CSP AT CSIRO
STATUS AND FUTURE

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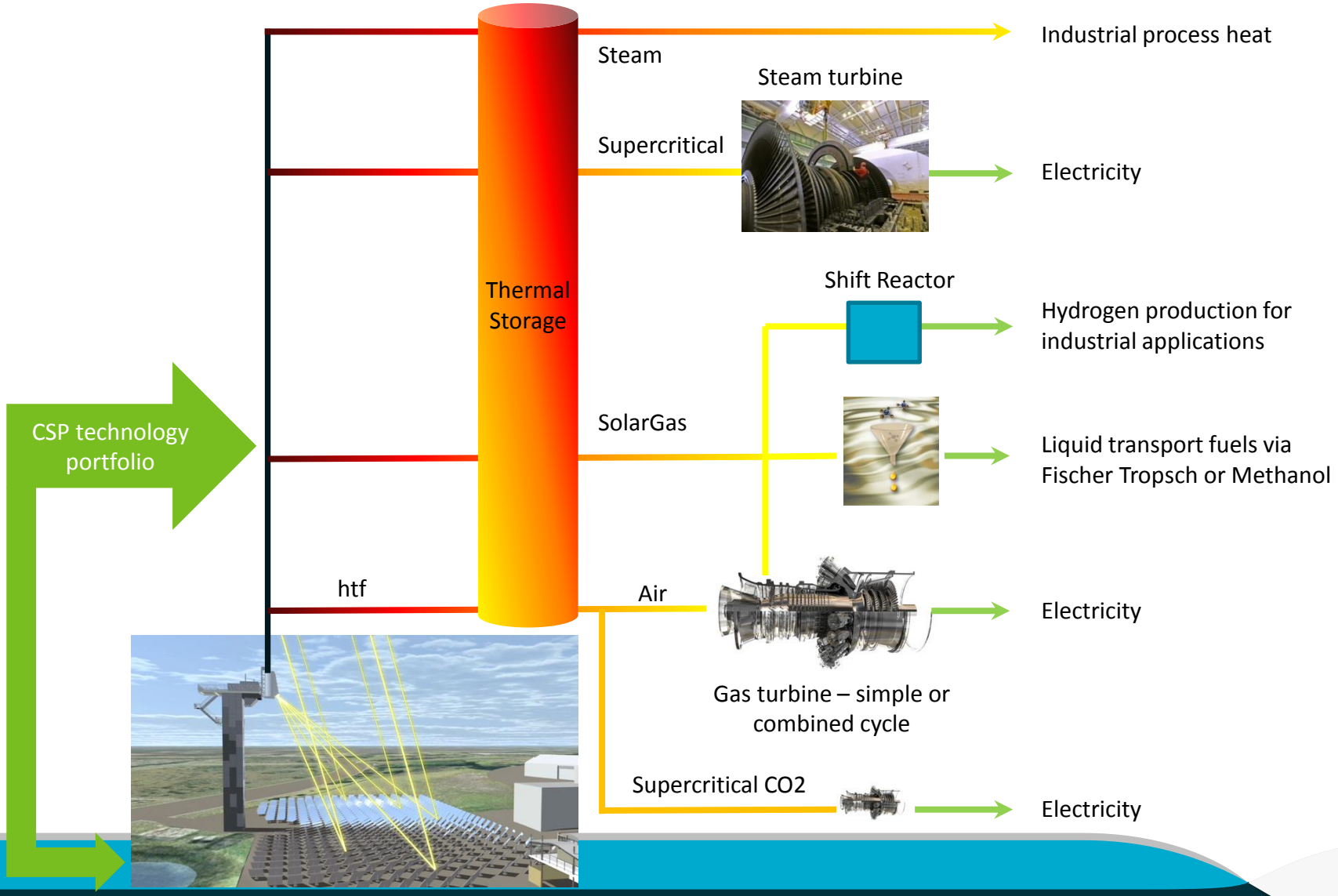
