Concentrating Solar Power in Eskom

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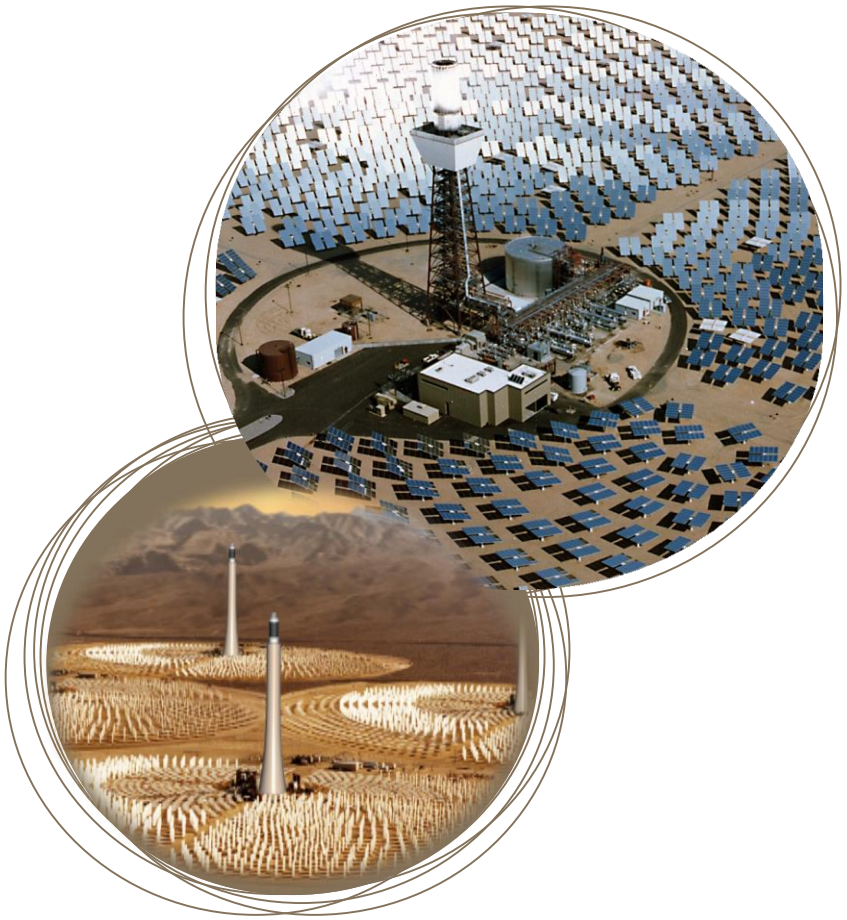
Outline

- **Introduction**
- **Update - Eskom Solar 1 / CSP 1**
- **Eskom Solar 2 and 3**
- **Solar Augmentation**



Introduction:

CO_2 reduction;
reduced coal usage; keep the lights on, Eskom reputation;
environmental footprint, social responsibility, job creation

IRP

- **Large scale Wind**
- **Large scale CSP**
- **Large scale PV**
- **Small Hydros**

Own Consumption

- **PV roll out**
- **Solar Augmentation**

Eskom Strategic imperative: reduce environmental footprint and pursue low-carbon growth opportunities.

Renewables Mandate: Drive Eskom's renewables generation capacity by developing and operating proven technologies and be a centre of excellence for renewables business initiatives.

IRP - Large Scale CSP: **CSP 1**

1 Technology

- 100 MWe minimum with CF > 60 %.
- Molten Salt Central Receiver
- Dry Cooled

2 Technical Update

- OE appointed.
- Concept and Basic designs complete.
- First draft PG&AT complete.

Source: Solar Reserve

3 Procurement.

- EPC main package The following six applicants pre-qualified:
  i. Tecnicas Reunidas S.A & TSK Electronica y Electricidad S.A;
  ii. Alstom Power Systems SA, Alstom Power Services (Pty) Ltd, Bright Source Energy Inc and Aries Ingenieria y Sistemas SA;
  iii. Cobra Instalciones y Servicios SA;
  iv. Elecnor SA, Idom SA, and Samsung C&T Corporation;
  v. Sener Ingeneria y Sistemas SA; and
  vi. Abener Energia S.A.
- O&M with EPC contractor.

