ENERGY RESEARCH CENTRE
UNIVERSITY OF CAPE TOWN

Energy Research Centre, University of Cape Town

CSP workshop – 22nd May 2009

Supported by Climate Strategies, Cambridge University

Cape Town – Breakwater Lodge

Workshop outline

09:30 – 10:00	Arrival Tea/Coffee/Juice
10:00 – 10:15	Welcome (Harald Winkler)
10:15 – 10:30	Opening remarks (David Mahuna)
10:30 – 10:45	Climate Change and CSP (Peter Lukey)
10:45 – 11:15	What is CSP? Framing the discussion (Max Edkins, Tom Fluri & Andrew Marquard)
11:15 – 11:30	Mid morning Tea/Coffee/Juice
11:30 – 13:00	3 Group Discussions – technical, infrastructure and industrial (facilitated by 3 group leaders)
13:00 – 14:00	Buffet Lunch
14:00 – 14:30	3 Group discussion feedback (Tasneem Essop as facilitator)
14:30 – 15:30	Discussion – open session: international support (Tasneem Essop as facilitator)
15:30 – 15:45	Summary (Tasneem Essop)
15:45 – 16:00	Conclusion (Harald Winkler)
16:00 – 16:30	Afternoon Tea/Coffee/Juice with biscuits

Funding from Climate Strategies is gratefully acknowledged

Climate Strategies

Introduction

On the 26th March 2009, the National Energy Regulator of SA approved the Renewable Energy Feed-In Tariff (REFIT) Guidelines. The REFIT provides for a Power Purchase Agreement of ZAR 2.10 per kWh (0.19Euro/kWh) for CSP developments in South Africa, a higher rate than for other renewable energy technologies for electricity generation. Already the country has seen some climate change related financing through the Clean Development Mechanism under the Kyoto Protocol and future (post-2012) financing could significantly scale up the financial and technological resources potentially available to South Africa's renewable energy projects, including CSP developments. It will be critical that the country makes full use of these opportunities. This workshop is designed to start a discussion on scaling up CSP, bringing together interested individuals from project developers, government, NGOs, research institutions and elsewhere.

South Africa has amongst some of the best solar resources in the world and already we have committed ourselves to a target of 10,000 GWh of renewable energy by 2013. At the DME Renewable Energy Summit in March 2009, the previous Energy Minister indicated that more ambitious targets "for the period 2013 and 2018 could be set in the range of six to nine percent and nine to fifteen percent of the current capacity respectively". Only by pursuing a higher renewable energy target and by maximizing our energy gain from the sun are we able to peak our GHG emissions by 2020-2025, stabilise them for ten years and decline them in absolute terms thereafter – a target required by science to prevent dangerous climate change.

Government is increasingly setting clear goals in policy and has put in place incentives through the REFIT. The purpose of the workshop was to discuss how large-scale roll-out of CSP can be realized. **What are the technical, industrial and infrastructure requirements for the large-scale rollout of CSP in South Africa?**

Workshop Design

The workshop was very timely, with the recent decision on the REFIT having spurred much interest in CSP developments in South Africa. Under Climate Strategies' Phase II of the "International Support for Domestic Action" project a number of workshops were completed in late May 2009 in a few developing countries around the world. These workshops aimed to assess stakeholder perception on a specific domestic climate change mitigation action. In particular the workshops aimed to discover what drivers and barriers the action faces, what international support should be requested to facilitate the action and what intermediate indicators may be employed to assess the progress of the action. The South African climate change mitigation initiative assessed in this workshop was the large-scale rollout of CSP (Figure 1).