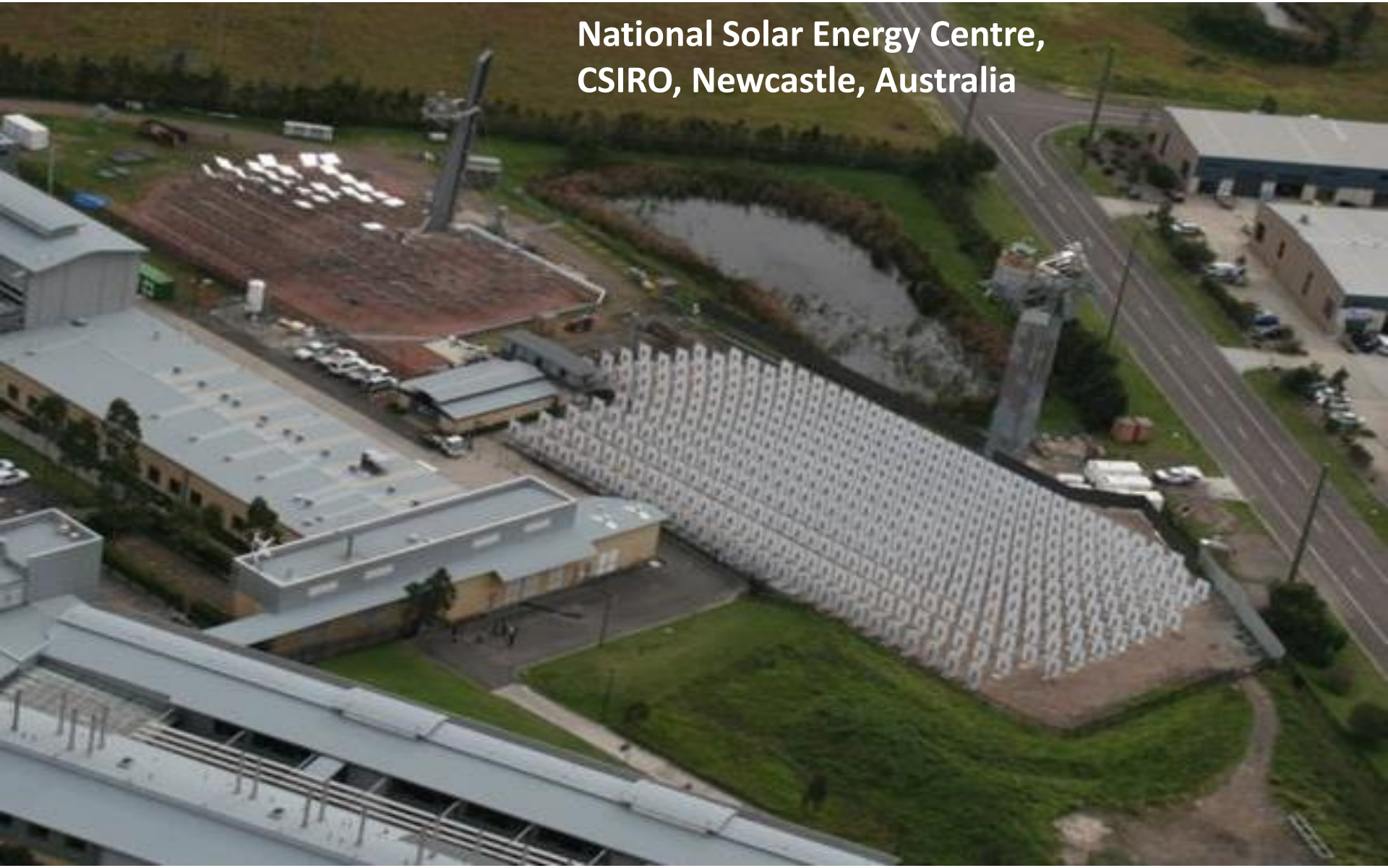
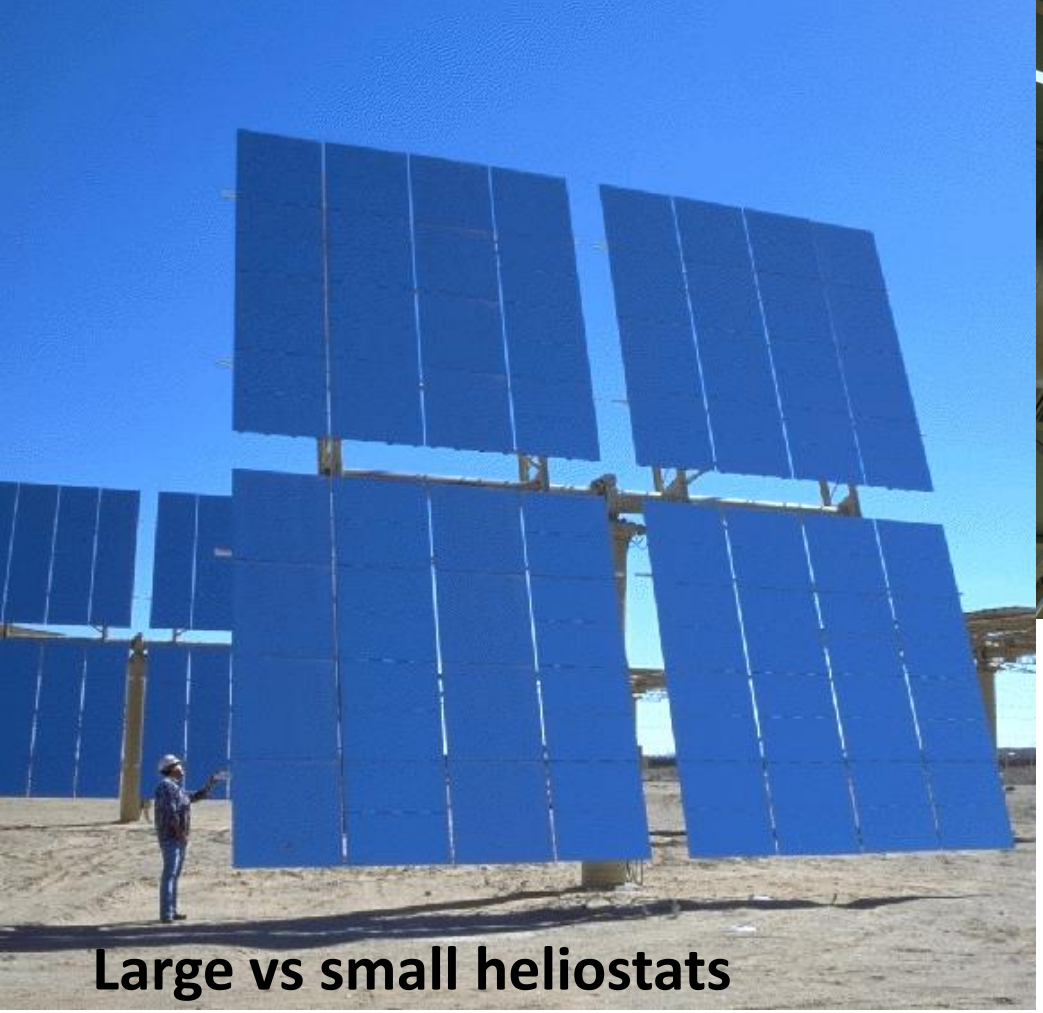
www.csiro.au

