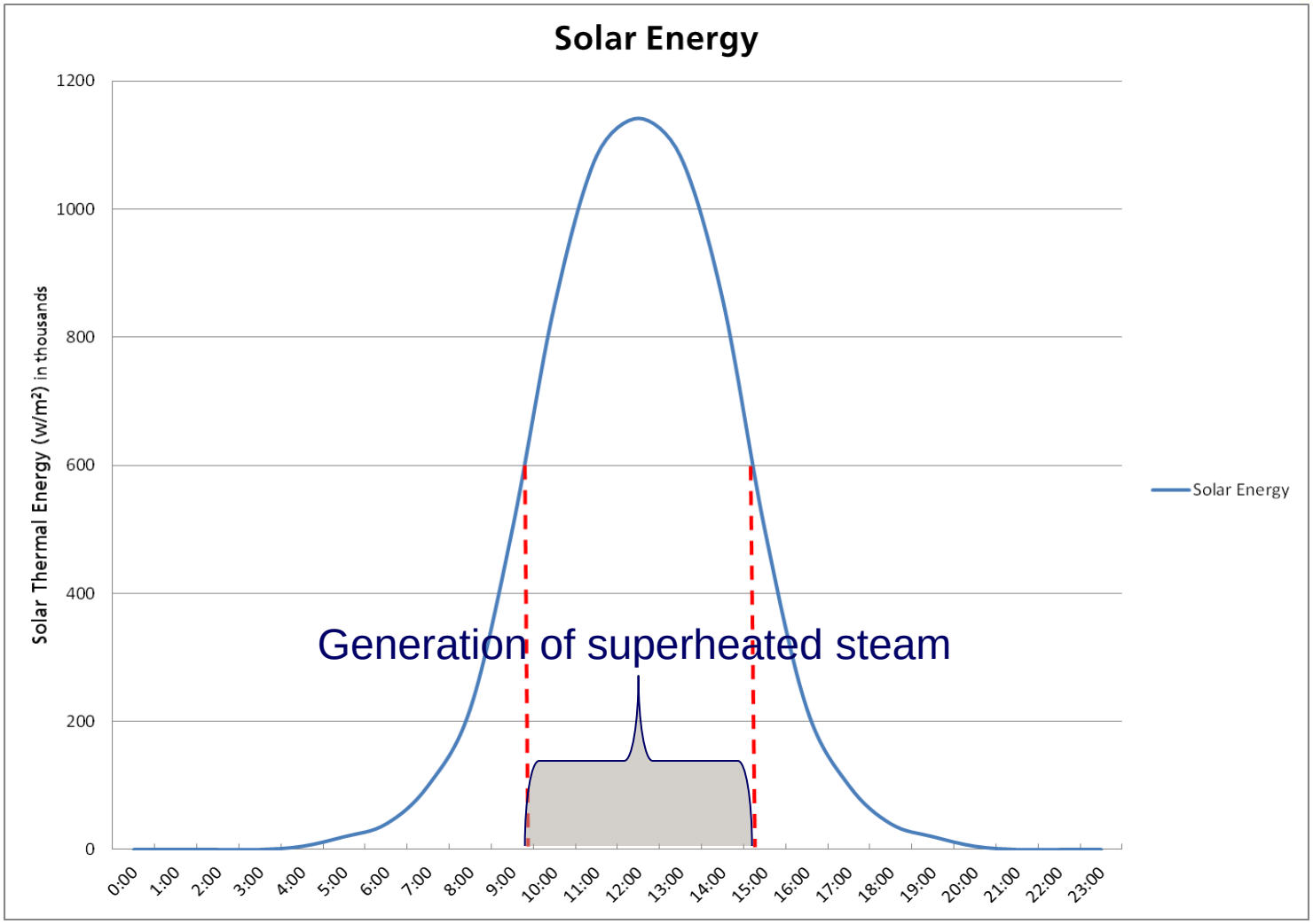
# Operating conditions

- Desert climate
  - Advantages
    - Maximum availability of solar thermal energy
    - Minimum attenuation of solar thermal energy
  - Disadvantages
    - Wind conditions
    - Rapid loss of stored energy
    - Heliostat maintenance

