Concentrating Solar Thermal Power Stations

Sustainable Green Energy Infrastructure for Peak, Mid-Merit & Base Load Electricity Supply

CESA Young Professionals Sustainability Imbizo

Premier Hotel, OR Tambo

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Pancho Ndebele : Emvelo Founder
1. EMVELO - Introduction
2. Solar Resources for CSP – Global, Africa and South Africa
3. Concentrating Solar Power (CSP) Technologies
4. CSP – Peak, Mid-merit and Baseload
5. CSP Developments in South Africa
6. Localisation & Industrialisation – Regional & National
7. CSP 2030 Regional Strategy
8. CSP Connecting with the NDP & the Green Economy Accord
9. Conclusion
1: Emvelo - Introduction

✓ Emvelo is a South African based company with interests in unlocking Africa’s green infrastructure opportunities.

✓ Emvelo’s vision is to be the most admired green infrastructure resources company in South Africa by 2018 and to be amongst the top 5 sustainable green infrastructure companies in Southern Africa by 2020 and in Africa by 2025.

✓ Emvelo’s core purpose is to develop and own utility scale solar thermal power plants

Emvelo comes from the “Zulu word” Ezemvelo which means; return to nature. Our name Emvelo, means all that encompasses the natural environment and an understanding of the balance required between humanity and nature to attain sustainable green growth, economic prosperity for all and the creation of sustainable communities where all dreams can thrive.
1.1: Emvelo’s Karoshoek 1GW Solar Valley

Located near Upington, Northern Cape and has one of the best solar radiation in the world.

Karoshoek Solar Valley project opportunities:

- Special purpose companies (SPC) will own Solar power facilities at Karoshoek
- Karoshoek site has excellent characteristics
- The vision for Karoshoek Solar Valley Park is to roll out 1 GW of solar projects by 2025

Transmission Infrastructure:

- Karoshoek Solar Valley is located in the middle of the 400kV infrastructure network currently under development (Green lines)
- The 400kV Solar Park Sub will tie into the 132kV Gordonia Sub in Q1 of 2017.
- The first 200-300MW from Karoshoek plants will connect to the 132kV line located on the western side of Karoshoek.

Water Supply:

- The Department of Water Affairs has confirmed that there is water available for the Karoshoek plants (Orange River).
- All the Karoshoek plants will have a lower water footprint as they will utilise dry cooling technology.
2: Global Renewable Energy Resources

Annual world energy demand

- Solar
- Wind
- Hydro
- Geothermal
- Biomass

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"Promoting the CSP Industry in Southern Africa"
2.1: Global Solar Resources for CSP

- The SADC & North Africa “sweet spots” for CSP are very large in land area and have the potential to generate multiples of the continent’s electricity needs and possible export to a Europe supportive of reducing global climate change impacts.
2.2: Africa’s Solar Resources for CSP

- Africa's Solar Thermal Fuel (DNI) and Transmission Infrastructure to evacuate power generated by CSP Power Stations
2.3: South Africa’s CSP ‘Sweetspots’

- No limitations on DNI in South Africa and the rest of Africa
2.4: South Africa – Transmission Infrastructure

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Promoting the CSP Industry in Southern Africa
2.5: Water Availability

Gap between existing supply and projected demand in 2030, % of 2030 demand

- Surplus
- Moderate (0 to -20%)
- Severe (-20% to -80%)

3: CSP Technologies that we use to mine the sun?

Parabolic troughs

Linear Fresnel Reflectors

Central Receiver / Heliostats

Parabolic dishes
3.1: Concentrated Solar Power – How it works?

Source: LEORNADO ENERGY

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"Promoting the CSP Industry in Southern Africa"
CSP Power Stations for the production of sustainable peak, mid merit (shoulder) and base load solar thermal electricity in Southern Africa.

Source: WRI, JUICE CONCENTRATE
4.1: CSP Power Stations with Storage

ANDASOL 1 – 7.5 HOURS STORAGE

GEMASOLAR – 15 HOURS STORAGE
5: Renewable Energy – REIPPPP CSP Projects to date

- Round 1 Preferred Bidders:

- Round 2 Preferred Bidders:

- In Round 3, 2 CSP projects, each of 100MW gross capacity, were awarded as Preferred Bidders – these projects were submitted by the Abengoa and Emvelo/Ilanga 1 consortiums and are currently working towards reaching Financial Close

- In Round 3.5, 3 CSP projects, each of 100MW, we submitted by ACWA, Emvelo / Ilanga 2 and GDF Suez consortiums. The 2 preferred bidders will be announced in August 2014

Impact of the R1 and R2 CSP projects

Investment: SA’s first 3 CSP projects will attract investment of R15.8bn, of which R4.0bn will be spent on local content, as per an analysis conducted by the DOE

Jobs: the DOE analysis further indicated that the 3 projects will create 1,827 construction and 120 operations and maintenance jobs