FIGURE 1: PRESENTATION BY DAVID MAHUNA

To assess the barriers faced by the large-scale rollout of CSP in South Africa it was decided to structure the discussion in three parts, namely the technical, infrastructural and industrial requirements. After introducing the climate change mitigation action, and the drivers thereof, with a number of presentations from Harald Winkler, David Mahuna, Peter Lukey, Max Edkins, Tom Fluri and Andrew Marquard, the workshop participants divided into three focus groups to discuss the three requirements for large-scale CSP deployment. Each focus group structured its discussion around the following questions under the guidance of a group leader (Figure 2):

1. Technology

    a. What CSP technology is best suited for South Africa?
    b. Should we pursue **one** technology or **many**?
    c. How important is **storage** in CSP?
    d. Should **dry cooling** be considered?
    e. Should **back up fuel** be considered, is it available?
    f. What are the other **key issues** in this area?

2. Infrastructure

    a. What **grid expansion** is necessary for large-scale deployment of CSP?
    b. Where is adequate **road access** available?
    c. Is there enough **water** available?
    d. Is there enough **land** available at a reasonable cost?
    e. Are there **other barriers** to grid connection?
    f. What are the other **key issues** in this area?

3. Industrial

    a. Which **industries** can be developed to support the large-scale rollout of CSP?
    b. What would the **R&D** requirements of a local CSP component industry be?
    c. How would **international support** under a prospective climate agreement make a difference to this?
    d. What are the other **key issues** in this area?

FIGURE 2: FOCUS GROUP DISCUSSION ON TECHNOLOGY – LED BY THOMAS ROOS

The post lunch discussion, facilitated by Tasneem Essop, saw feedback from each group and engaged questions on the feedback. The open session of the discussion was designed to highlight additional requirements for large-scale CSP development that had not yet been raised in the discussions. Furthermore, the workshop at this stage aimed to bring questions around international support for CSP in South Africa. A survey (Appendix 1), handed out at the beginning of the day, was designed to spur thought around these issues, with a particular emphasis on assessing the stakeholder's perception of the REFIT, their understanding of what international support is necessary for large-scale CSP deployment, and their sentiment on which indicators would be successful in measuring the progress of the action.

Workshop outcomes - presentations

Forty-six participants attended the workshop, from government, industry, NGOs and research institutions (Appendix 2). Harald Winkler opened the workshop presenting the Climate Strategies' project and the Energy Research Centre's involvement. He mentioned the background and aim of the workshop, with a particular emphasis on the international and domestic framing of the action – the large-scale rollout of CSP. The potential of CSP to address three challenges – mitigation of climate change, energy security and access to energy services for the poor. David Mahuna from the government department formerly known as the Department of Minerals and Energy gave a presentation on the future roll CSP could contribute to South Africa's electricity generation. He highlighted the cabinet approved Long-term Mitigation Scenarios (LTMS) for South Africa and the specific roll of renewable energy in achieving the target of peaking South Africa's GHG emissions by 2020-2025, stabilising them for ten years and thereafter declining them in absolute terms – a target required by science to prevent dangerous climate change. He further mentioned, "Currently financial constraints are the barrier to the large-scale expansion of renewable energies".

Peter Lukey, from the former Department of the Environment and Tourism, presented his "dream of the future". Lukey presented a number of fictional newspaper articles from the future, which gave a perception of what the large-scale rollout of CSP may mean in reality. Upington was "a-buzz" with solar power developments, encouraged by a solar industry that was the fastest growing sector in South Africa. By 2012 the first 1000 MW of CSP capacity was constructed and by 2015 employment in Upington is 93% with a blooming downstream industry developing to supply the CSP boom. Early CSP industry exports start in 2017 and by 2025 the "African Century" is driven by clean energy, with the South Africa-Namibia-Botswana Trans-frontier Solar Park being the largest concentrating solar facility in the world.

More technical background information on CSP was presented by Max Edkins, Tom Fluri and Aandrew Marquard, with Edkins introducing the different CSP technologies, their industry requirements, the global industry and newest developments in CSP, as well as an estimation of the cost involved in CSP development. With an estimated investment cost of ZAR 5-8 billion for a 100MW plant in Spain and ZAR 3 billion for a 100MW plant in the US, the levelised electricity cost of CSP is thought to be around 2008ZAR 1.50/kWh today and is projected to decrease to under 2008ZAR 1.00/kWh by 2015-2020 (Figure 3).