# Typical solar energy curve



# Typical solar energy curve



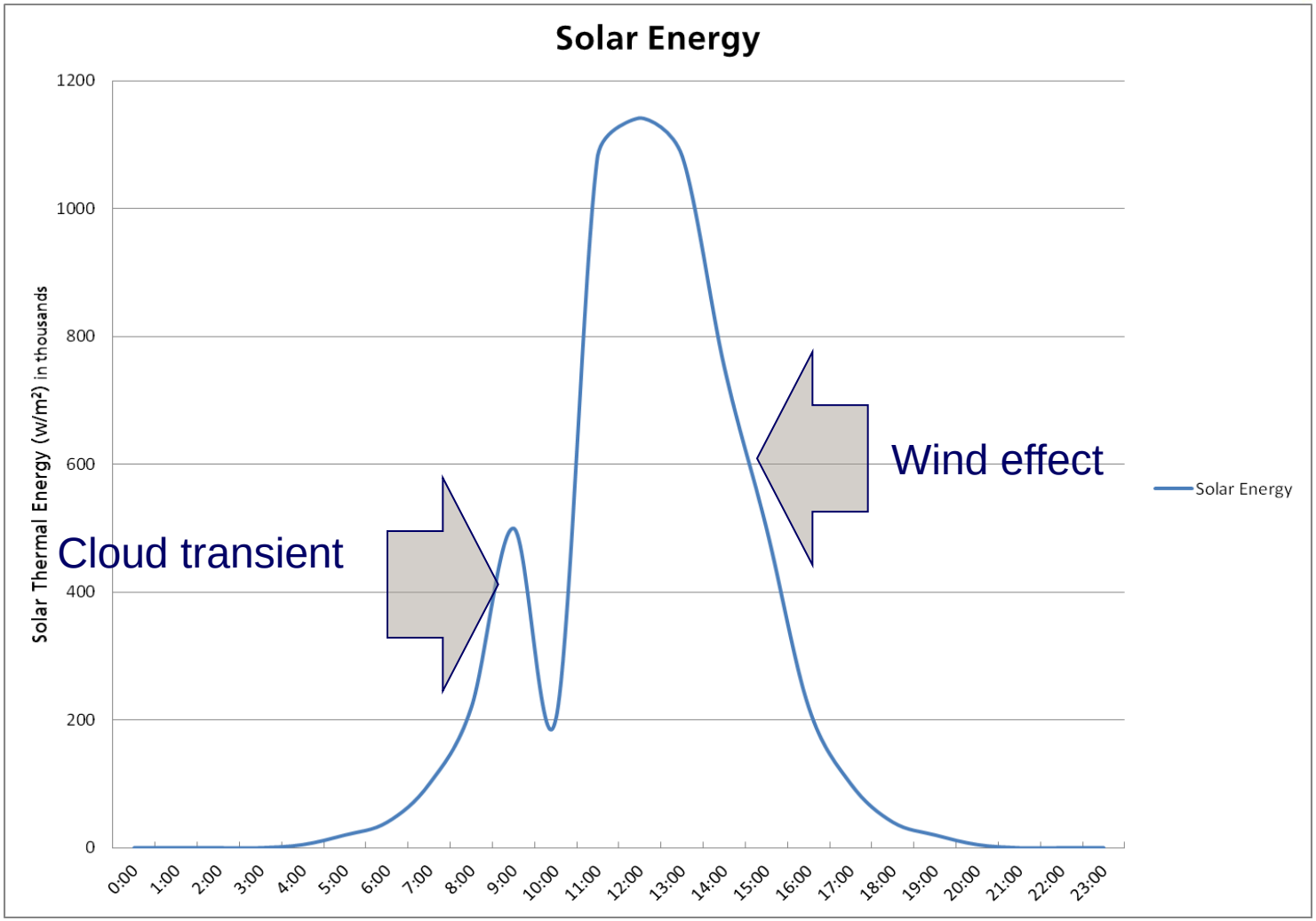
# Sustainability concerns

- Heat-up/cool-down rate
  - Rapid heat-up during initial hours of sunlight risk exceeding allowable stress levels
  - Rapid cool-down due to convective heat loss
- Water chemistry
  - Experienced issues with
    - Heavy scaling on waterside
    - Oxygen corrosion
- Deaerator inefficiency
  - Unable to maintain operating temperature
  - Oxygen content of feedwater
  - Use of secondary gas-fired boiler may affect renewable energy status

# Evaluation concerns

- Inspection and maintenance
  - Receiver (boiler) located on top of 200-foot or higher tower
  - Design may not be conducive to internal inspection
    - Internal critical due to water chemistry concerns
    - Use of Boroscopic examination for thorough internal inspection
  - Environmental factors may prohibit entrance into tower
  - Lockout/tagout procedure must include repositioning and de-energizing heliostat servo motors
    - Control often times at alternate location