Targeted portfolio of CSP Research Activities



National Solar Energy Centre, CSIRO, Newcastle, Australia

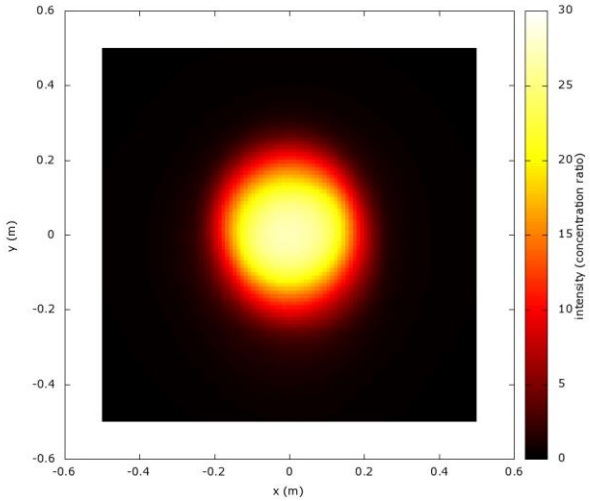


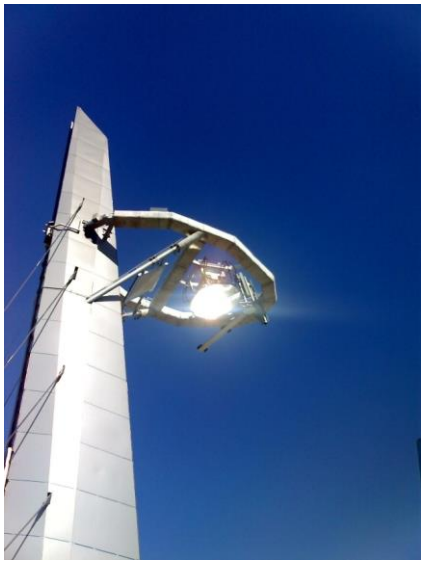


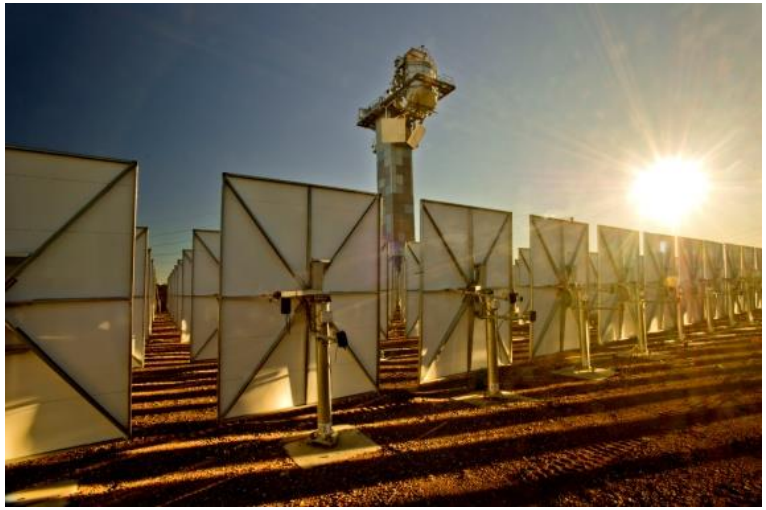
Large vs small heliostats

- Economies of scale vs mass production
- Simplicity of in-field calibration
- Manufacturing and handling
- High concentration optics

Heliostat and Receiver Performance





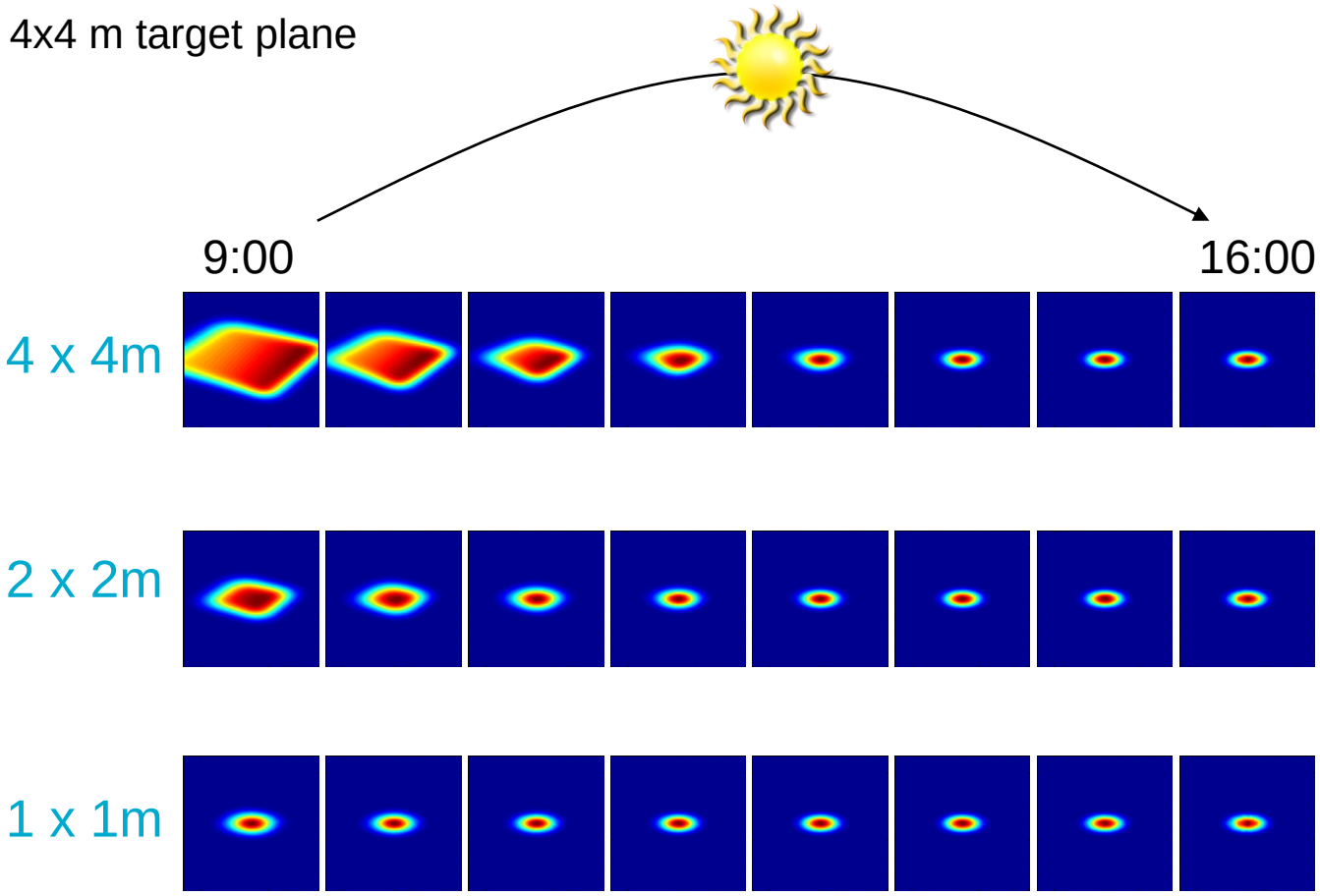


A CSIRO heliostat:

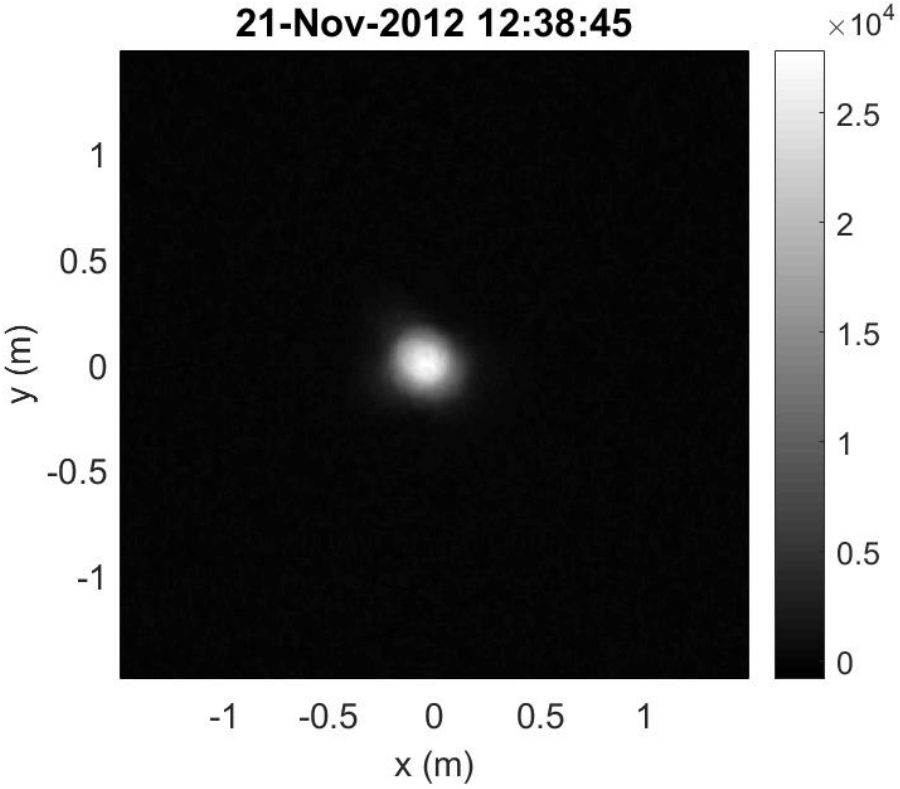
- About 50kg of steel
- 5m^2 of high reflectivity glass mirror
- Actuators
- Fancy electronics