4 Funding

- Loan Agreements signed with IBRD, CTF, AfDB, AFD, KfW.
- EIB – Board approval obtained
- 90 % Debt (secured) through concessionary finance, 10 % Equity

5 Schedule .

- Expanded clarification ; Business Case, PFMA approval, Contract award – end 2015
- Construction 2016 To 2018
- Provisional Acceptance & COD 2018
- Final Acceptance < 3 years thereafter

IRP - Large Scale CSP: **CSP 2 & 3**

1 **Technology**

•100 MWe minimum with storage
•Molten Salt Central Receiver or Parabolic Trough with salt storage
•Dry Cooled

2

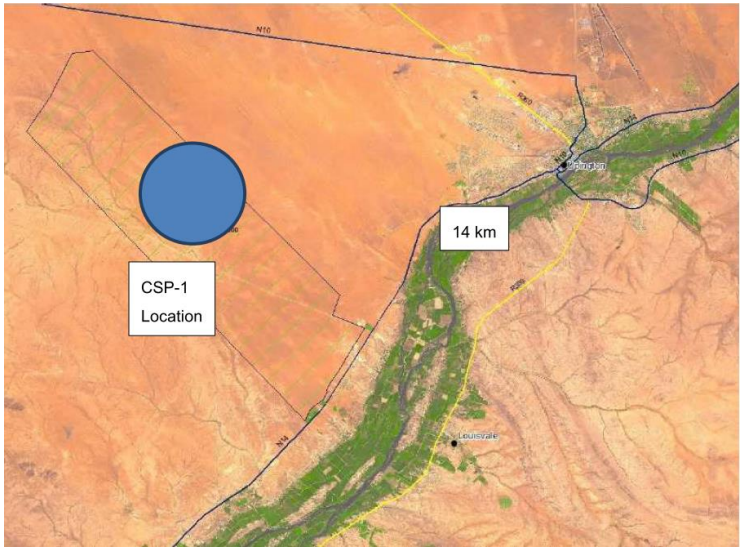
Procurement and Funding.

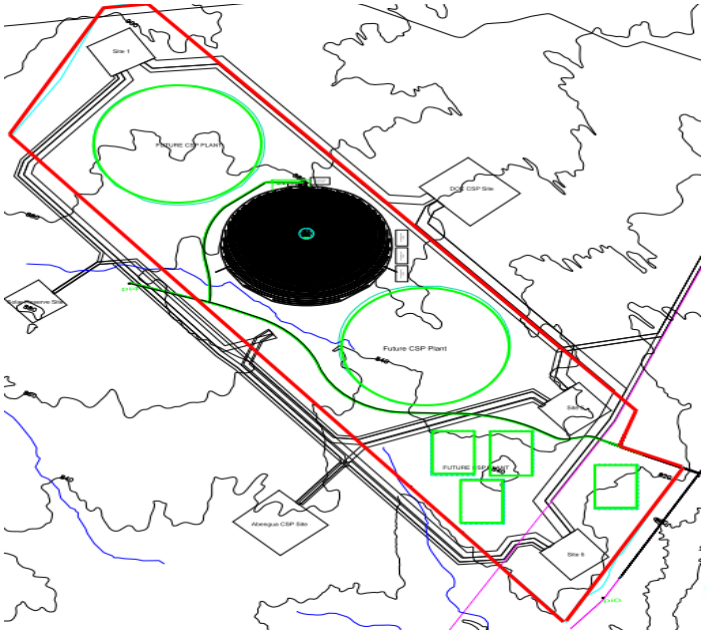
- Strategic Partnerships with equity injection
- SPV – Joint development and execution

