

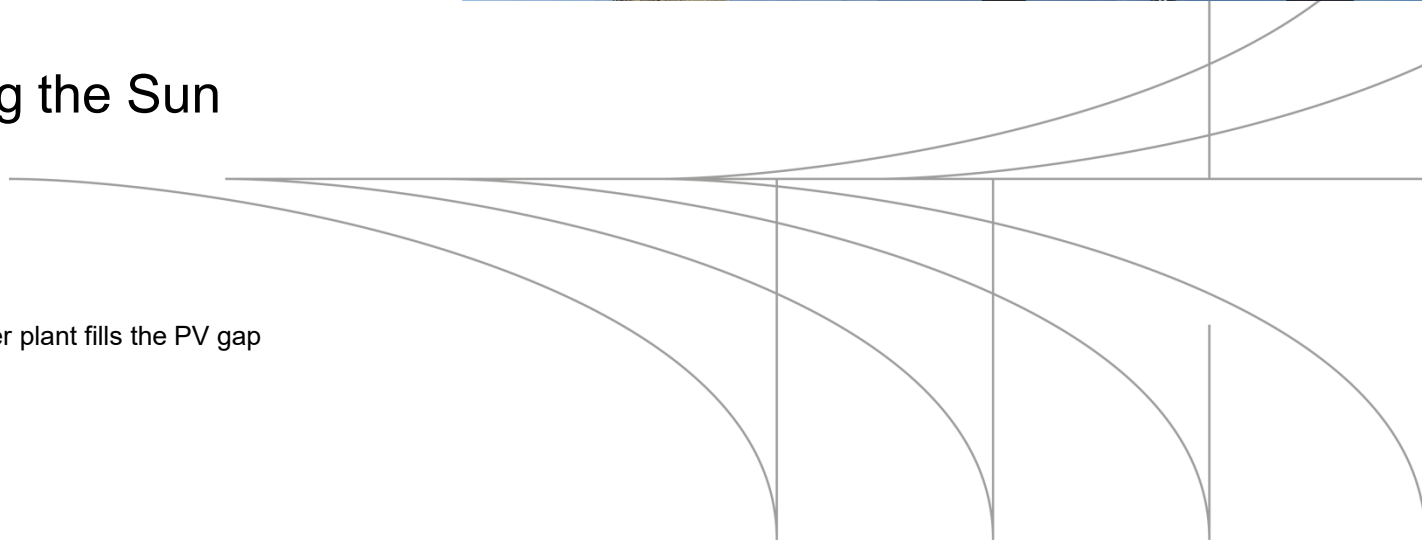
sbp

schlaich
bergemann partner



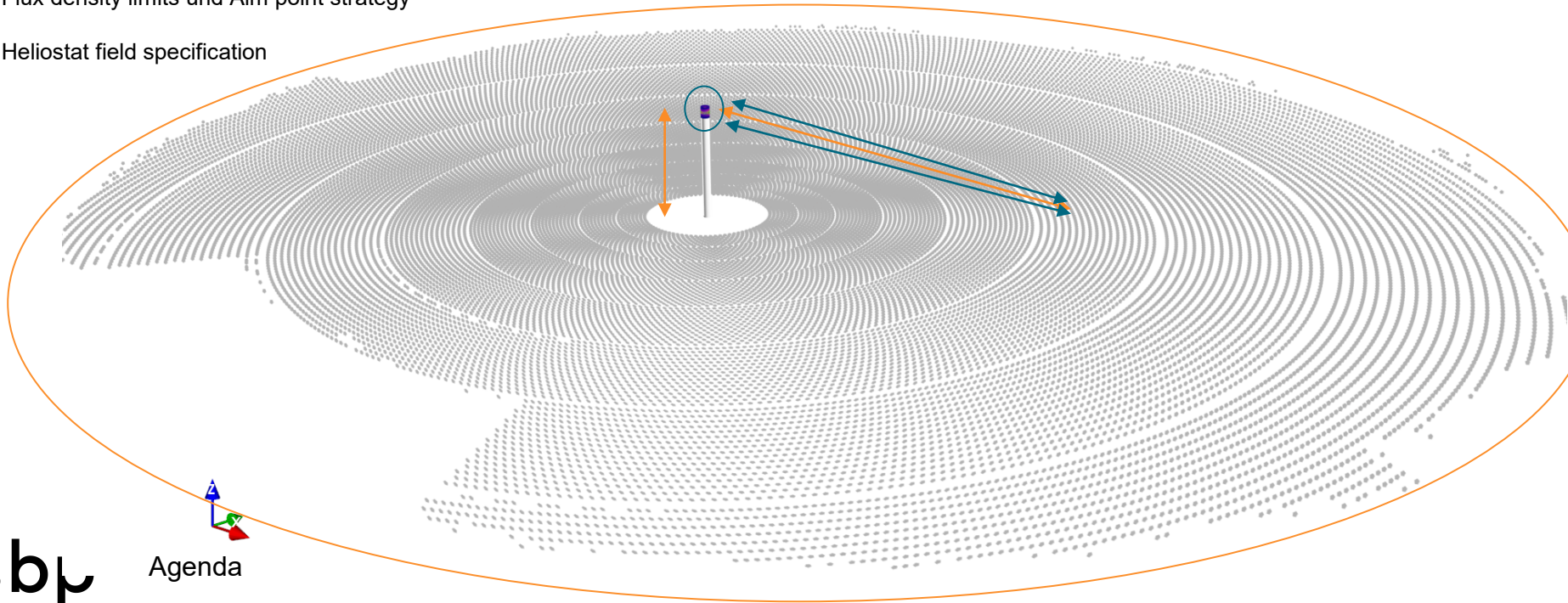
Concentrating the Sun

CSP from dusk till dawn:
Blueprint for 200 MW tower plant fills the PV gap
Fabian Gross



Heliostat field: Layout & Specification

- Boundary conditions
- Tower height
- Interplay Field <-> Receiver