Cost of “dumb” materials – about \$50/m^2

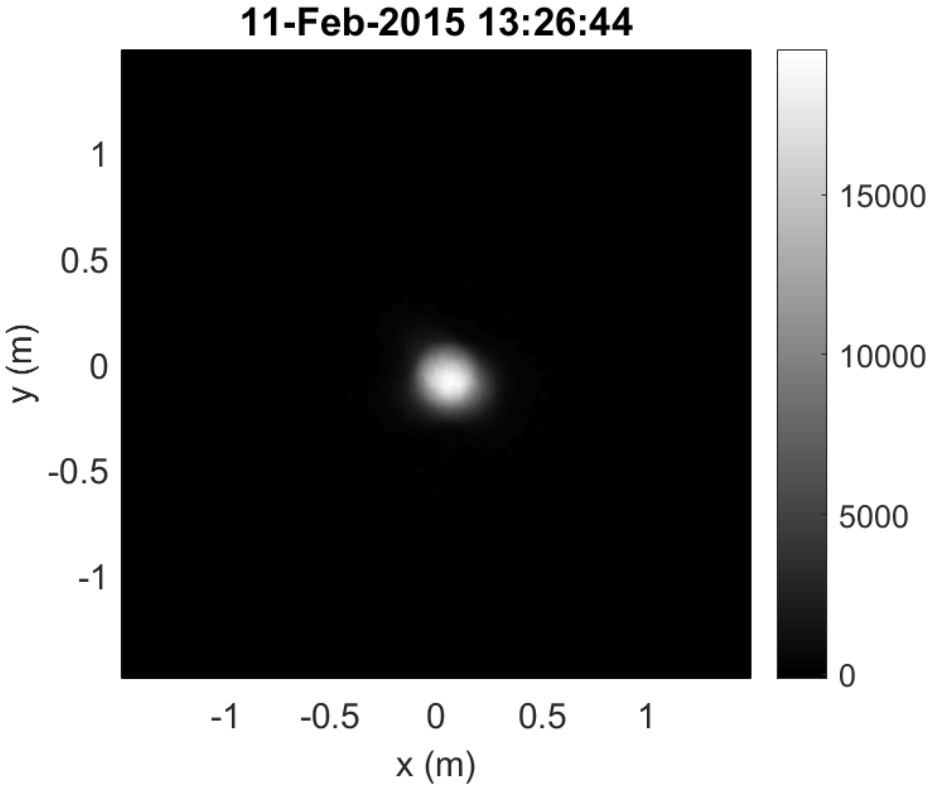
Flux images - mirror size and time of day



Comparison first and last calibration images at similar elevation (ID235)

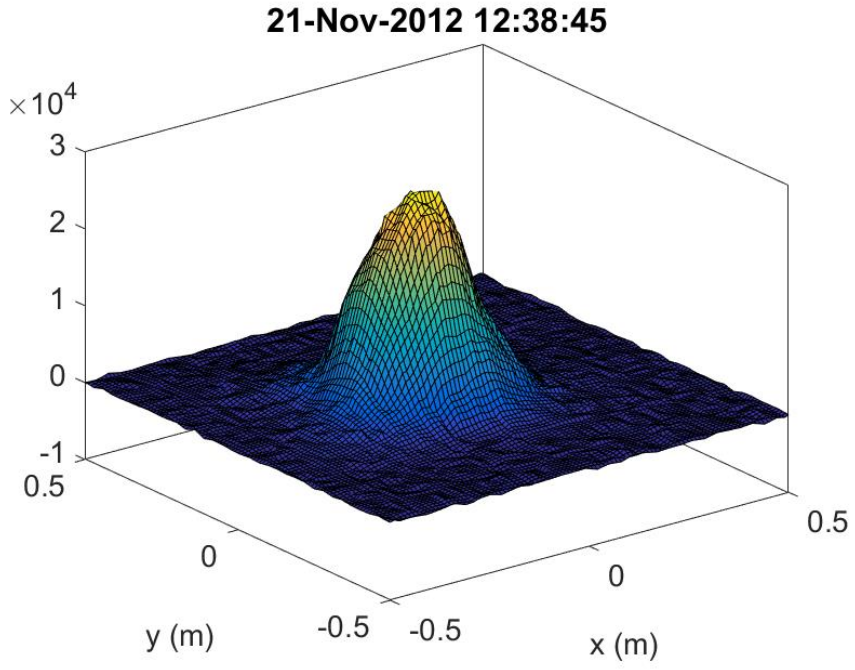


Solar elevation angle = 77.1°

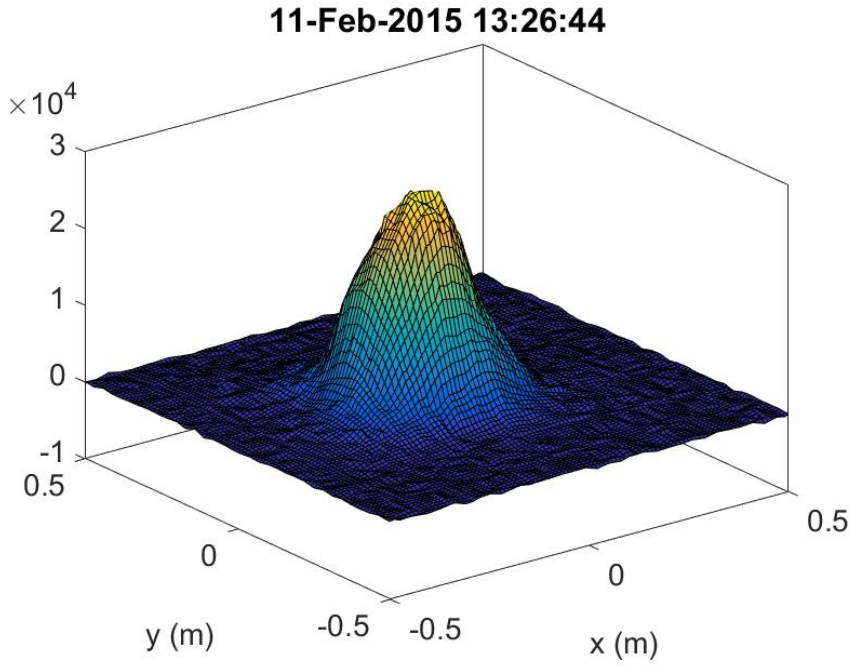


Solar elevation angle = 70.8°

Comparison first and last calibration images at similar elevation (ID235) – 3D image