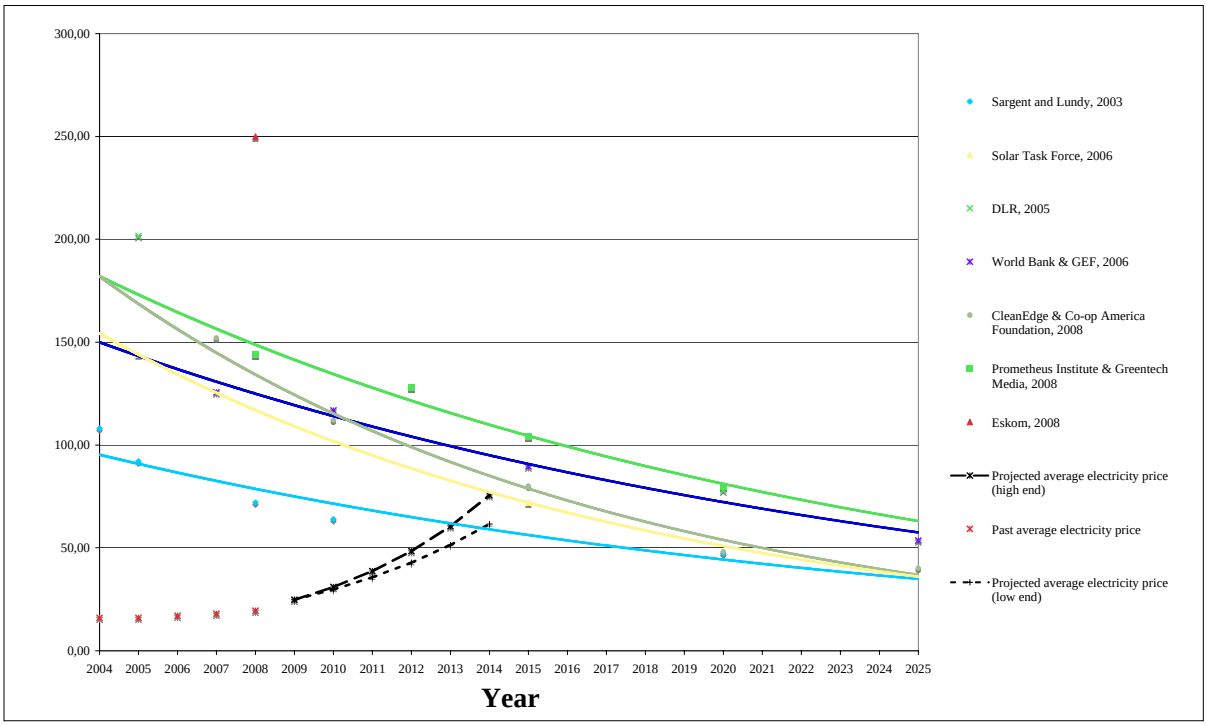

FIGURE 3: LEVELISED ELECTRICITY COST ESTIMATES FROM CSP PLANTS PROJECTED FROM THE LITERATURE, EXPRESSED IN 2008ZAR/KWH (AT A ZAR 8 TO THE US$ EXCHANGE RATE), AND COMPARED TO THE PROJECTED SOUTH AFRICAN ELECTRICITY PRICE.

Fluri presented a mapping study assessing the CSP potential in South Africa, where a number of CSP construction requirements were screened, including solar irradiation, available land, and electricity grid and road access (Figure 4). He showed that the potential net energy generation (TWh/a) was 3.3 to 5.4 times the total electricity requirement forecast for South Africa for the year 2025. Fluri highlight water availability as a possible infrastructure barrier, particularly in the Northern Cape, which probably reduces the CSP development potential in South Africa.