- Flux density limits und Aim point strategy
- Heliostat field specification



Heliostat mirror area

1.5 km²

Receiver nominal capacity

700 MW_{th} = 1700 kg molten salt/s

DNI

2.5 MWh/m²/a

Attenuation

low

Storage

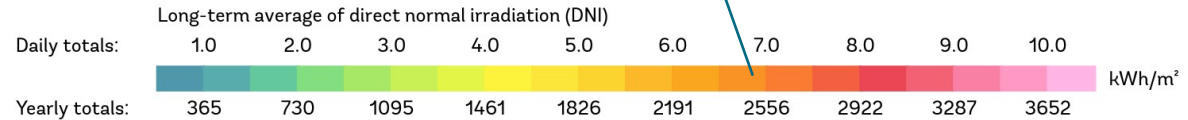
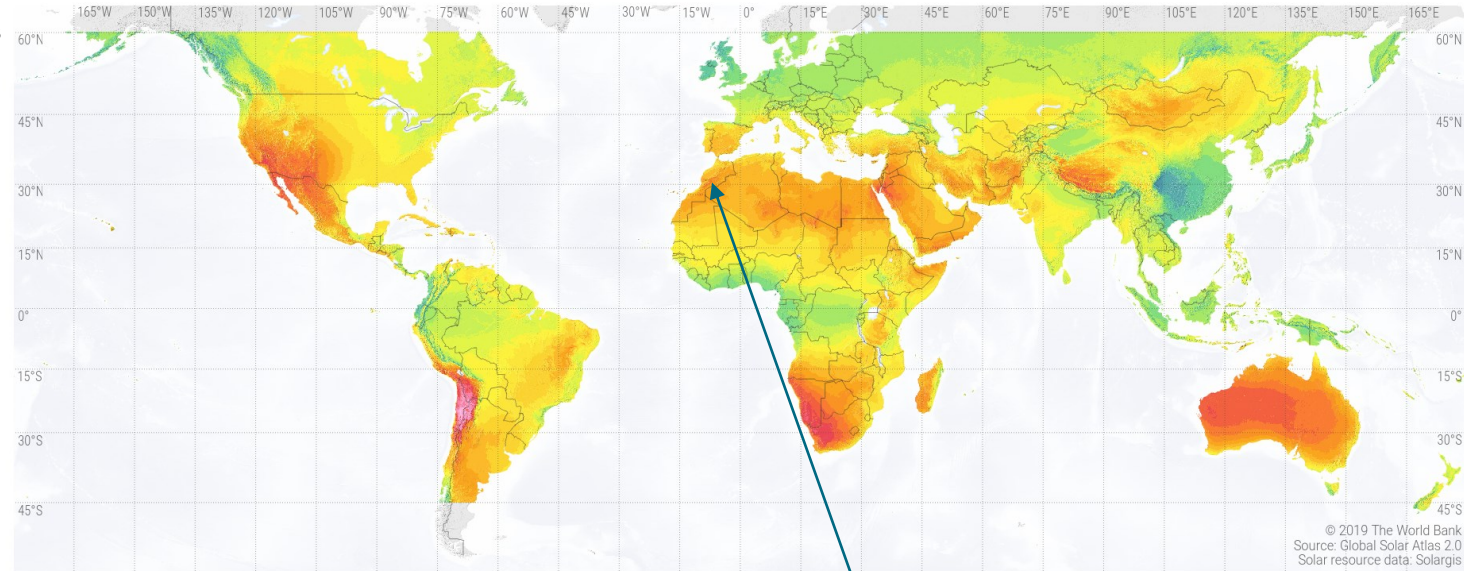
> 6 GWh_{th} = 13 h @ 200 MW_e