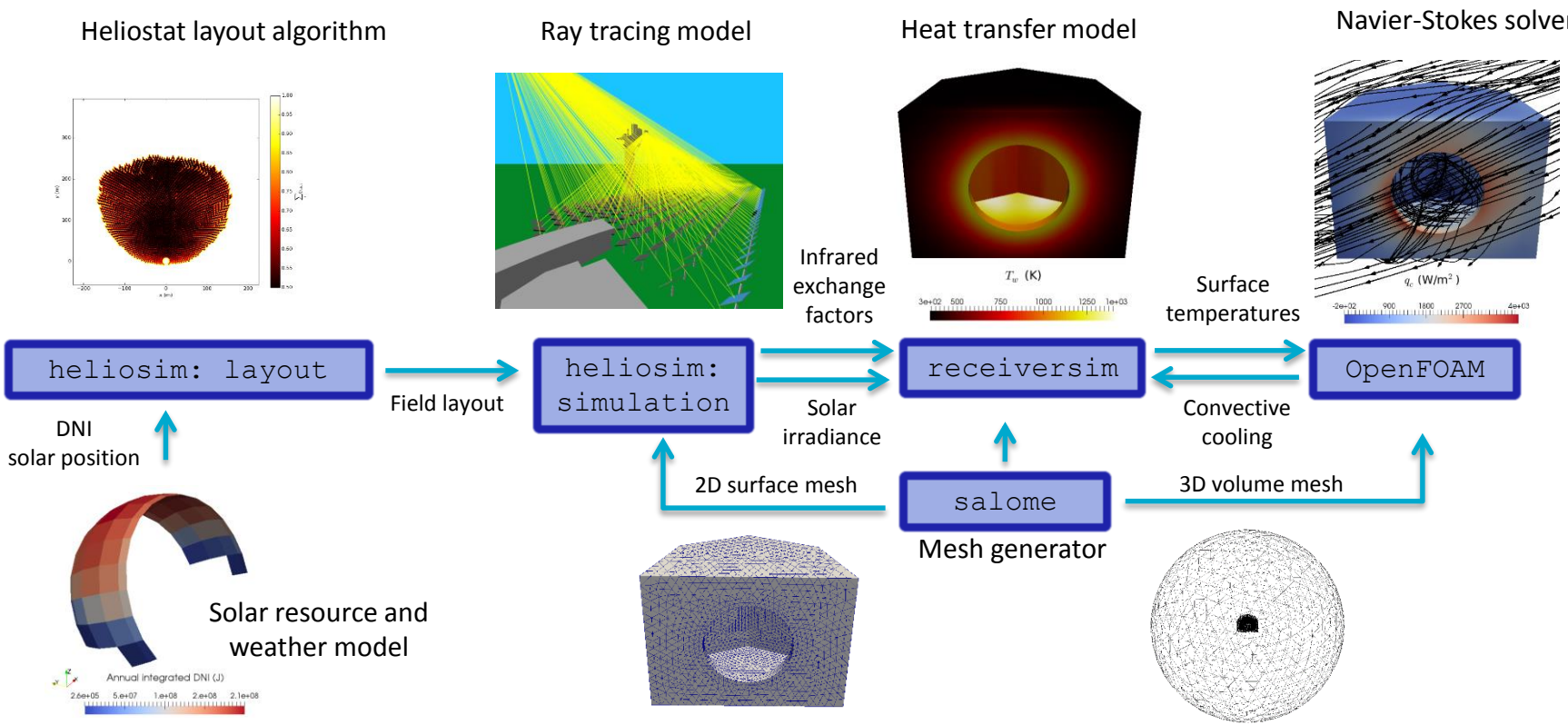


Solar zenith angle = 77.1°



Solar zenith angle = 70.8°

Integrated model for field and receiver design



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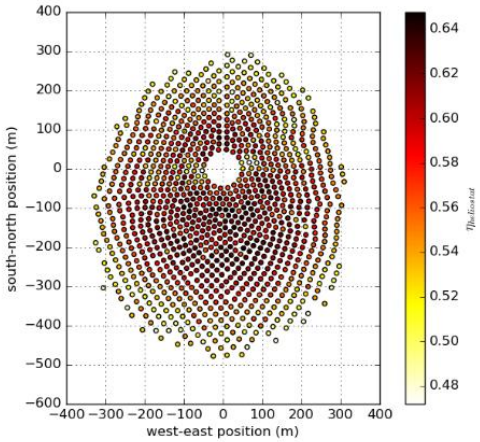
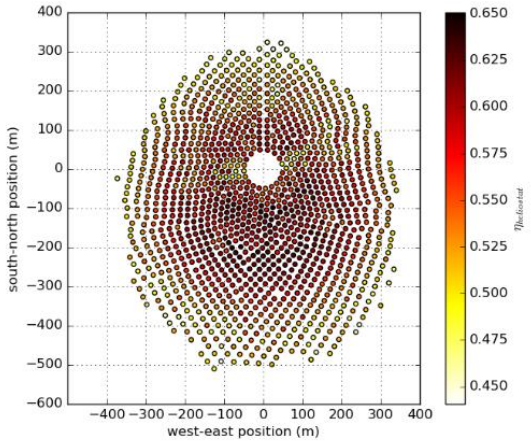
Field layout tool

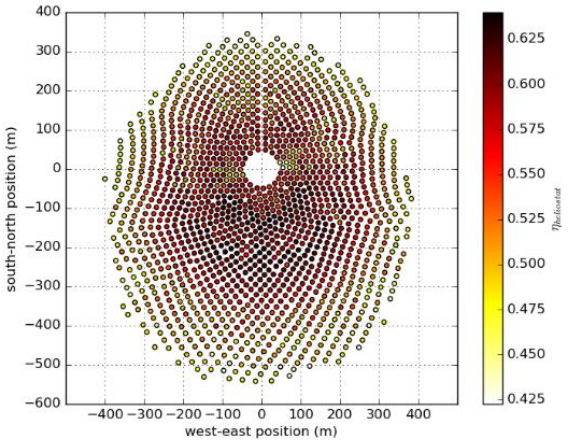
Example: Optimised Design of an 85 MW_t Molten Salt Central Receiver System