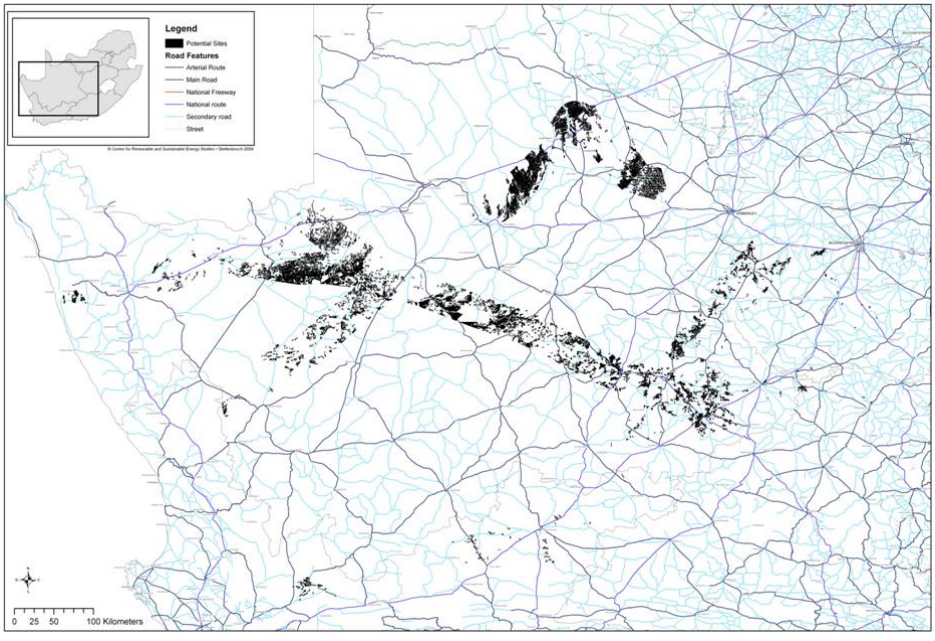

FIGURE 4: DETAILED MAP HIGHLIGHTING POTENTIAL LAND AVAILABLE FOR THE CONTRUCTION OF CSP PLANTS.

Marquard presented two modelling exercises, that of the LTMS for a 27% and 50% renewable electricity supply target by 2050 and that of a 15% target of renewable electricity supply by 2020. He indicated that by 2014 the first 100MW CSP plants would have to come online, after which at least ten 100MW CSP plants would have to be constructed per year to reach the 15% by 2020 and the 27% by 2050 targets. To reach the more ambitious 50% by 2050 target CSP rollout would have to scaled up from at least ten 100MW plants to about 20 to 40 per year from 2030 on to 2050 (Figure 5).