3

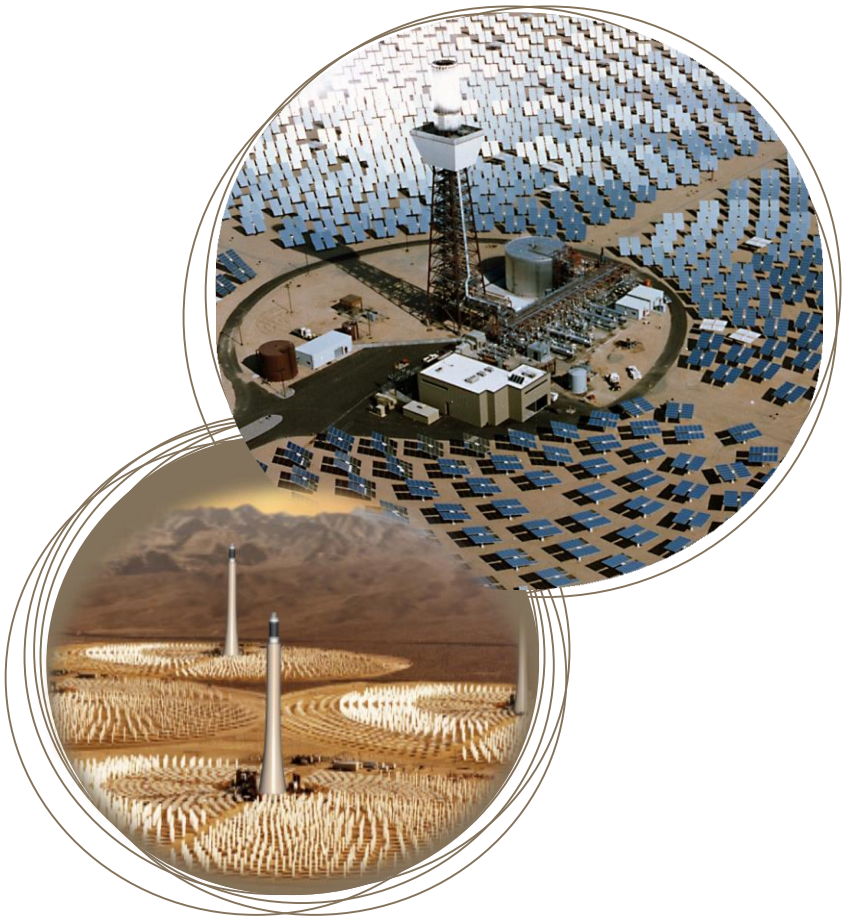
Way forward

- EIA to commence shortly
- Identify sources of funding
- Address legislative and regulatory issues



