



# INTRODUCTION TO DISH STIRLING CSP TECHNOLOGY



SOLAR SOUTH  
AFRICA  
21 June 2011



# Main CSP Technologies

## Parabolic Trough



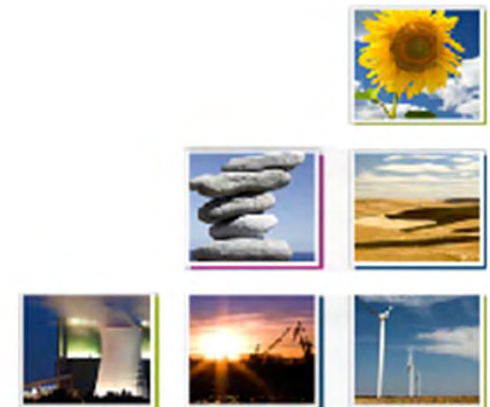
## Linear Fresnel Reflectors



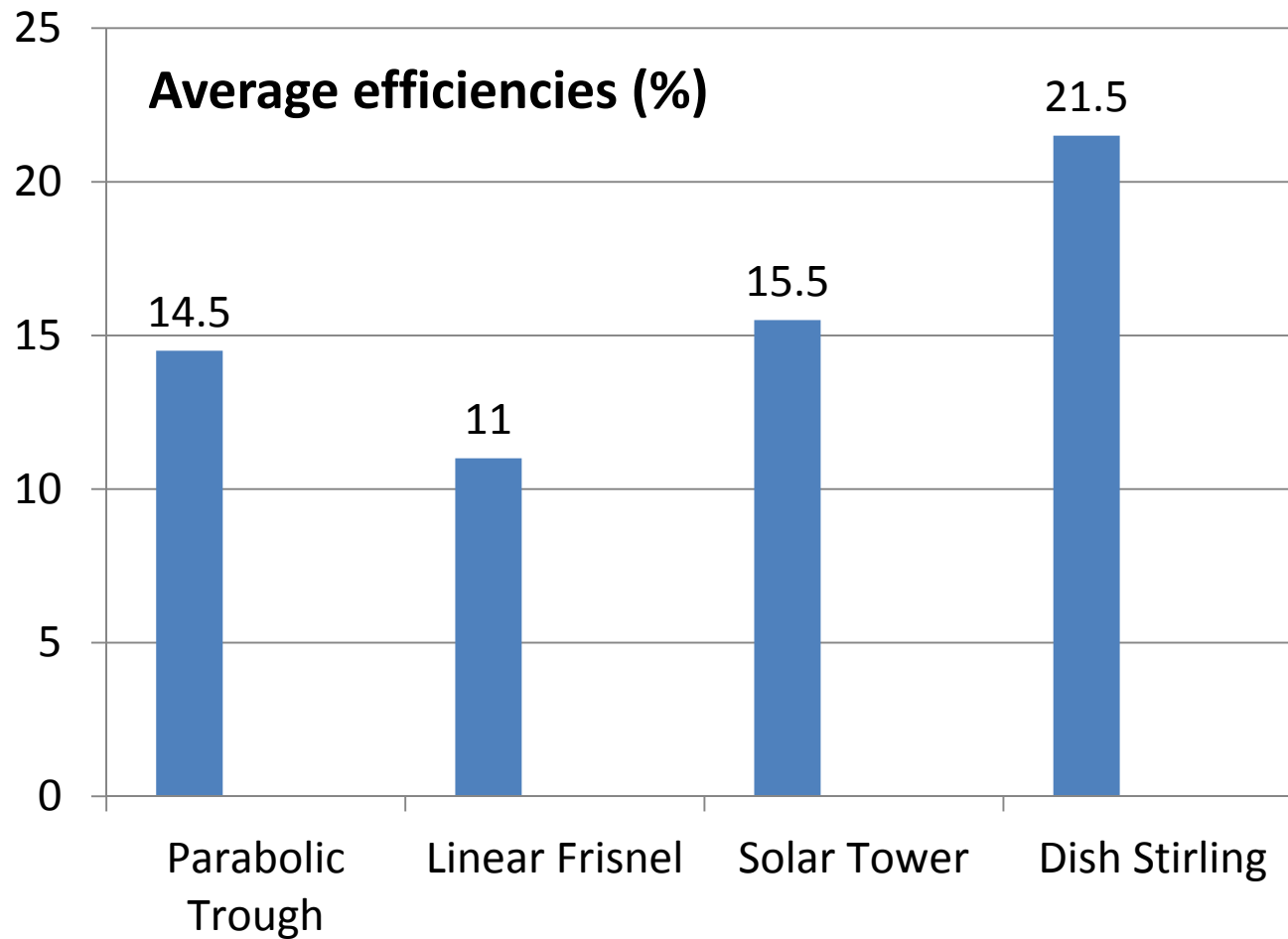
## Solar Tower



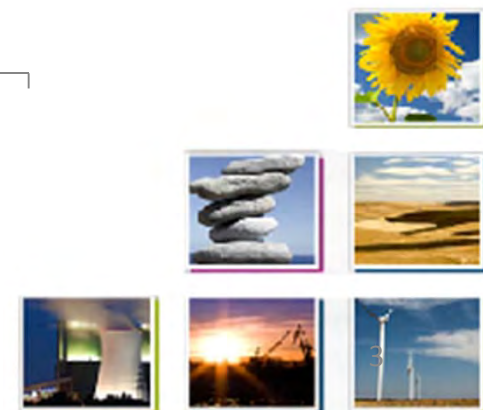
## Dish Stirling



# Efficiency