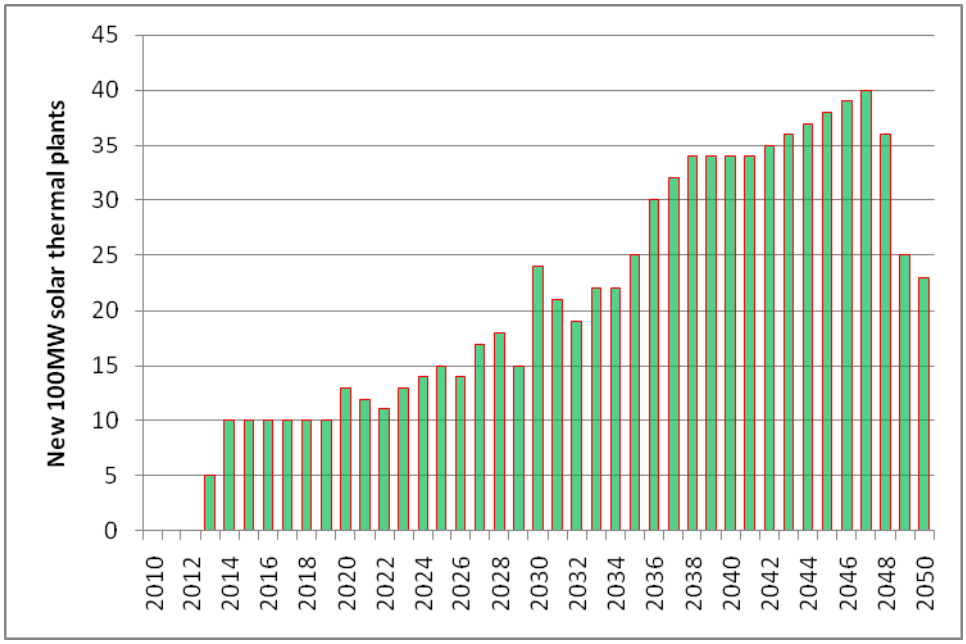

FIGURE 5: NUMBER OF 100MW CSP PLANTS WHICH HAVE TO BE BUILT PER YEAR TO ACHIEVE THE 50% OF RENEWABLE ELECTRICITY SUPPLY BY 2050 AS MODELLED BY THE LTMS.

Workshop outcomes – discussions

Group Feedback

1. Technology

Discussing which technology to pursue the group decided that it would be in South Africa's best interest to take on a two-track approach. On one hand, it makes immediate sense to construct the most commercially viable technology, namely Parabolic Trough Power Plants, as these have already reached a cumulative global deployment of almost 600 MWe. Central Receiver technology, on the other hand, has barely reached commercial deployment above 40MWe, even if there have been a few test plants constructed in the past, including SolarOne and SolarTwo. Linear Fresnel technology is even lest established, with no commercial plants haven been built to date, though it is a technology, which may result in cost savings.

The second angle to pursuing a CSP technology is aimed at establishing market competitiveness globally through investing in CSP technologies that the South African industry base can more easily adapt to. Central Receivers and Linear Fresnel Systems belong to this track, because they do not require the specialised parabolic mirror systems of the Parabolic Trough Systems. In short, therefore the first plants should probably be Parabolic Troughs, based on imported international technology, while at the same time South Africa should focus on developing the manufacturing base for the Central Receivers and Linear Fresnel technologies, which in the near future may become the dominant technology for the large-scale rollout of CSP in South Africa. In the discussion it was also mentioned that R&D into Linear Fresnel technology for rooftop application should also be supported. Eskom, for one, seems to be pushing the second track of the technology approach as they are developing a 100MWe Central Receiver System with a custom heliostat design, which are to be produced locally.

While discussing the storage technology necessary for CSP development, a major barrier to large-scale CSP rollout in South Africa was identified, namely the confusion around whether the REFIT prescribed a minimum of 6 hours of storage for any CSP development in South Africa. Since there is little commercially proven storage technology available, it was noted that such a requirement would discourage some CSP investor in South Africa, who either felt that investing in unproven storage technology as too risky or who were only invested in a bankable CSP project without storage and would therefore end up investing elsewhere. It was therefore recommended that NERSA should address this issue with more clarity and should consider establishing an alternative feed-in tariff for CSP without storage or with less storage, so as to accommodate all CSP developers – a requisite for the large-scale rollout of CSP. South Africa should also investigate alternative storage options at a national grid level, such as through the promotion of electric vehicles or more pump-storage schemes, and it was suggested that such storage capabilities should be considered for funding through the REFIT.

It was further recommended that the REFIT is expanded to incorporating off-grid power generation from renewable energy sources, such as a CSP with back-up fuel supply. The discussion thereby highlighted another restriction to large-scale CSP deployment, namely the questions of whether backup fuel was available, in what form, and whether it was allowed under the REFIT. It was suggested that some form of maximum allowable backup should be allowed, as for example in Spain, where up to 15% of generation form a CSP plant can be from a backup fuel.