# Cloud & wind effect



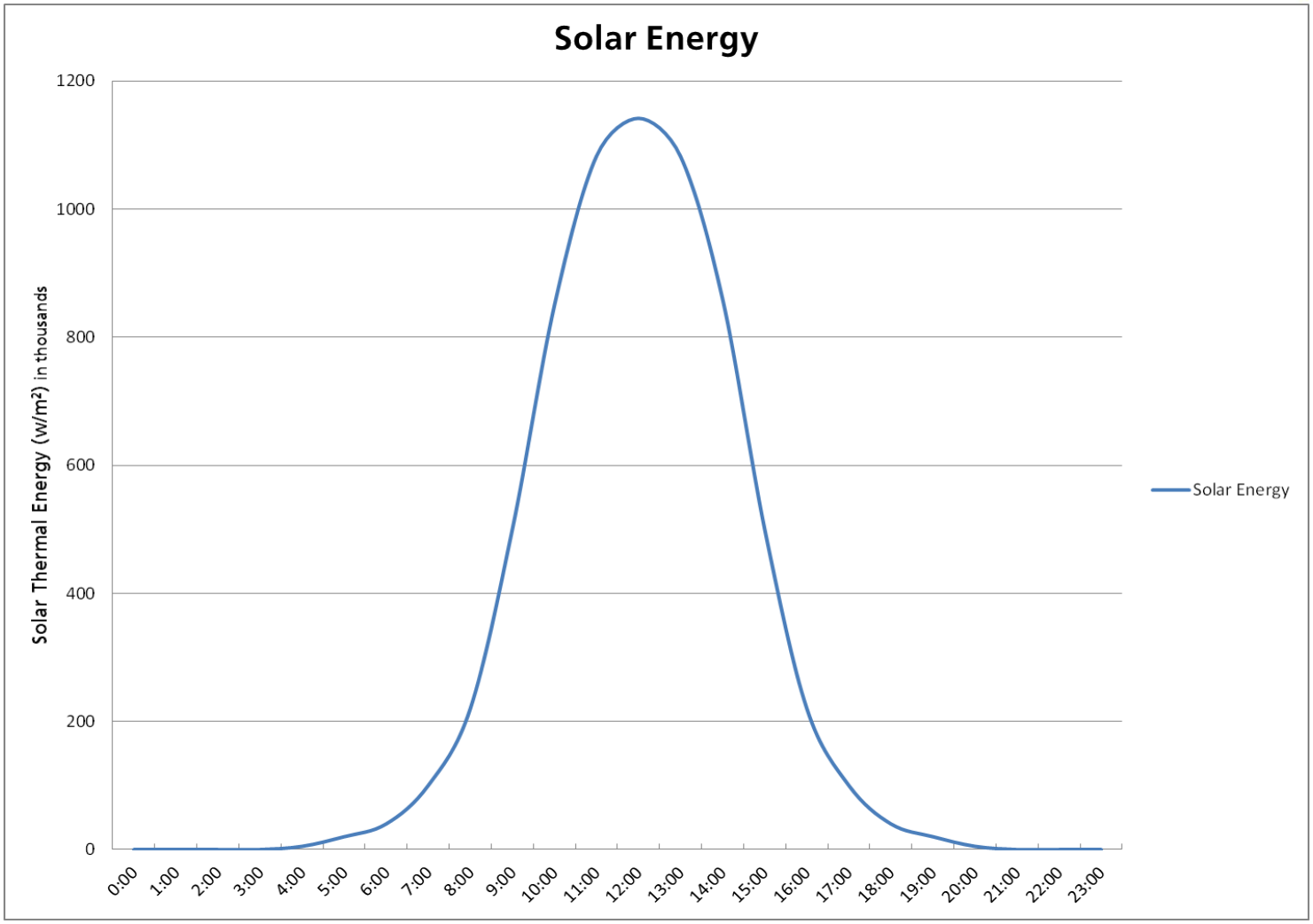
# Operational concerns

- Overcast skies render unit inoperable
- Cloud transient
  - Supplement loss of energy by additional heliostat focus
  - End of transient with numerous heliostats in view
  - Detection algorithm needed to prevent rapid overheating of receiver material at end of transient
- Heliostat control failure
  - Damage to structural surfaces
  - Trip position critical