(a) $A_{mirrors}$ = 125000 m^2, E_{RMY} = *217.5 GWh_t*



(b) $A_{mirrors}$ = 150000 m^2, E_{RMY} = *241.8 GWh_t*



(c) $A_{mirrors}$ = 175000 m^2, E_{RMY} = *260.4 GWh_t*

Heliostat field layouts for various total mirror areas visualised by heliostat efficiency

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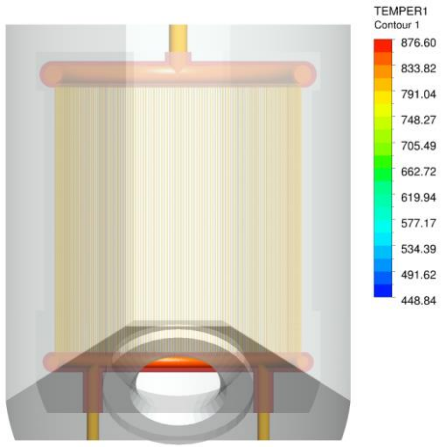
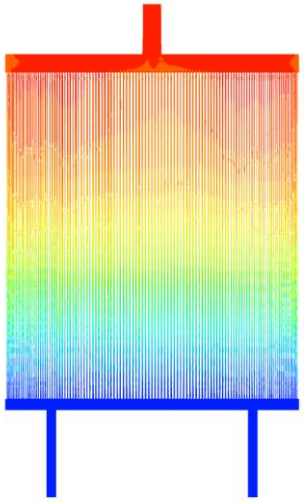
CSIRO Receiver Capability

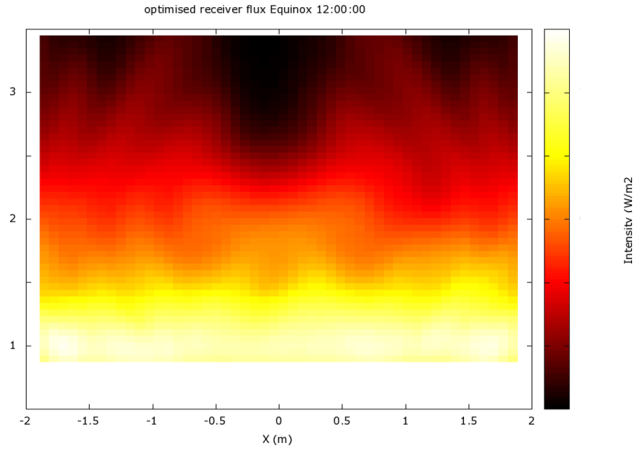
Example: Design, build test and analsyse a 600kWt Tubular air receiver
5 bar, 850°C air keeping hottest surface T lower than 920°C