2. Infrastructure

The first major barrier encountered in this discussion group was the grid connectivity for CSP plants. It was thought to become the “invisible non-technical barrier” and be the main reason for not reaching a large-scale rollout of CSP, as stipulated by the 50% target by 2050. For the large-scale rollout of CSP it is believed that a large-scale grid expansion program would have to take place. Specific citing of switchboards seemed to an issue. There were also numerous questions around who should shoulder the costs of grid expansion en-mass into the north-eastern parts of South Africa and beyond into Namibia and Botswana with the aim of expanding the Southern African Power Pool. Initial integration of smaller sized CSP plants was noted as not being too much of an issue.

The focus group believed that a Transmission Planning Study needed to be completed as soon as possible, potentially commissioned by the new Energy Department of government. Although this should be based around existing structures the study needed to focus beyond Eskom's direct need to incorporate those of the IPPs, in particular the CSP developers. It is hoped that such a study would result in updated Distribution Codes, building on existing regulatory structures. Road access would also have to be assessed, especially since South Africa would have to create a new Industrial Development Zone for the large-scale rollout of CSP.

As noted in Fluri's presentation land availability did not seem to be much of a barrier to CSP development, though water supply would certainly become a restricting factor. Eskom's 100MW CSP Plant proposal, for example, would use 300,000 m^3 of water per annum, and for the large-scale development of CSP plants, where ten or more of these are build every year, this would have a severe impact on an already water-stressed South Africa. The upper Orange River basin may yield the greatest supply, though climate change impacts may also further reduce the water availability. Careful planning for CSP developments would therefore have to be conducted, in line with the needs of the Department of Water and the Environment. Dry cooling technology could be an option for alleviating the water requirements, but even with this technology, at a large-scale, water availability will be a barrier.

3. Industry

South Africa's industry was noted as a potential major driver of CSP development in South Africa. In particular the presence of a large automotive industry would yield itself well to supplying CSP components such as steel, glass and reflective coating, and South Africa's construction sector is well established. The concept "from Hummer to heliostats" was born. It was further mentioned that under the present global economic outlook developing a solar industry might be a great opportunity. Nonetheless, one barrier the group identified was the high risk involved in investing in developing the industry. It was noted that without a pilot CSP plant it would be difficult to convince investors in shaping the CSP industry support base. To gain financial confidence in a CSP industry the group participants mentioned that the REFIT would have to work, which in the mean time remained a barrier, until it had proven itself.

Furthermore, financial confidence would be achieved if the scale of the CSP industry were well defined – whether government or NERSA highlighted how much CSP new build should be targeted annually. There seems to be an educational and perception barrier in that CSP rollout in South Africa has not yet been perceived anything more than "a pilot development", which may have to do with Eskom's position over their "test plant". They should have branded their development as "building an industry" – the Solar Industry Development Programme. A national planning framework, possibly lead by the Department of Trade and Industry, would have to be established to encourage the industry by coordinating with other government departments and interested industrial sectors. It was suggested that government should initiate a public-private partnership and thereby invite CSP developers to establish test facilities. Small town or regional electrification was highlighted as a potential way of getting the CSP rollout to take root. Similar to the experience gained from the World Bank support for South Africa's rapid bus transport system development, initial investment steps have to be completed in-country before international support can be lobbied.

4. Legal and Regulatory

During the open discussion a number of additional potential barriers were highlighted. One possible one is the bureaucratic Environmental Impact Assessment (EIA) process, though Lukey, from the government department, formerly known as the Department of Environmental Affairs and Tourism, assured the group that EIAs for sustainable energy developments were being mainstreamed and should not become the hindering factor.