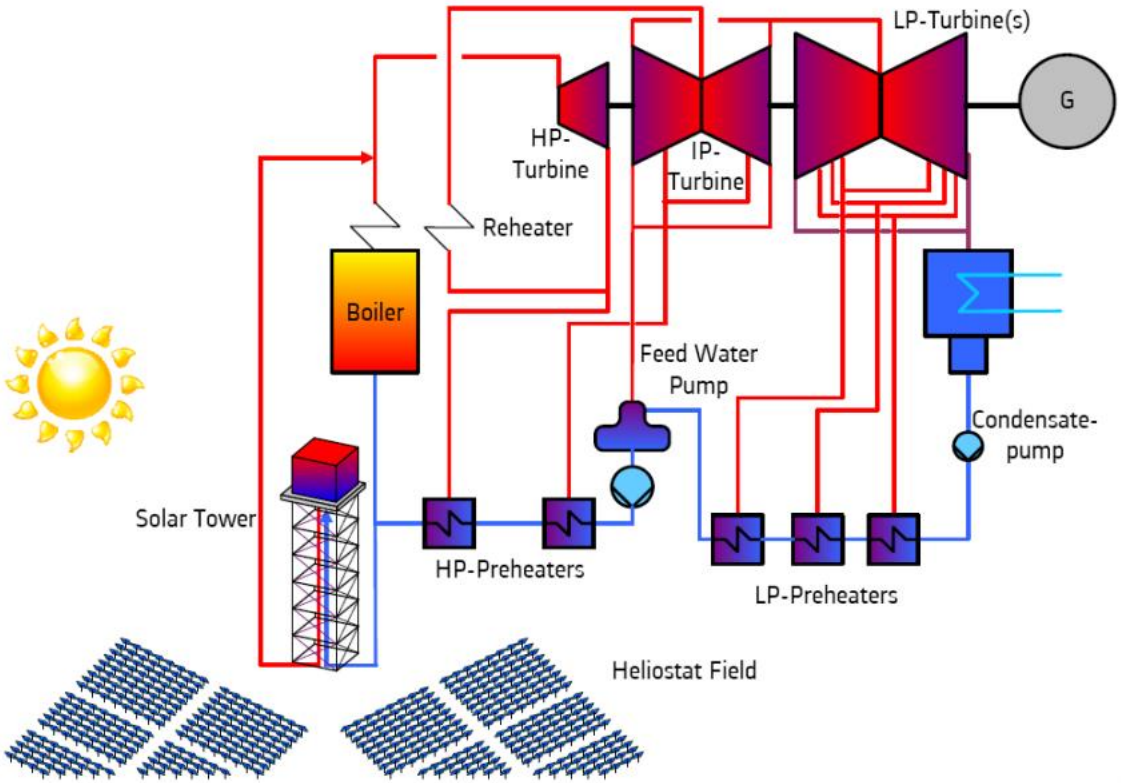


Solar Augmentation



Eskom work on Solar Augmentation

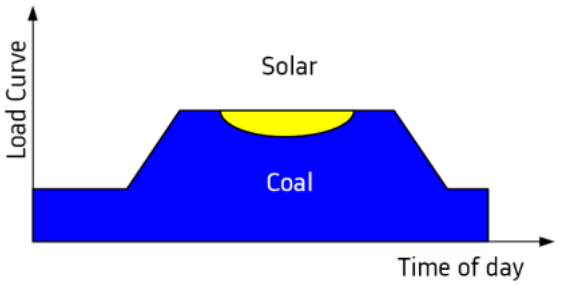
Illustration – Main Steam Injection



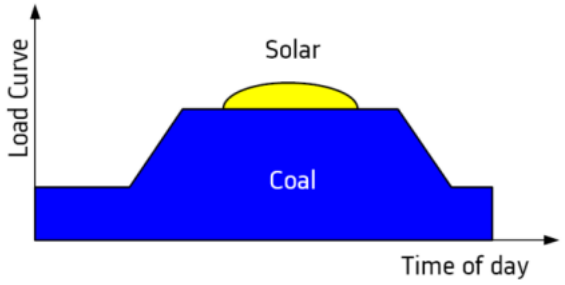
Courtesy - Alstom

Operation modes

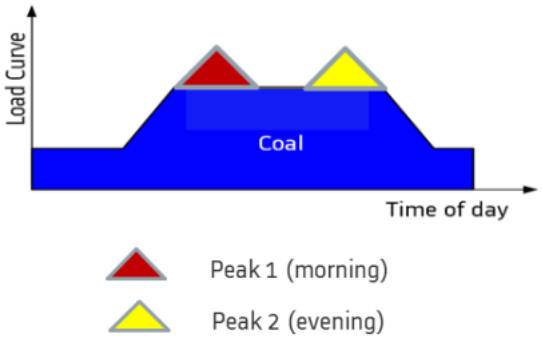
Reduced Coal Consumption



Additional Power Output



Additional Dispatchable Capacity



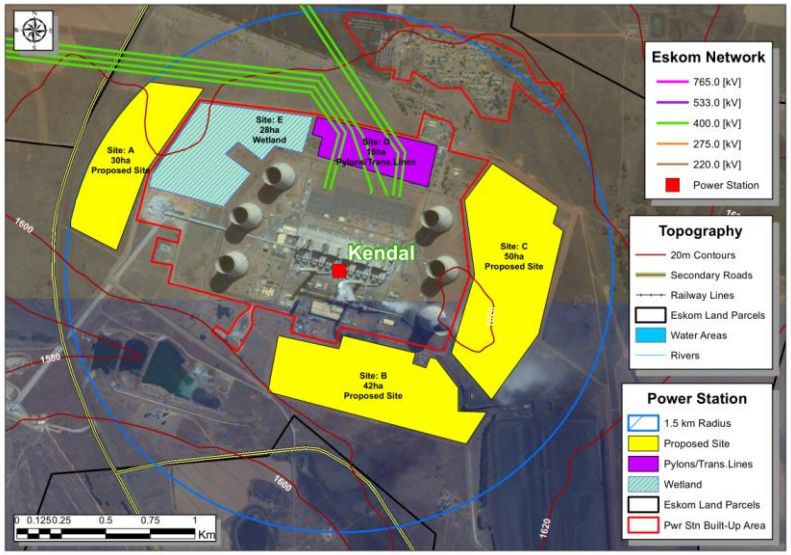
Technology

- Technology Neutral (CR, PT, CLFR)
- No Storage except steam accumulators
- Size is site specific for best integration opportunity (min 10 MWe). No integration option excluded.
- Boosting to increase output and / or Fuel Saver to reduce emissions, Peaking to assist system..

Eskom work on Solar Augmentation

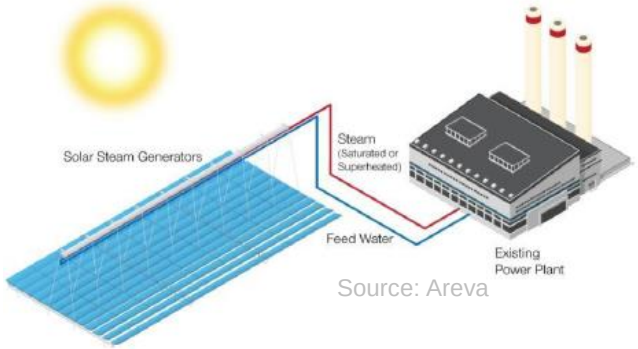
Site Screening

- Solar Resource
- Land
  - Parcel size and ownership
  - Topography
  - Distance from site (proximity to heat receiver, coal and ash heap (soiling risk)
  - Possible shading from structures and water vapour, environmental diversity, further solar augmentation expansion…
- Host plant
  - Years of operation remaining of host plant.
  - Capacity factor of host plant.
  - Technical challenges.
  - Current performance and emission issues.



Further Scope

- Determine technical-operational and financial viability.
- Establish capital and O&M cost
- Determine the Levelised Cost of Energy (LCoE) for each option
- Determine risks / fatal flaws and identify risk treatment plans.
- Rank stations and develop concept designs for the top 4 sites
- Explore opportunities for strategic partnerships for joint further development and execution.
- Explore sources of funding with possibility equity injection from strategic partners.



Source: Areva

Benefits of Solar Augmentation

Increased Renewable Energy

- Decrease CO_2, emissions and increased fuel saving during the day.
- "Greens" existing assets.

Courtesy: Alstom SA

Reduced Capex for the Same Output

- Integrates with conventional steam power blocks and leverages existing power station infrastructure and grid access.
- Repower/extend life of existing power plants.
- Technical life longer than capital payback ie. Free energy after capital payoff

Provide options to derate supply at certain mines

- Solar energy is free and provides certainty of supply to provide some mitigation against difficult coal contracts (wet coal, fines, and coal quality).

Job creation and skills development

- Majority of the plant components could be sourced locally.

Rapid deployment

- Depending on size and configuration, CSP hybrid plants could be completed in less than two years from notice to proceed.

No DoE Renewable Energy allocation required

- The Integrated Resources Plan 2010 refers to green field plants. Eskom could pursue hybridisation options without the need to apply to DoE for IRP allocation.

Benefits of Solar Augmentation

Extends life of existing plant

- Reduced coal and ash handling with associated reduction on load on components like FFP, ID fans, mills, ash crushers etc.