Power block

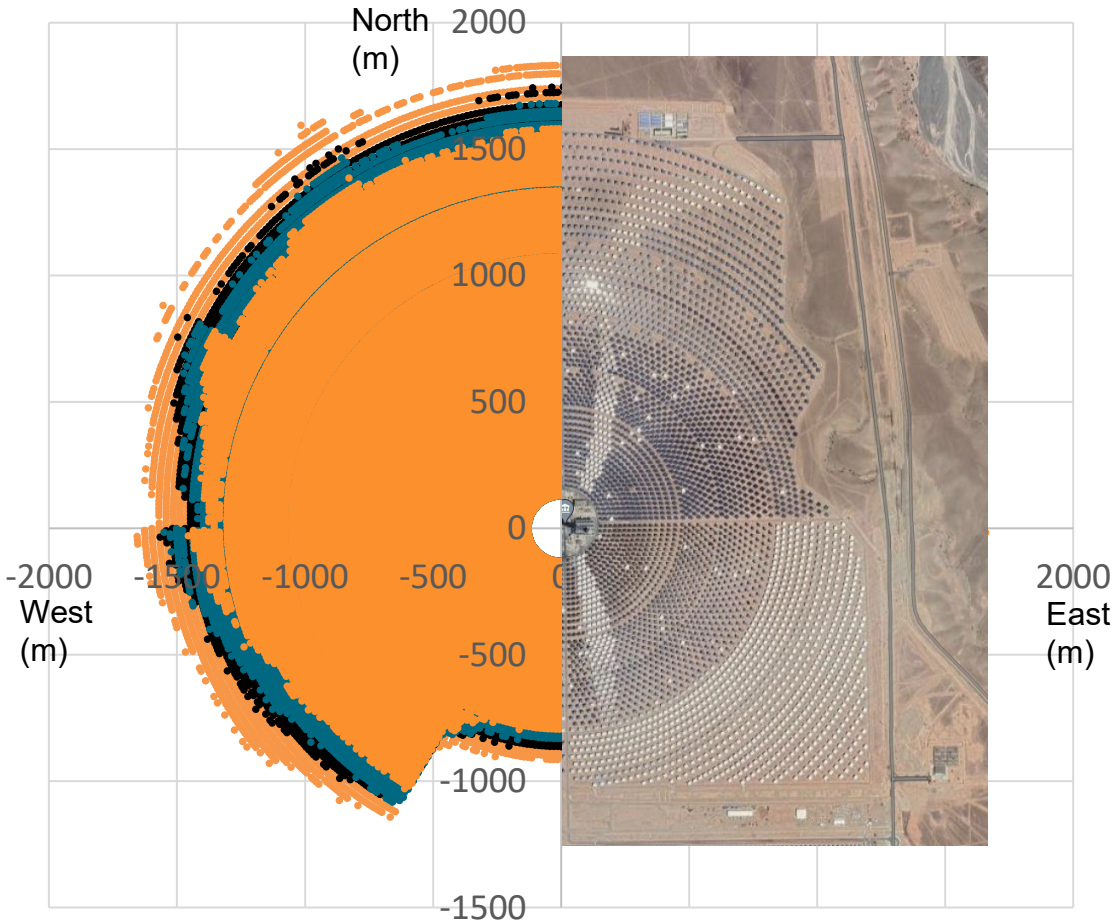
200 or 400 MW_e

SOLAR RESOURCE MAP

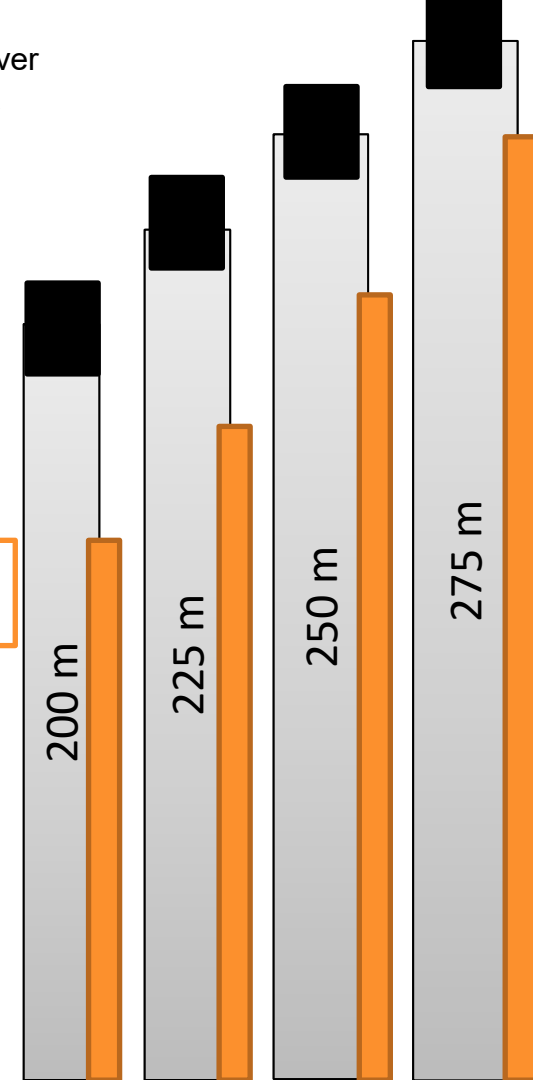
DIRECT NORMAL IRRADIATION



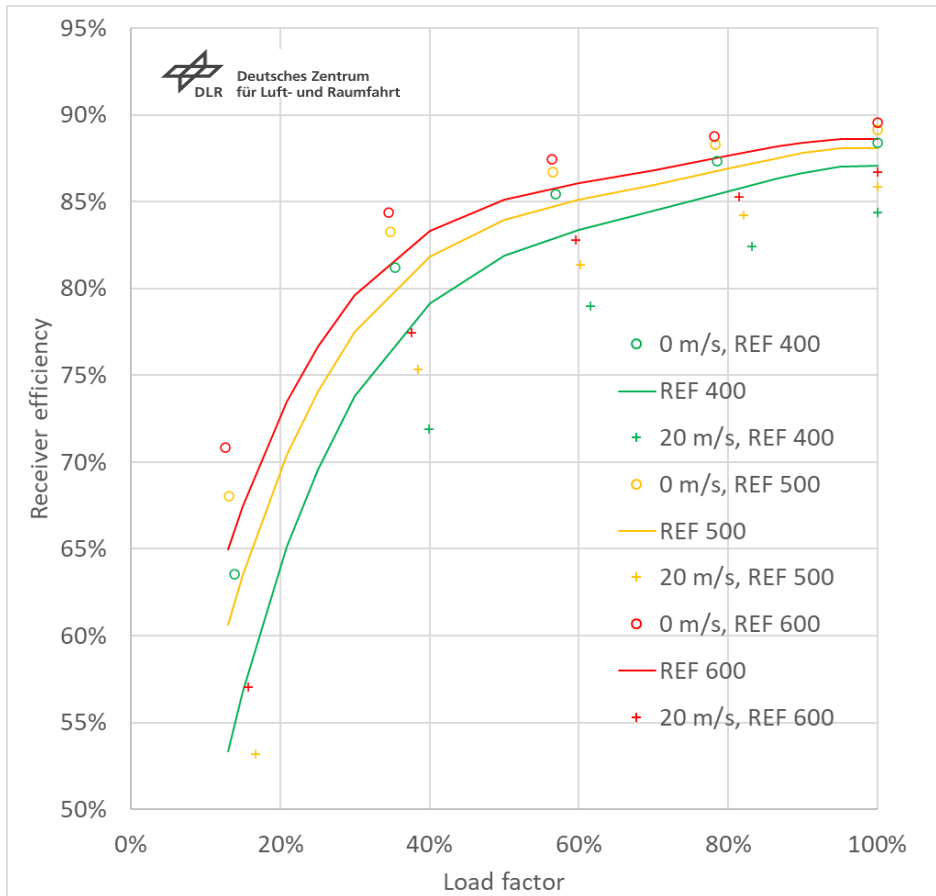
This map is published by the World Bank Group, funded by ESMAP, and prepared by Solargis. For more information and terms of use, please visit <http://globalsolaratlas.info>.