The further seems to be some confusion about the Department of Minerals and Energy's statement, prior to the announcement of the REFIT, that renewable energy projects have to go through a bidding process to gain the power purchase agreements. Questions were raised as to how the bidding process would be married with the REFIT, and until this becomes clear it seems to be an administrative barrier preventing immediate CSP developments in South Africa.

Lastly there was a notion that Eskom needs to support the large-scale CSP rollout programme, by firstly breaking its monopoly control of the power generating industry and secondly being more transparent and sharing with CSP-specific information, such as solar radiation maps. It was suggested that Eskom should support the grander vision of developing a CSP industry in line with the discussion outcomes of this workshop. IPPASA announced its aims and a follow-up meeting was suggested to take place as a side event to the solar conference in October 2009.

Workshop outcomes - survey

The survey was designed to gain a deeper understanding of how the stakeholders present at the workshop felt about the domestic action of achieving large-scale rollout of CSP. The National Energy Regulator has designed the first input indicator, namely the REFIT, which stipulates that CSP developers are assured a price of ZAR 2.10 per kWh electricity produced. Of the 21 surveys completed the majority indicated some positive sentiment for the REFIT with about 50% noting that the REFIT is "very" sufficient, 30% marking "somewhat" and about 20% marking "overwhelmingly so" to scale up CSP in South Africa. Nonetheless a number of criticisms, which were already highlighted in the discussion, were mentioned, including that the REFIT is too narrow in its scope, as well as the lack of clarity on the "storage restriction".

From the survey it is noted that financial support was the most desired international support actions (16 of 21), as technology support and policy and institutional capacity support would only make sense with financial support. Largely this has to do with the high investment costs of CSP developments. It seems that the technical and engineering requirements are quite well understood, but only with financial support are CSP developers able to prepare feasibility studies, which then can be taken to the banks for further financing. The current global economic climate also seems to make it difficult for CSP developers to accessing financing, and hence international financial support is necessary. Besides going to feasibility studies and R&D research, the financial support was thought to aid capacity building in the Single Buyer Office of Eskom, who will be in charge of all the CSP power-purchase agreements, as well as

supporting infrastructure development, such as grid expansion into the Northern Cape. Up-scaling the CDM for greater financial support was deemed necessary by a few, where programmatic or no-lose targets were mentioned, and one person mentioned a guaranteed basic carbon price as a useful international support action for encouraging CSP rollout in South Africa.

Other international support actions that were highlighted in the survey include a strengthened global GHG mitigation target, education and capacity building in local CSP supply industry (such as the auto industry), and support in getting the first power purchase agreement off the ground under the REFIT in South Africa under the "policy and institutional capacity building support". Under "technology support" participants highlighted the need for demonstration plants in South Africa, storage technology transfer and technical support towards establishing a local CSP component supply industry.

On projecting CSP rollout in South Africa a majority of participants (10 participants) thought that 30% of South Africa's electricity could be supplied by CSP in 2025, whereas 6 participants thought it would be 10% and 1 thought only 5%, while a further 4 believed it could be 50% by 2025 (Figure 6).

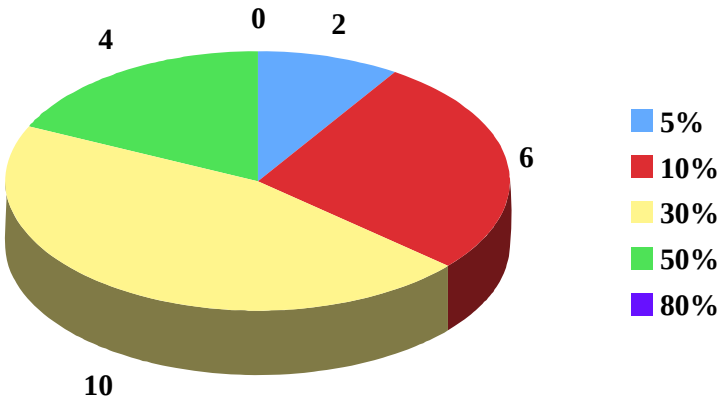

FIGURE 6: NUMBER OF PARTICIPANTS SURVEYED, WHO THOUGHT CSP COULD SUPPLY 5%, 10%, 30%, 50% AND 80% OF THE ELECTRICITY GENERATED IN SOUTH AFRICA BY 2025.