Receiver
Fabricated





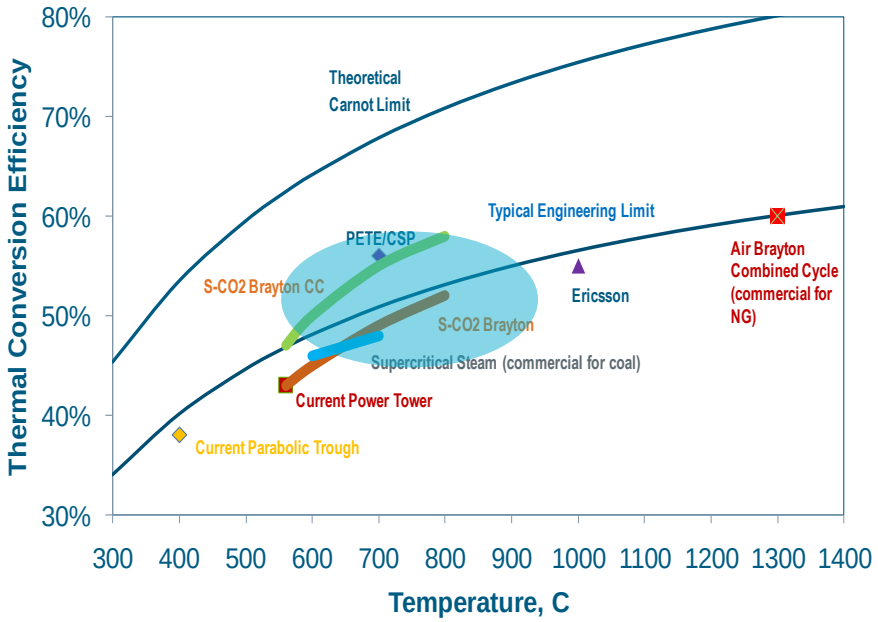
Air Temperature



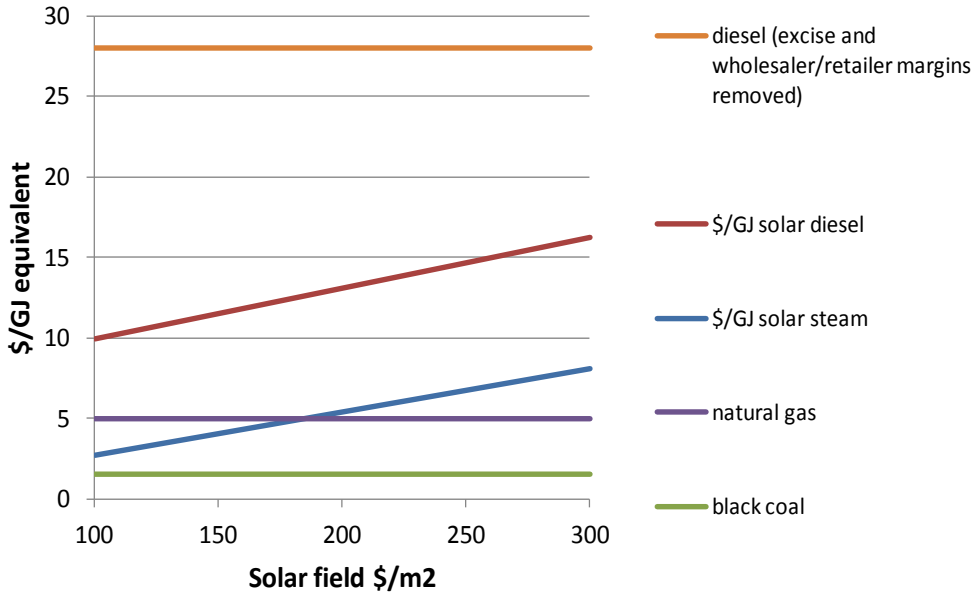
Solar flux
supplied

The key to cost-effective energy from CSP

High efficiency solar electricity



Solar fuels



CSIRO s-CO_2 activities

IN-FIELD PILOT

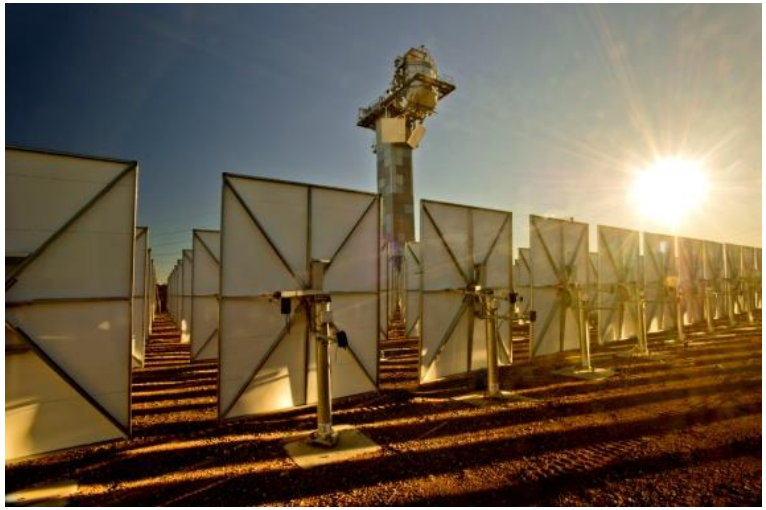
- Completed fabrication of s-CO_2 test loop and solar receiver, receiver rated for up to 720°C and 30MPa output though most testing will be at ≈23MPa.
- System operated at supercritical conditions (on gas heater) for commissioning
- Plumbing allowance made for a future small turbine.

MATERIALS EXPERIMENTS

- High temperature materials “lifing” experiments and creep calculations for s-CO_2 >700°C, >25MPa

SYSTEM & PROCESS MODELLING

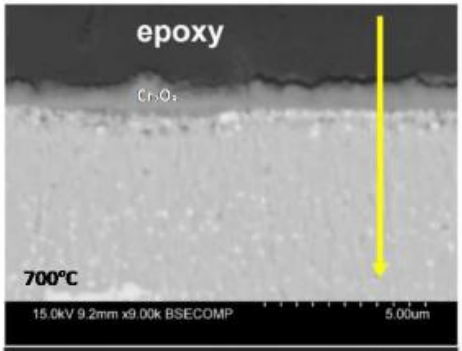
- The material, component and system knowledge gained will be used for development of a solar s-CO_2 demonstration project.