Tower CAPEX

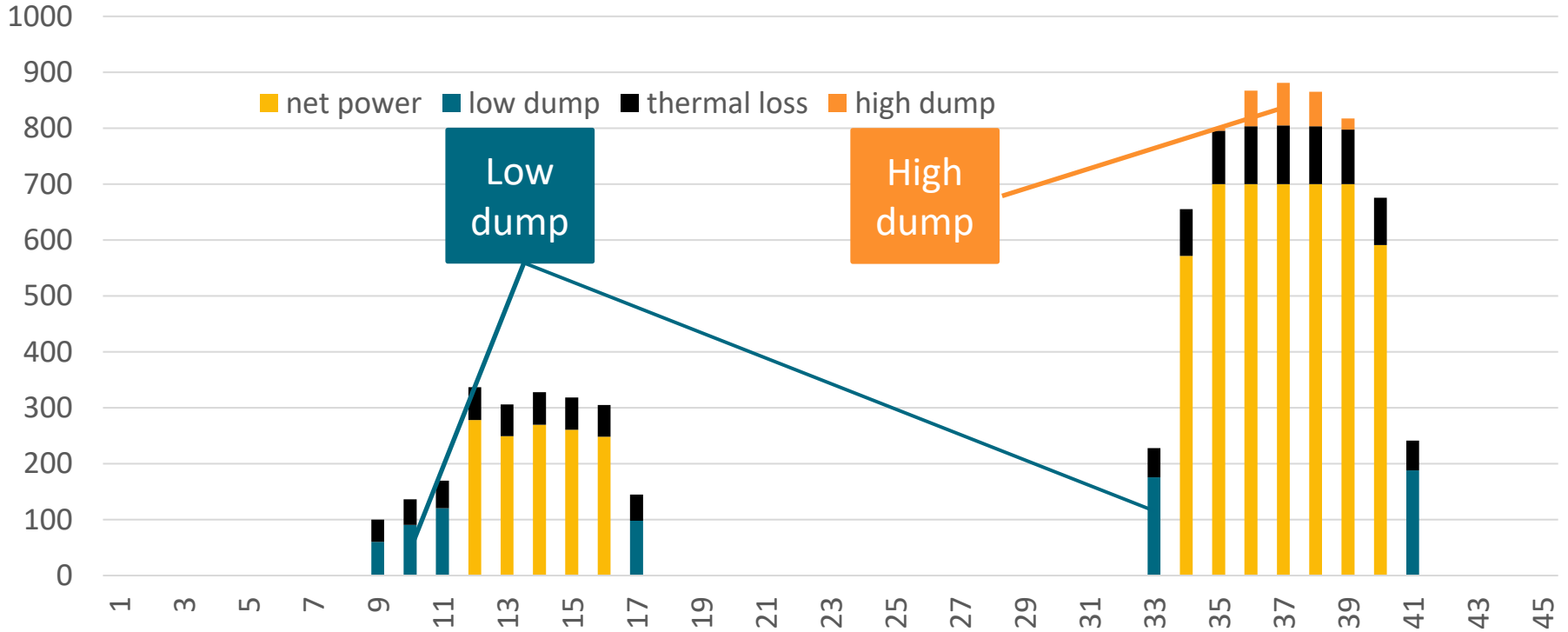


Fields for REF500 with receiver height in [200, 225, 250, 275] m

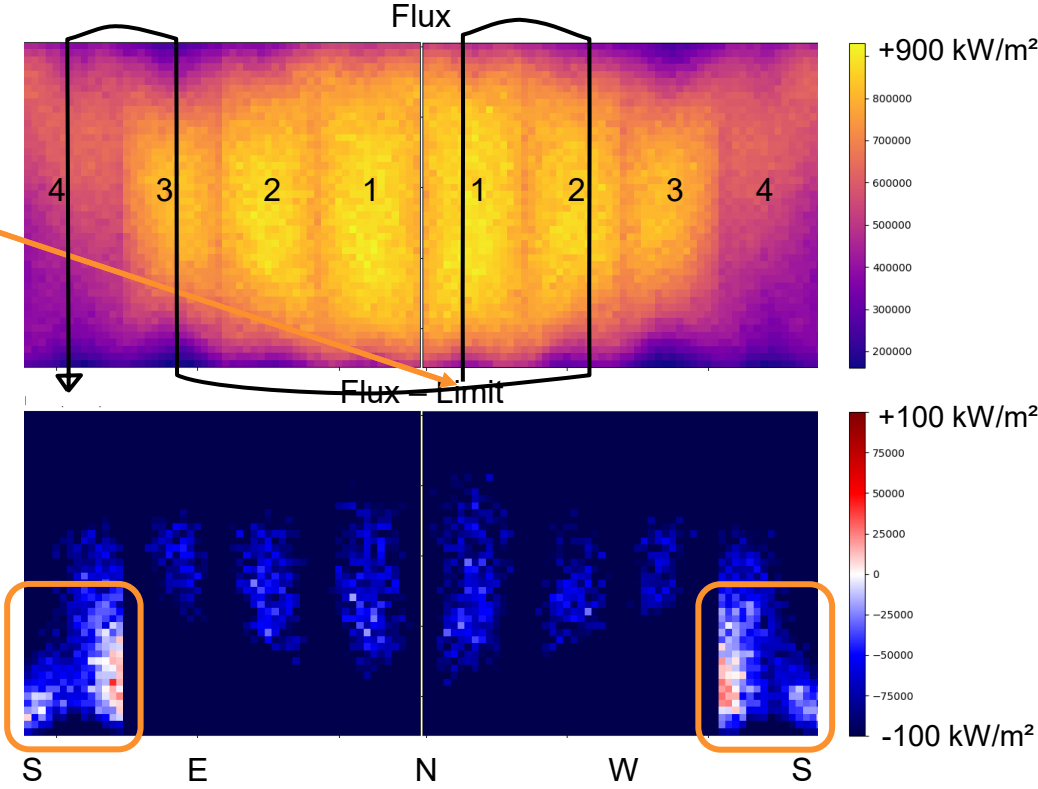
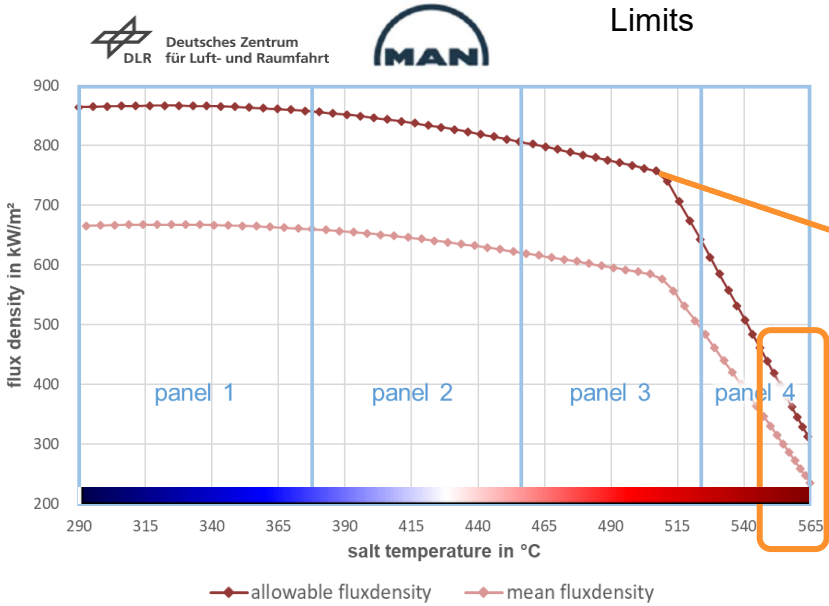