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<th>KaXu Solar One</th>
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<td>State/Region</td>
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<tr>
<td>Bokpoort</td>
<td>Upington</td>
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<td>Gross Capacity</td>
<td>Gross Capacity</td>
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<tr>
<td>100MW</td>
<td>50MW</td>
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<td>Developers</td>
<td>Developers</td>
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<td>Abengoa</td>
<td>Abengoa</td>
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<td>Development</td>
<td>Corporation</td>
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<td>EPC Group</td>
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<td>Technology</td>
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<td>Parabolic</td>
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<td>Trough</td>
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<td>Cooling Technology</td>
<td>Dry</td>
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<td>Storage (Hours)</td>
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<th>Bokpoort Solar Facility</th>
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<td>Storage (Hours)</td>
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"Promoting the CSP Industry in Southern Africa"
5.1: CSP Projects in construction & development

- Round 1 and Round 2 Projects under construction (200 MW) -
- Round 3 Projects under construction (200 MW)
- Round 3.5 projects in financial close (200 MW)

CSP Parks Potential = 3 - 5 GW

Source: EMVELO
6: Localisation & Industrialisation - CSP Components

Local content target of 75% by 2020
We can create a regional industry that manufactures CSP components in Southern Africa by adopting the ‘airbus model’, where SADC countries can manufacture different CSP components for Regional Solar Thermal Power Stations.
Assessment of the localisation, industrialisation and job creation potential of CSP infrastructure projects in South Africa - 2030 Strategy & Action Plan
7.1: 2030 CSP Strategy & Action Plan

- **Scenario A - IRP 2010 Scenario**: deployment of the 1GW of CSP in the IRP 2010 by 2020 instead of 2025;

- **Scenario B - Northern Cape Solar Corridor (NOCASCO) Scenario**: this scenario is in line with the 5 GW solar park/corridor under investigation by the DoE.

- **Scenario C – 60% CSP**: this scenario assumes that the Conventional Energy Options (Nuclear) in the IRP 2010 are not deployed and are replaced by 60% of CSP with storage alongside gas power; and

- **Scenario D - SADC Scenario**: as per Scenario C, plus an additional deployment of 10GW of CSP power stations across (SADC)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Total (GW)</th>
<th>By 2020</th>
<th>By 2025</th>
<th>By 2025 for export</th>
<th>By 2030</th>
<th>By 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario A</td>
<td>1GW</td>
<td></td>
<td>1GW</td>
<td></td>
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<td></td>
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<tr>
<td>Scenario B</td>
<td>6GW</td>
<td></td>
<td>5GW</td>
<td>1GW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario C</td>
<td>12GW</td>
<td></td>
<td></td>
<td>10GW</td>
<td>2GW hybridisation</td>
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<tr>
<td>Scenario D</td>
<td>22GW</td>
<td></td>
<td></td>
<td>10GW</td>
<td>10GW SADC</td>
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## 7.2 : CSP 2030 Strategy – Economic Contribution

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<th>Total (GW)</th>
<th>Contribution to GDP</th>
<th>Full time jobs created in peak year</th>
<th>Job years</th>
<th>Net CSP foreign trade balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario A</td>
<td>1GW</td>
<td>R24bn</td>
<td>3,500</td>
<td>60,000</td>
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<tr>
<td>Scenario B</td>
<td>6GW</td>
<td>R108bn</td>
<td>17,000</td>
<td>320,000</td>
</tr>
<tr>
<td>Scenario C</td>
<td>12GW</td>
<td>R205bn</td>
<td>35,000</td>
<td>750,000</td>
</tr>
<tr>
<td>Scenario D</td>
<td>22GW</td>
<td>R251bn</td>
<td>37,000</td>
<td>790,000</td>
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*Source: EY analysis*
CHAPTER 3: ECONOMY & EMPLOYMENT

✓ CSP can play a key role in helping drive down the unemployment rate from 24.9% to 14% by 2020

CHAPTER 4: ECONOMIC INFRASTRUCTURE

✓ CSP can help achieve the following objectives and actions:

✓ The proportion of people with access to the electricity grid should rise to at least 90% by 2030, with non grid available for the rest.

✓ The country would need an additional 29 000MW of electricity by 2030. About 10 900MW of existing capacity is to be retired implying new build of more than 40 000MW

✓ At least 20 000MW of this capacity should come from renewable sources.

✓ Move to less carbon intensive electricity production through procuring at least 20 000MW of renewable energy, increased hydro imports etc.
CHAPTER 5: ENVIRONMENTAL SUSTAINABILITY & RESILIENCE

- At least 20 000MW of renewable energy should be contracted by 2030
9: Conclusion

- **CSP lifetime**, unlike other renewables (PV & Wind) has a **35+ year lifetime** which is close to other conventional options (coal & nuclear).

- A CSP roll out will position **South Africa** and the region to challenge **Saudi Arabia (25 GW by 2030)** for the race to become a global leader in the industrialisation, manufacturing, deployment of CSP and export of CSP components.

- CSP can contribute immensely to localisation & Job Creation and will fulfill the objectives of the following interventions
  
  - **New Development Plan**.
  - **The National Climate Change Response Policy**.
  - **The Green Economy Accord**
THANK YOU

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