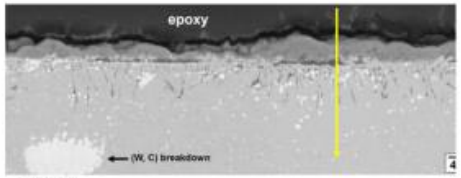


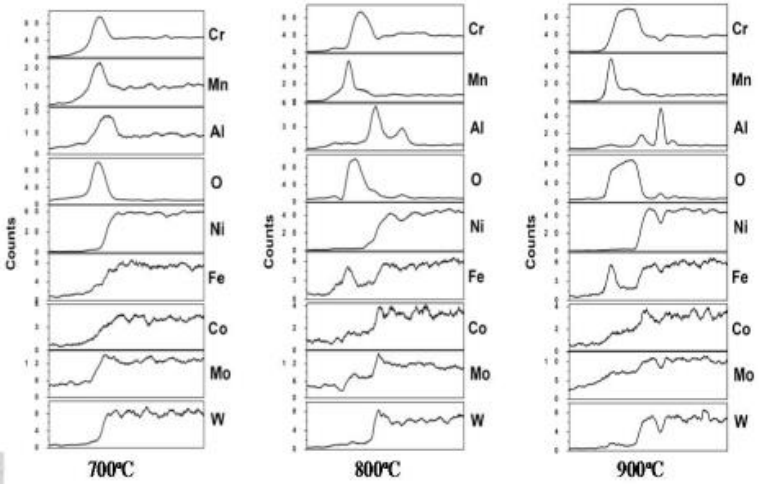
s-CO_2 Solar thermal Receiver

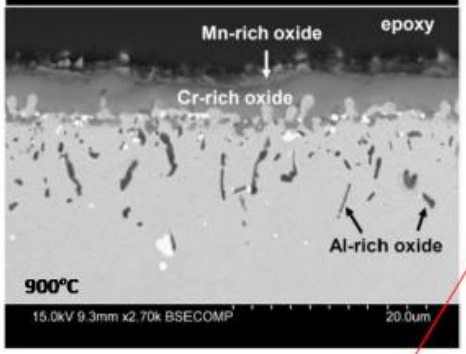
s-CO_2 solar receiver

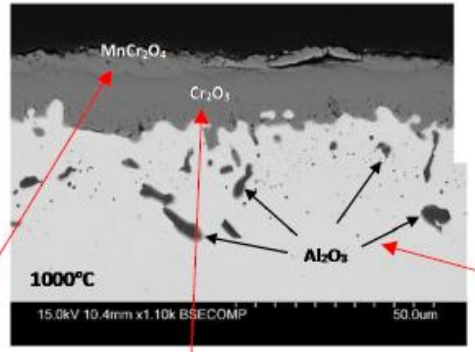
Corrosion results Haynes 230

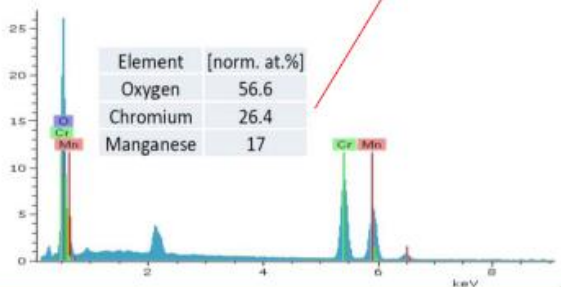


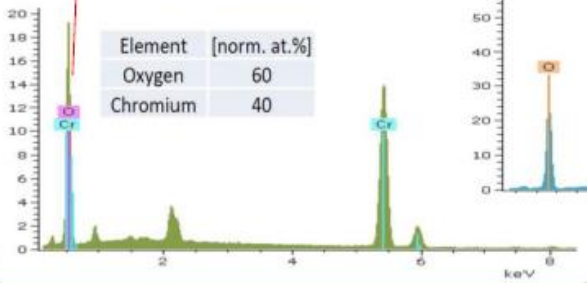


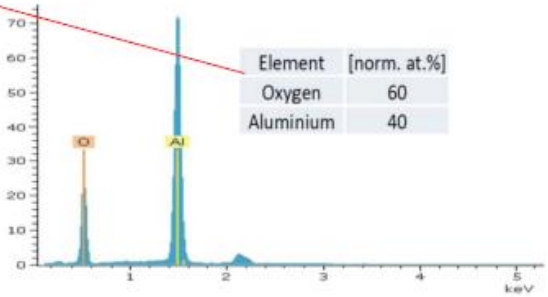










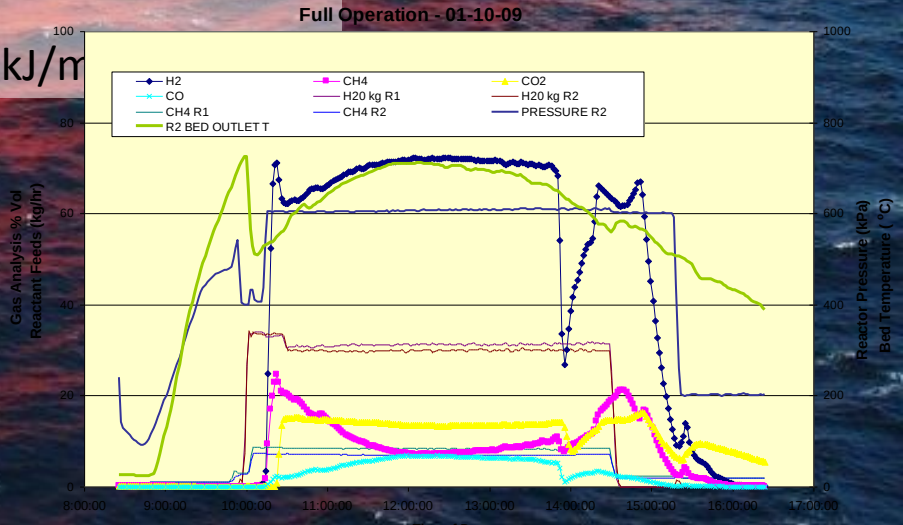


Solar enhanced fuels

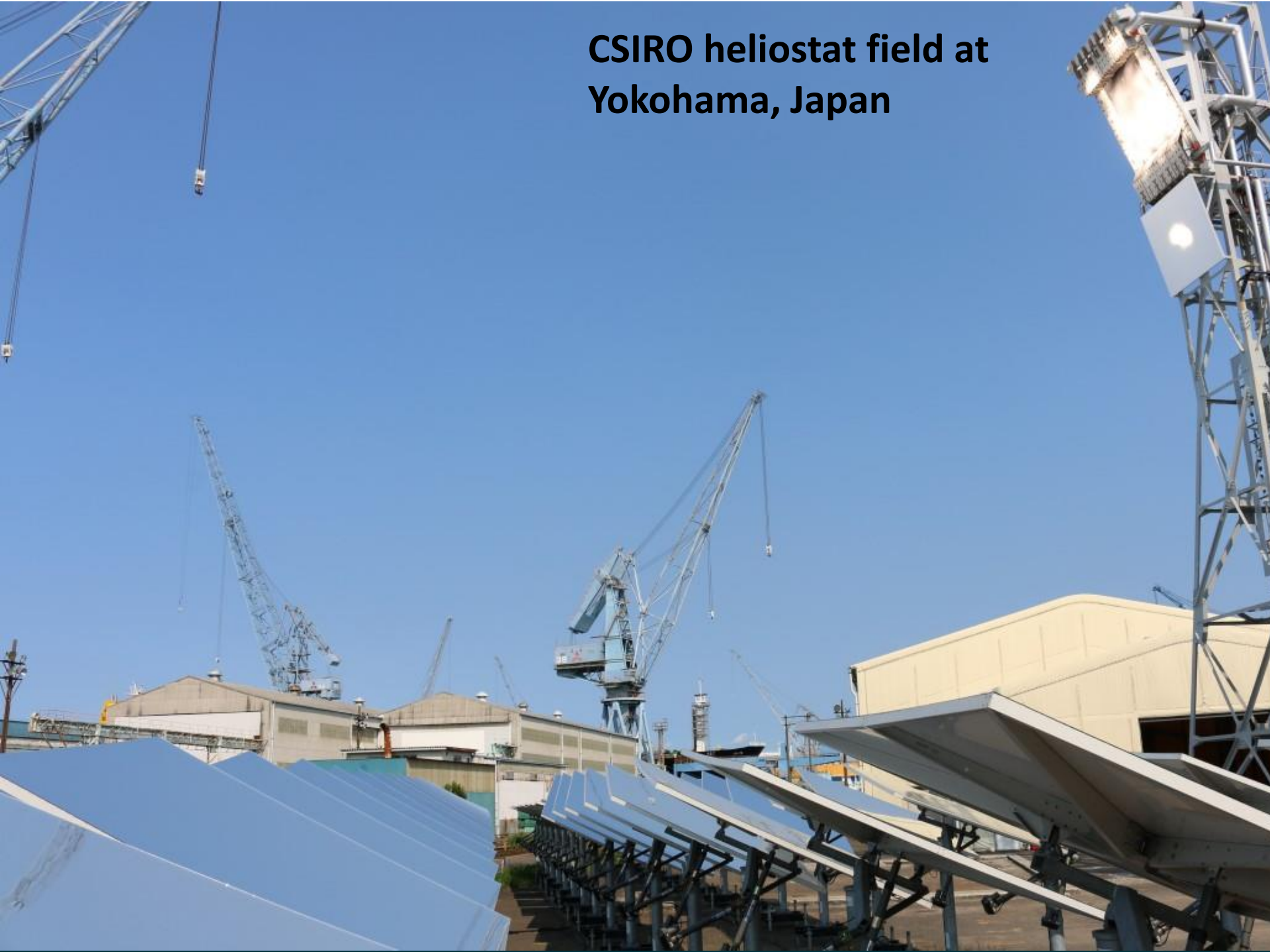
Thermal decomposition of carbonaceous or organic materials such as coal, natural gas or biomass to fuels. Because they are endothermic reactions, the fuel product has solar energy embodied in the chemical bonds.

$CH_4 + H_2O = CO + 3H_2$ +206 kJ/mol

$CH_4 + CO_2 = 2CO + 2H_2$ +247 kJ/m




CSIRO heliostat field at
Cyprus Research Institute


CSIRO heliostat field at
Yokohama, Japan

Thank you

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