of Different CSP Systems

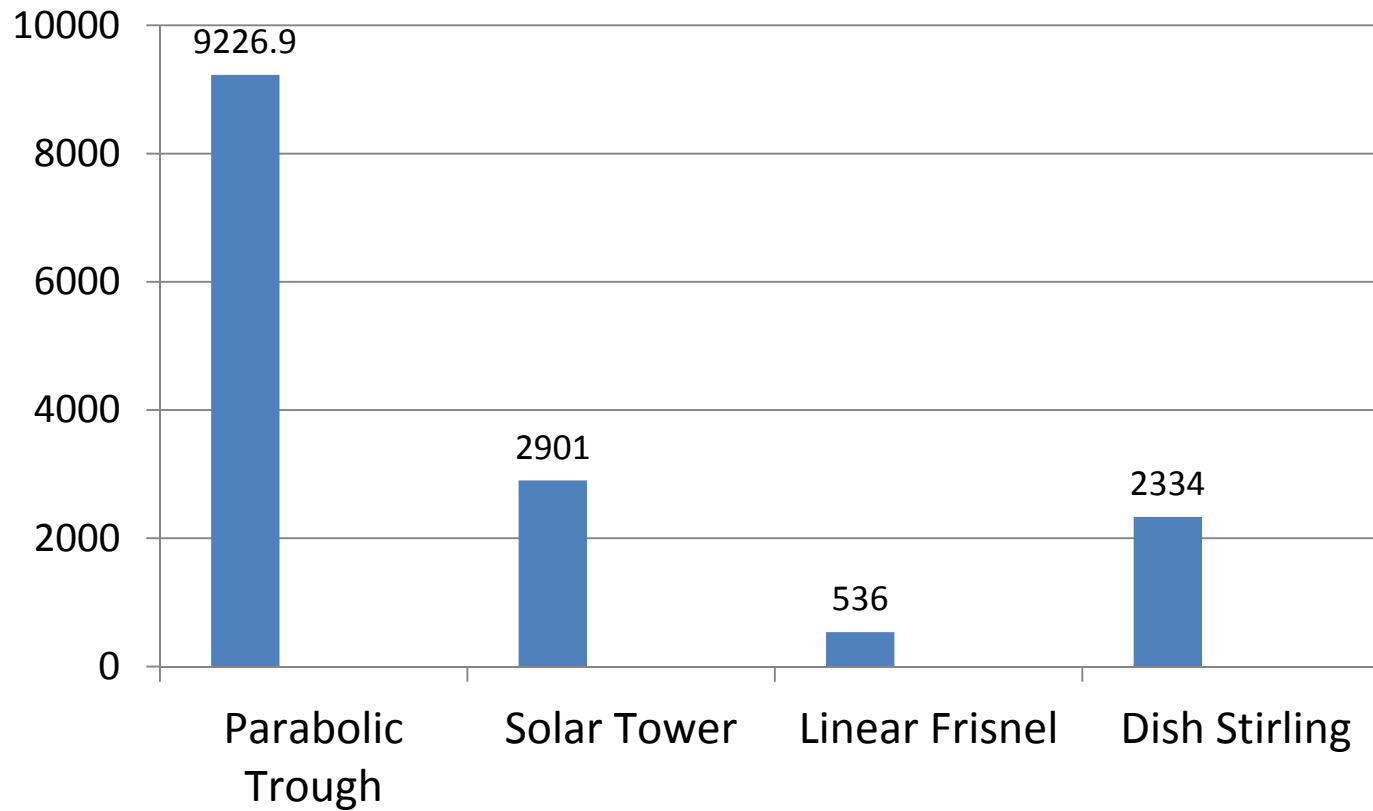


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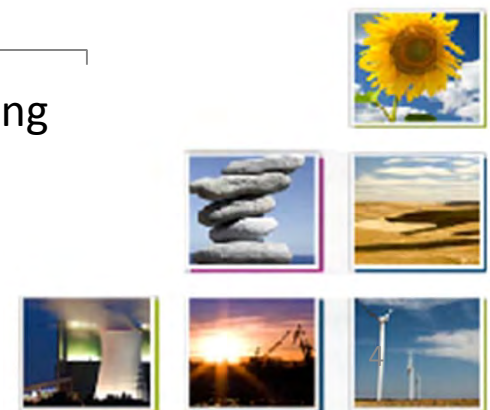