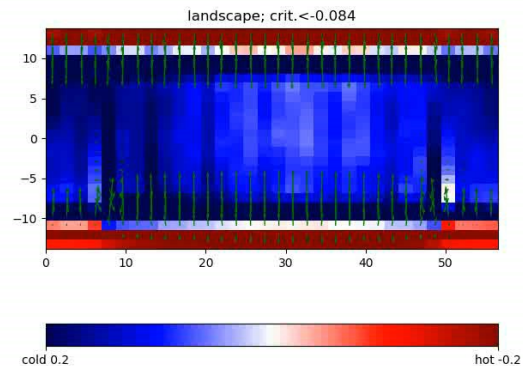
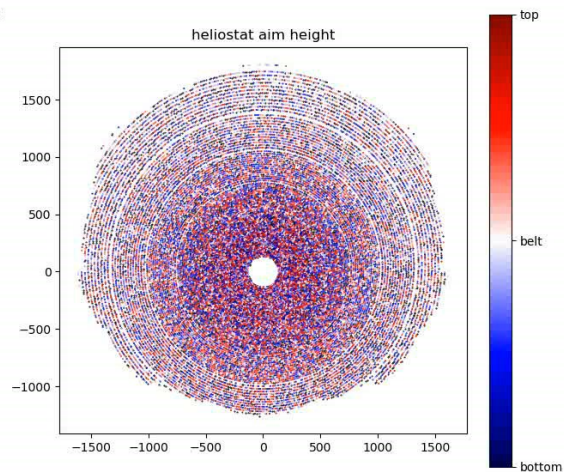
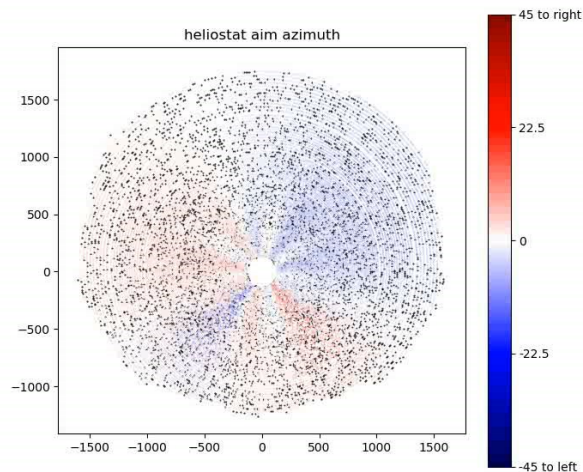
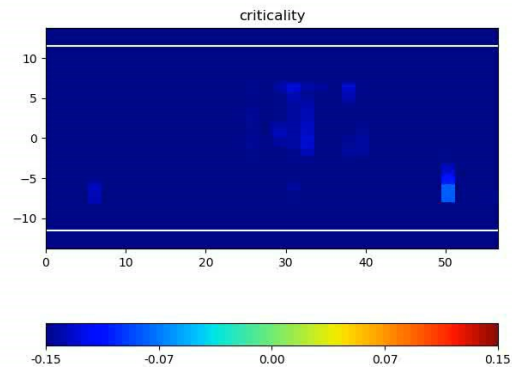
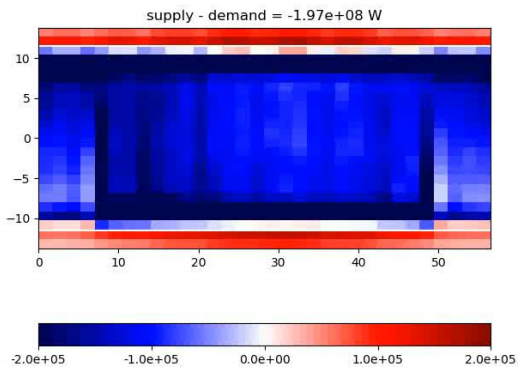
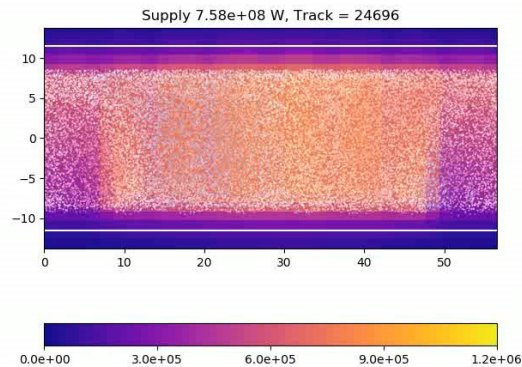
Receiver	Area (m ²)	Avg. Flux (kW/m ²)
REF 400	1753	452
REF 500	1396	562
REF 600	1165	671