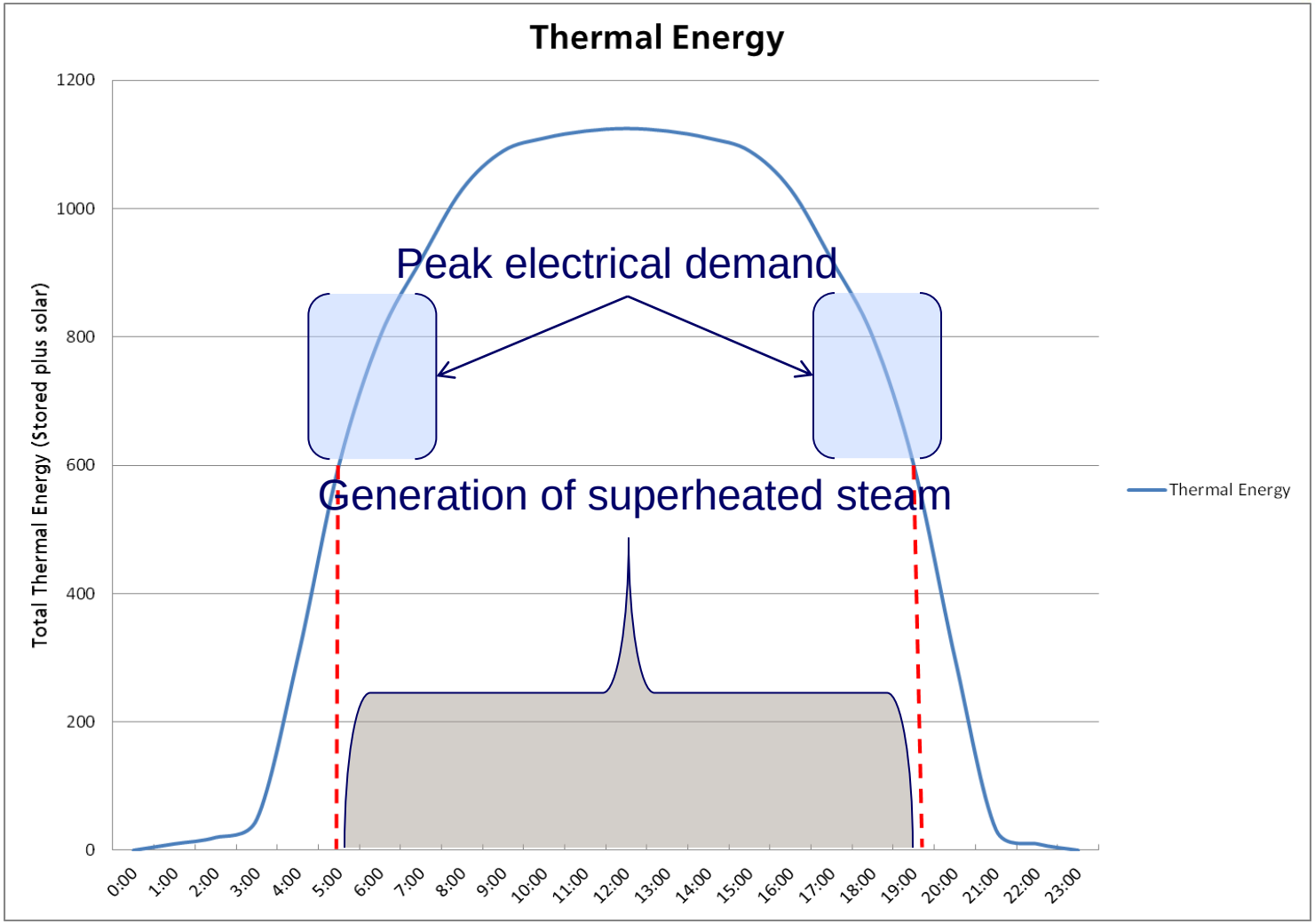
# Operational concerns

- Efficiency and maximum output
  - Cleanliness of heliostat surface
    - Maximize transfer of solar thermal energy
  - Minimizing the loss of stored energy
  - Molten salt to store thermal energy
    - Aid in maintaining DA operating temperature
    - Allow for longer daily production periods

# Typical solar energy curve



# Possible thermal energy curve
## (molten salt)



# Thank you


The information in this publication and presentation was compiled by Zurich Services Corporation from sources believed to be reliable. Further, all sample policies and procedures herein should serve as a guideline which you can use to create your own policies and procedures. We trust that you will customize these samples to reflect your own operations and believe that these samples may serve as a helpful platform for this endeavor. Any and all information contained herein is not intended to constitute legal advice and accordingly, you should consult with your own attorneys when developing programs and policies. We do not guarantee the accuracy of this information or any results and further assume no liability in connection with this publication and presentation and sample policies and procedures, including any information, methods or safety suggestions contained herein. Moreover, Zurich Services Corporation reminds you that this cannot be assumed to contain every acceptable safety and compliance procedure or that additional procedures might not be appropriate under the circumstances. The subject matter of this publication and presentation is not tied to any specific insurance product nor will adopting these policies and procedures ensure coverage under any insurance policy.