# Planned CSP Capacity per Technology

## Planned CSP Capacity per Technology (MW)

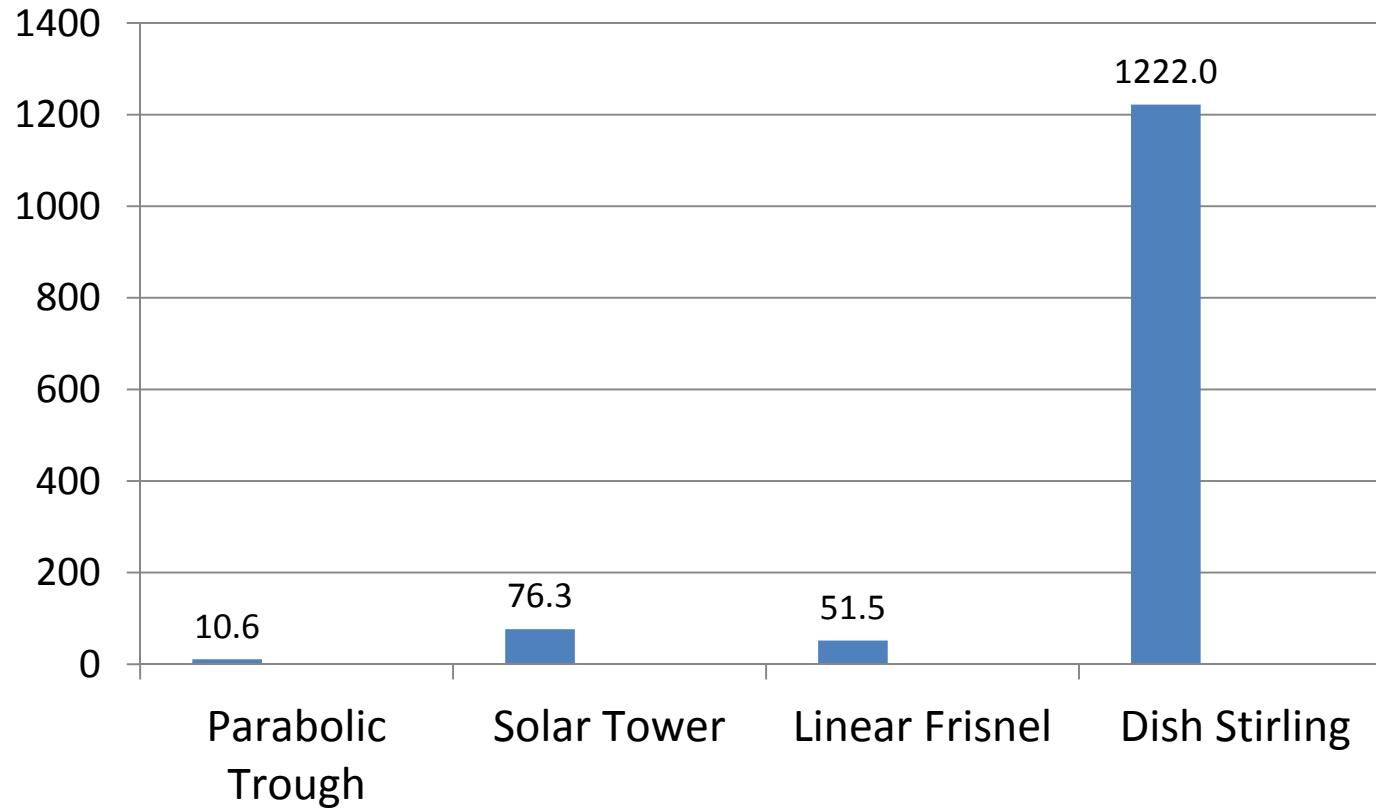


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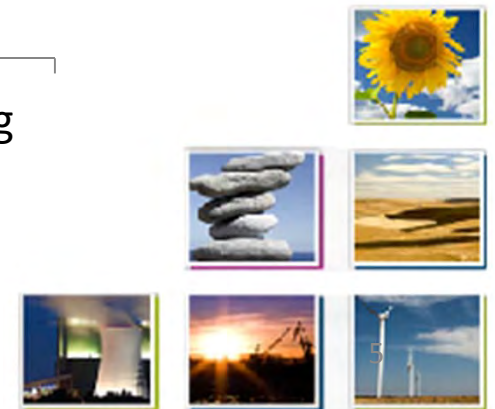


# Planned/Installed Capacity Ratio per Technology

## Planned/Installed Capacity Ratio per Technology (MW)



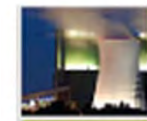
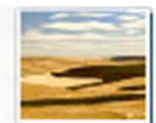
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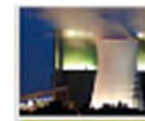
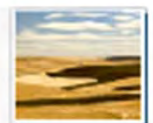
# Advantages of Dish Stirling Technology

- Smaller land requirement due to higher efficiencies (2.5 Ha/MW).
- Modularity enables uniquely scalable power sizes.
- Economy through mass production rather than economy of scale.
- Short construction times – 10 months, 20 MW.
- High localization and job creation potential.
- No water needed for cooling.
- No need for flat terrain – can be installed on rolling terrain.
- Low maintenance and operating costs.
- Flexible and simple installation using low skilled labour.
- More stable output than PV.
- Dual-axis tracking, which results in high capacity factor ( $\pm 32\%$ ).