Receiver operation

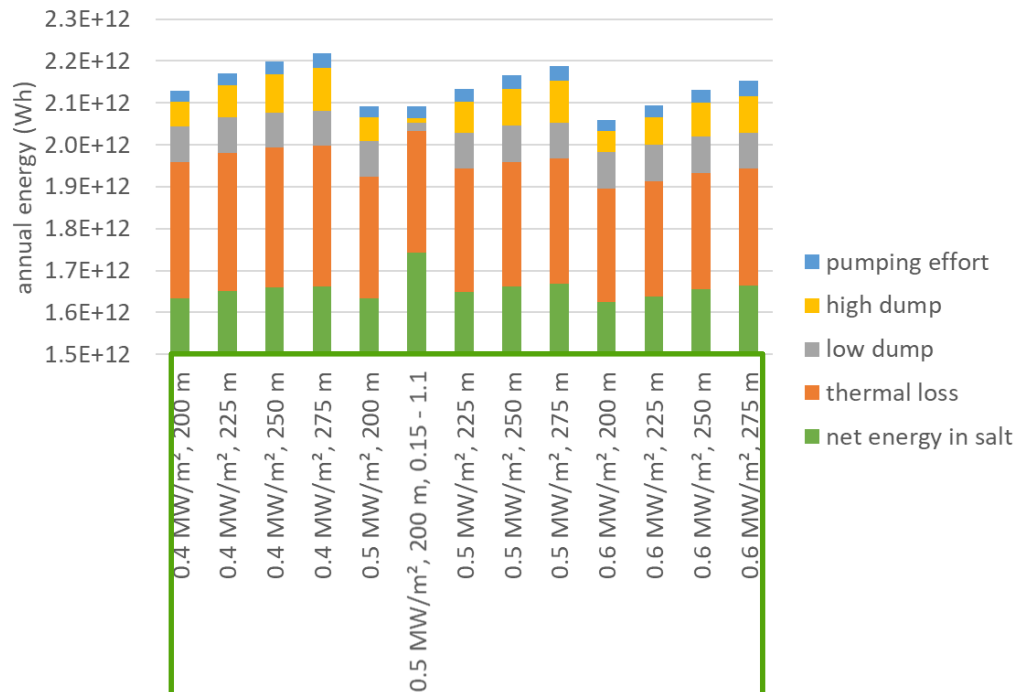


Local receiver limits need dedicated Aim point strategy





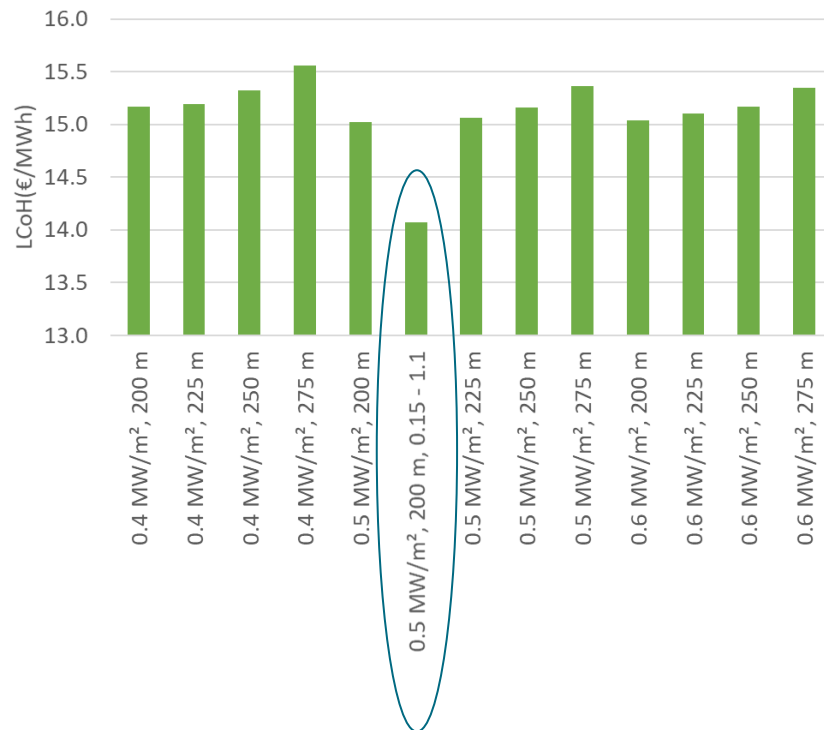
Energy collection and losses



1.7 TWh_{th} / a
= 4.7 GWh_{th} / d
= 1.8 GWh_{el} / d

Tower height – 200 m are techno-economically viable


LCoH




Heliostat field specification

- All relevant parameters with clear definitions
- Boundary conditions / interfaces consolidated between components
- Timeline
- Guidelines & Standards
- Quality assurance and Testing