Maximises local spend per installed MW

- Traditionally imported items like turbines, generators, transformers etc. would not be required as existing infrastructure would be leveraged. CSP fields lend themselves to localisation due to the nature of the items constructed.

Less coal will be required and less ash will be generated

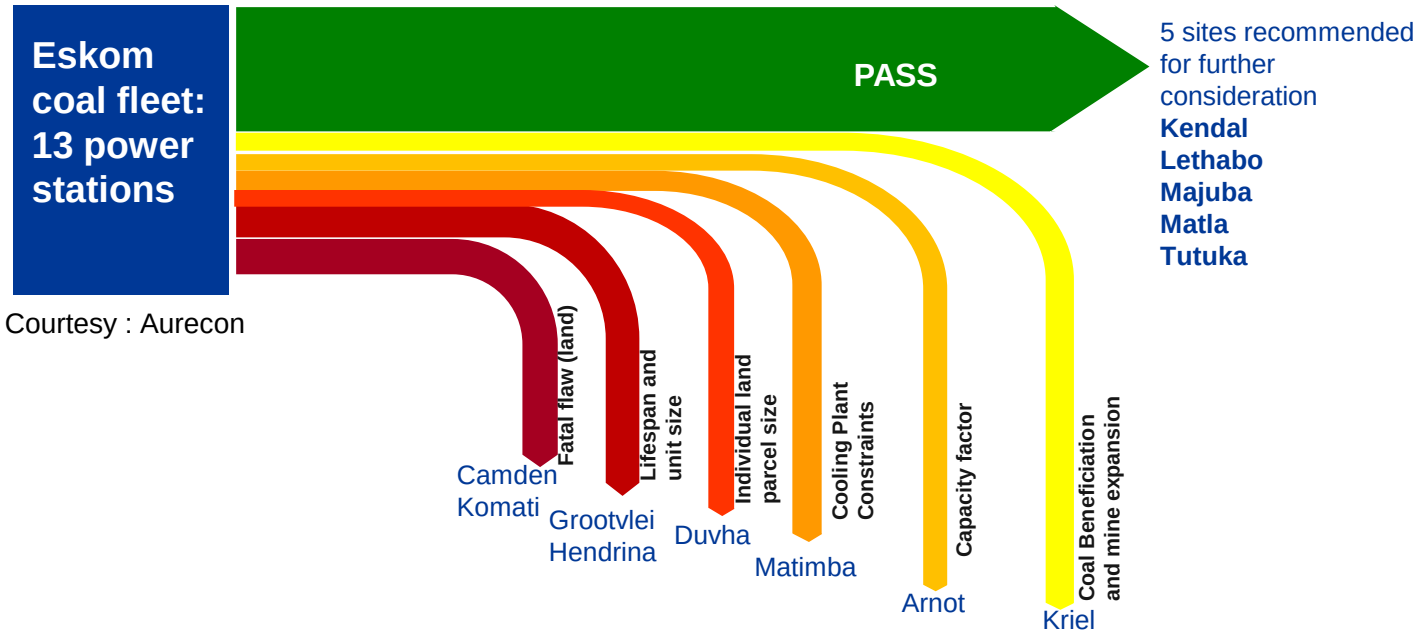
- Reduced coal transportation and ash handling costs.
- Reduced future carbon tax.
- Could mitigate against the need to upgrade FFP and ESP plants

Source: Hitachi Power Africa

Findings

Preliminary findings

- DNI not a deciding factor – within a 6 % range.
- Difficult to financially justify fuel saver mode alone.
- Challenge in determining suitable PPA price.
- Suitable land is a challenge given mining activities (past, current, future) in the vicinity.
- Encouraging support and collaboration within Generation and at power stations.



Summary and conclusions

1 CSP Demo Plant

- Delays in procurement but commercial process has begun. Construction to commence in 2016.

2 Eskom Solar 2 & 3

- EIA to commence shortly on Eskom owned land. Strategic partnership to be explored.

3 Solar Augmentation

- Studies commenced. Concept designs delayed due to site verification / suitability studies. To be complete by end 2014. Execution timelines dependent on partnerships.

Thank you

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