**All these translate into very attractive economics**

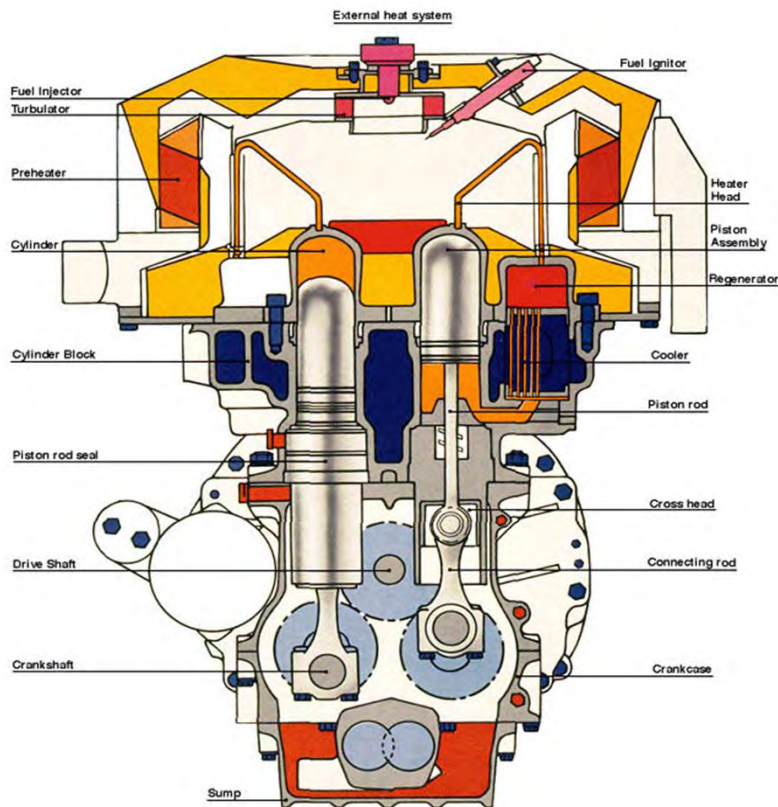


# Description of a Dish Stirling System

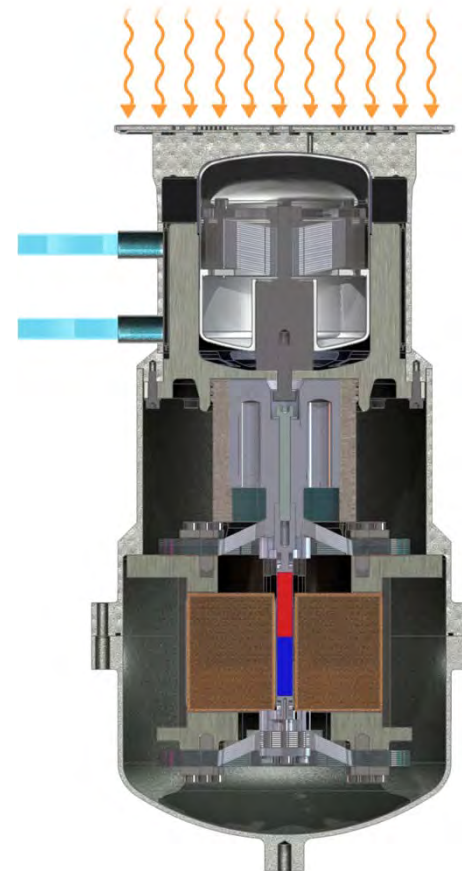


# Two Types of Stirling Engines

## Kinematic



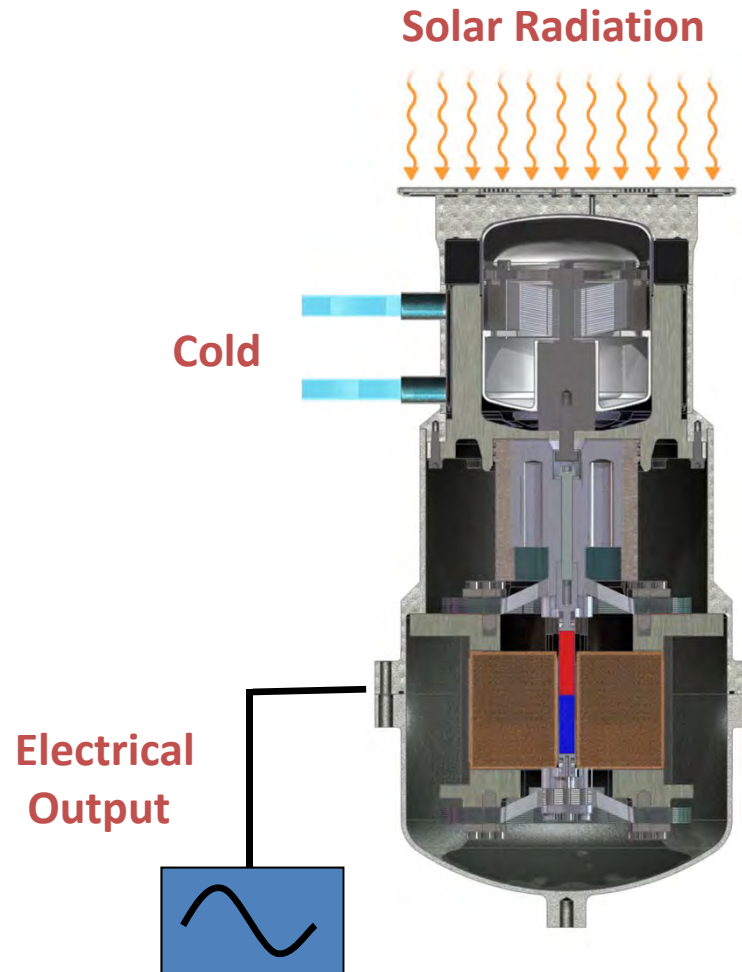
## Free-Piston





# Infinia's FPSE Stirling Engine

- Mature
  - NASA, DOE, DOD
  - Bosch, Rinnai, Merloni, Enatec
  - Over million operating hours
- Robust
  - No life-limiting components
  - 25 year service life
- Zero Maintenance
  - Helium working fluid
  - Sealed unit
  - No lubricants