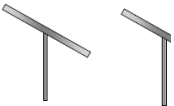
Solar Power and Chemical Energy Systems
IEA Technology Collaboration Programme






SolarPACES
Guideline
for Heliostat Performance Testing

Draft Version 0.991
22.08.2018

Edited by Marc Röger
DLR, Institute of Solar Research



COLLECTOR SYSTEM

EPC Tasks/Schedule Solar Field	Deliverables / Milestones	Months after PO (exemplary for CSP Refernzkraftwerk)																																														
Scope of work		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17																														
<div> <div>  </div> <div> <p>Table 3: Example of a heliostat performance test report (excerpt)</p> <p>HELIOSTAT PERFORMANCE TEST</p> <p>Photo or simplified scheme of general heliostat configuration</p>  <p>Heliostat manufacturer name Heliodor Name of heliostat model Superb Serial number or other identifier PA Total number of heliostats investigated 1 Name and address of testing laboratory R&D Testing Center, Street Name, City, Country Testing location Plataforma Solar de Almería, 04030 Tabernas, Spain Date of testing period 30.04.17 - 30.07.17 Date of erection of heliostat 01.04.17 Reference to guideline version SolarPACES Heliostat Performance Guideline v1.0 Report format This report and data CD Date, signature and stamp of testing lab</p> <p>HELIOSTAT PERFORMANCE TEST – PARAMETERS</p> <table> <tr> <th>n</th> <th>Full Parameter Name (Symbol)</th> <th>Value</th> <th>Unit</th> <th>Meas. Technique</th> <th>Measurement Report</th> </tr> <tr> <td>1</td> <td>Heliostat General Type</td> <td>T-shape</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>17</td> <td>Optics Conc. RealShape_3D_RMS</td> <td>1.6</td> <td>mm</td> <td>Defectometry</td> <td>Misc01p1.pdf</td> </tr> <tr> <td>18</td> <td>Optics Conc. RealShape_3Dn</td> <td>CD</td> <td>mm</td> <td>Defectometry</td> <td>Misc01p1.pdf</td> </tr> <tr> <td>50</td> <td>Cost Specific</td> <td>120</td> <td>€/m²</td> <td>-</td> <td>CostReport.pdf</td> </tr> </table> </div> </div>	n	Full Parameter Name (Symbol)	Value	Unit	Meas. Technique	Measurement Report	1	Heliostat General Type	T-shape	-	-	-	17	Optics Conc. RealShape_3D_RMS	1.6	mm	Defectometry	Misc01p1.pdf	18	Optics Conc. RealShape_3Dn	CD	mm	Defectometry	Misc01p1.pdf	50	Cost Specific	120	€/m ²	-	CostReport.pdf	<div> <div>  </div> <div> <p>GVB - Gesamtvorhabenbeschreibung</p> <p>Heliodor</p> <p>Gesamtvorhabenbeschreibung Inklusive Teilvorhabenbeschreibungen</p> <p>Abnahmetests für Heliostatfelder</p> <p>6. Forschungsprogramm des Bundesministeriums für Wirtschaft und Energie</p> <p>Antragsteller</p> <ul style="list-style-type: none"> DLR (Deutsches Zentrum für Luft- und Raumfahrt e.V.) CSBS (CSP Services GmbH) SBP (sbp - Sonne GmbH) KAM (Kraftanlagen München GmbH) Helikon (Helikon GmbH) <p>Deutsches Zentrum für Luft- und Raumfahrt e.V. DLR</p> <p>CSP Services CONCENTRATING SOLAR POWER SERVICES</p> <p>Kraftanlagen München</p> <p>sbp schlaich bergmann partner</p> <p>HELIKON</p> <p>Datum: 06.03.2018</p> <p>Kontaktadresse: Deutsches Zentrum für Luft- und Raumfahrt e.V. Institut für Solarforschung Linder Höhe, 51147 Köln Eckhard Lüpertz E-Mail: eckhard.luepertz@dlr.de</p> </div> </div>																	
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HERMAL AGE SYS1																																																

Heliostat field supplies flux easily to receiver demand.

- with low specific costs ($< 100 \text{ € / m}^2$)
- high optical quality (1-D slope $< 1.2 \text{ mrad}$ & tracking $< 0.5 \text{ mrad}$)
- fine-tuned operation due to aim point strategy
- easily adaptable to site, tower, receiver, meteo...

Specification documents are ready for tender.

Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages



During the day

- Pumps ~4.5 MW_{el}
- Heliostaten ~0.6 MW
- Ca. 7 MW PV_{dc}
 - 35000 m² of modules
 - Module area = 2 % of mirror area,
 - PV plant area = 2 % of CSP plant area