3 kW peak at 850 W/m<sup>2</sup>

24% net efficiency

Two-axis tracking

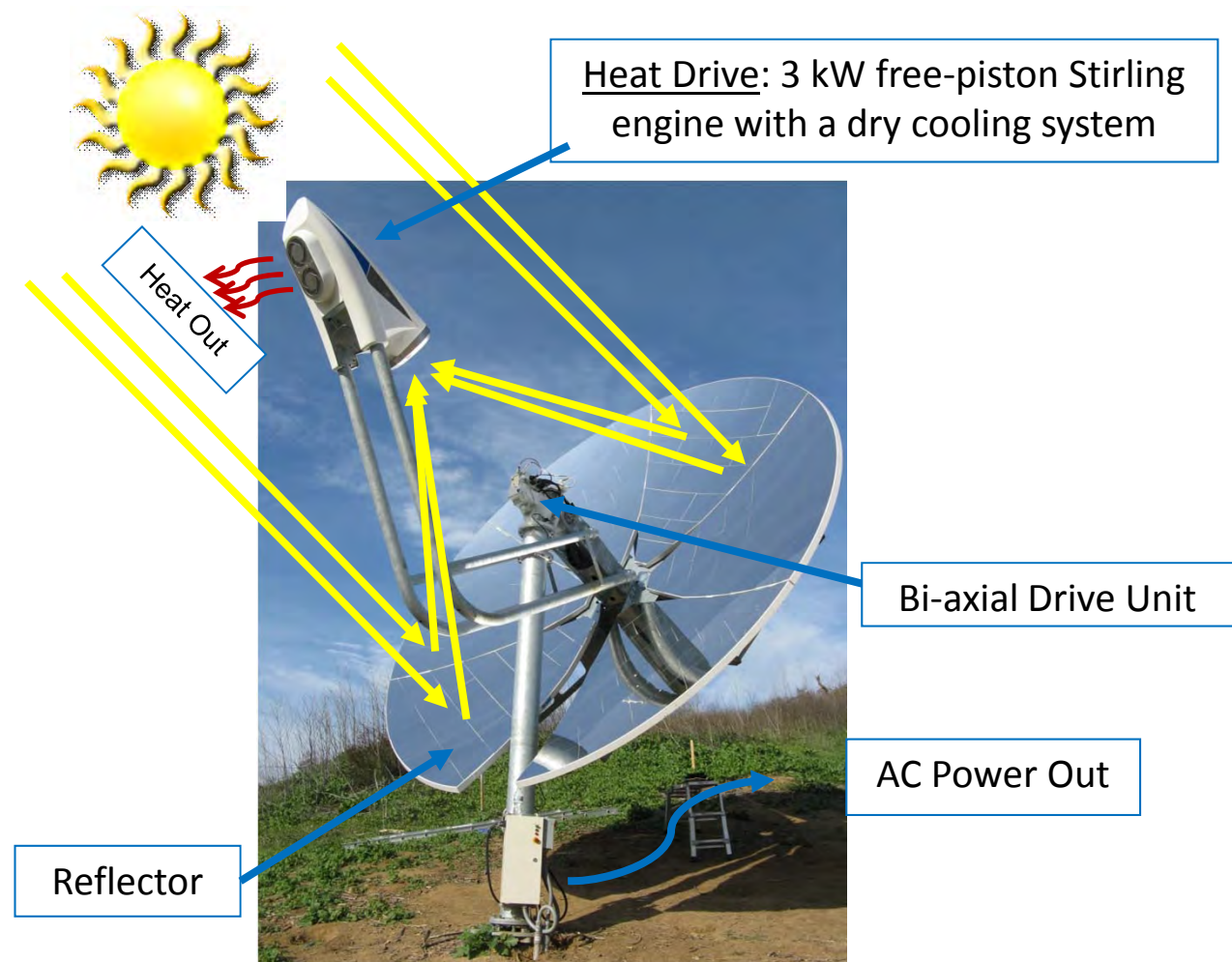
Zero-alignment optics

Closed-loop cooling system

Remote/unattended operation

Fully certified and grid-safe

No water for cooling



# Commercial Units – Casa Grande, Arizona

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# Pilot Units - Sandia, NM - September '09

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# 30 Pilot Units– Spain- since May '09

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# Commercial Units: Yuma, AZ– June'10

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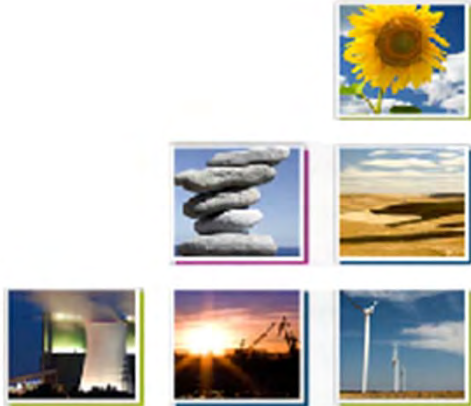
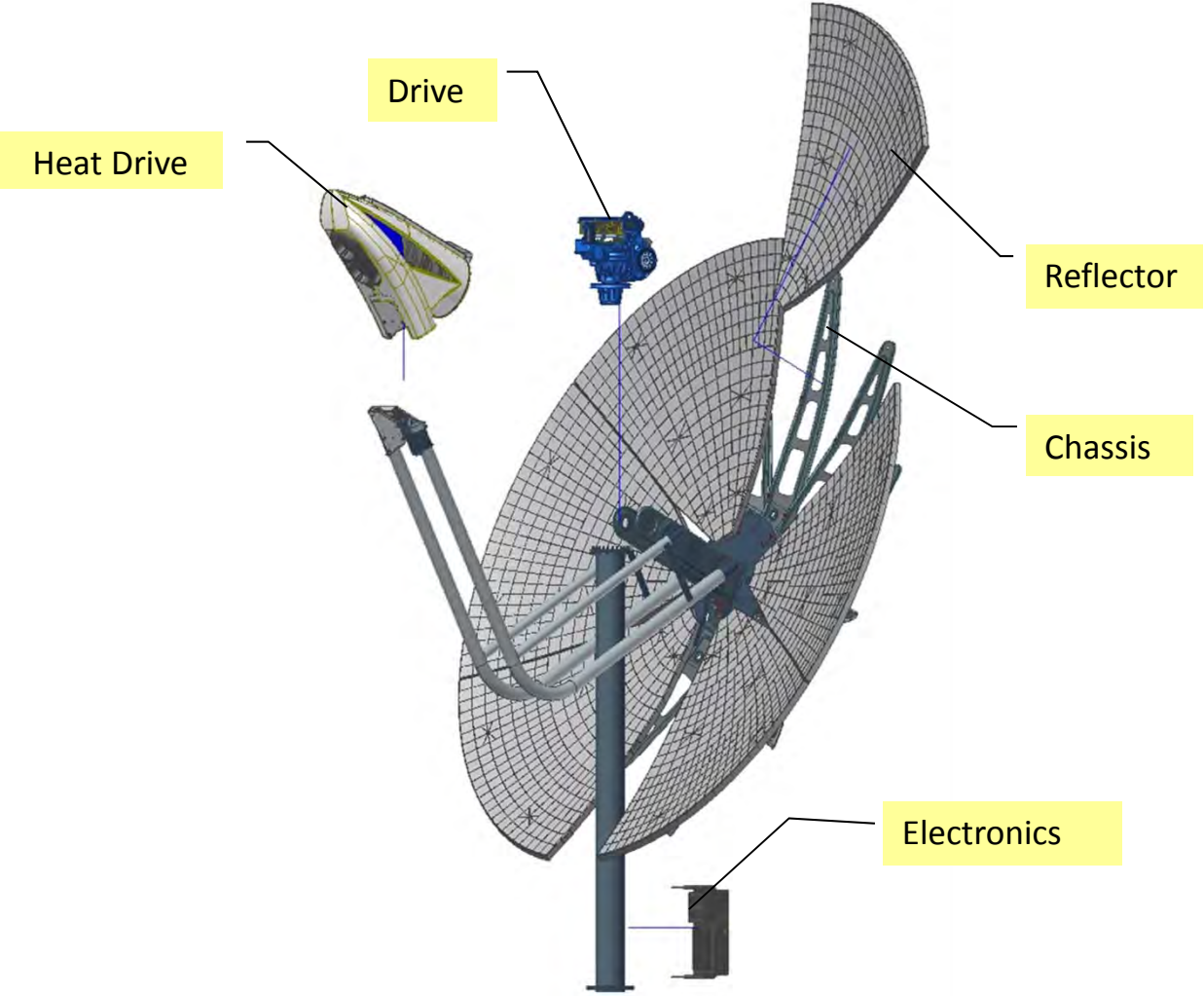


# Designed With Installation in Mind

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# Kit Delivery





# Ease of Installation

- *Materials Delivered to Site*
- *Packaged for Ease of Handling*

# Ease of Installation

- *Basic Hand Tools*
- *No Special Skills Required*
- *8 Man Hours Targeted for Unit Assembly*



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# *Ease of Installation*

- *Assembled at Ground Level*



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# *Ease of Installation*

- *No Mirror Adjustment*



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## *Ease of Installation*

- *Simple Mounting*
- *Minimal Connections*



# Infinia's Sales Pipeline

- 82MW under contract
  - Europe (Spain)
  - India
  - USA
- 400MW under MOU
  - China
  - Europe
  - USA
- 1.5GW indicative interest



# Financing

- US ExIm Bank has thoroughly evaluated the PowerDish technology and has given tacit approval to fund all PowerDish projects.
- ExIm Bank funds about 75% of total project cost.
- Repayment Term: 18+ years.
- Standard minimum interest rate: 4.71 %.
- **Small risk to investors, NO risk to SA Government.**

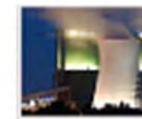
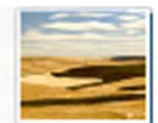


# Conclusion

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Dish Stirling: A solution to large or small-scale CSP which is:

- Affordable
- Flexible
- Scalable
- Modular
- Reliable
- Available





## Contact information

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