To assess the progress of large-scale CSP rollout a number of intermediate indicators were suggested in the questionnaire, with "electricity produced from CSP plants (kWh)" being ranked the most successful by the respondents, see figure 7 below. The "percentage of CSP in the national planning process", the "amount of land and water rights committed to CSP development" and the "percentage of CSP developers with offices in South Africa" were deemed to be a less successful intermediate indicator, which probably is due to that fact that neither of these indicate real progress towards achieving a low carbon electricity supply in South Africa, but rather indicate the amount of interest in CSP developments in South Africa. Most of the respondents thought that such intermediate indicators should be reported annually, or more frequently.

Intermediate progress indicator	Not at all	Not successful	Somewhat	Successful	Very Successful
GHG mitigated			◄———	———►	
Electricity produced from CSP Plants (kWh)				◄———	———►
CSP Plant licenses issued			◄———	———	———►
CSP Plants under construction			◄———	———	———►
Committed finance to CSP developments			◄———	———	———►
% of CSP in national planning process	◄———	———	———►		
Amount of land and water rights committed to CSP development	◄———	———	———	———►	
% of CSP developers engaged in South Africa		◄———	———	———►	
% of CSP developers with offices in South Africa		◄———	———►		

FIGURE 7: RANGE INDICATING SUCCESS OF DIFFERENT INTERMEDIATE INDICATORS FOR THE LARGE-SCALE ROLLOUT OF CSP IN SOUTH AFRICA.

Conclusions

The workshop was very successful in identifying the immediate technical, infrastructure and industry requirements for the large-scale rollout of CSP in South Africa. It also gave a good indication of what the stakeholders feel is possible, how this should be supported internationally and what intermediate indicators would be most successful in monitoring the CSP deployment. Many immediate and long-term barriers to achieving the rollout of CSP were identified, including technical, infrastructural, industrial, as well as legal and regulatory issues. These were discussed thoroughly and a number of recommendations were made.

Appendix 1: Survey

Please indicate which stakeholder group you consider yourself to be part of:

NGO	Energy business	Government	Research	Consulting	Other

What is you interest in CSP?

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…….

1. Financial Questions

a. How sufficient is the REFIT to scale up CSP developments in South Africa? Please explain your choice.

Not at all	Not really	Somewhat	Very	Overwhelmingly so

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……
……

b. What additional (international) financing is required to encourage CSP developments? What actions should the financing support?

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……

2. Intermediate targets questions

c. What is an achievable percentage of the electricity supply (TWh) that can be generated from renewable technologies by 2025 (10 000 MWh by 2013 is about 4 %)? Please explain your choice.

5 %	10 %	30 %	50 %	80 %

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……
……

d. During discussions on international cooperation for tackling climate change, it has become clear that defining emission targets alone will not suffice. Cooperation on technology, capacity building, and direct provision of financial support for action in developing countries is receiving increasing attention. This has raised the question of which indicators can be used to measure such activities.

Please mark how successful you think the following intermediate indicators may be for large-scale CSP deployment in South Africa.

Intermediate progress indicator	Not at all	Not successful	Somewhat	Successful	Very Successful
GHG mitigated					
Electricity produced from CSP Plants (kWh)					
CSP Plant licenses issued					
CSP Plants under construction					
Committed finance to CSP developments					
% of CSP in national planning process					
Amount of land and water rights committed to CSP development					
% of CSP developers engaged in South Africa					
% of CSP developers with offices in South Africa					

Mention any other intermediate progress indicators:

……
……

How often should these be reported?

……
……

3. International support

Please identify 3 measures per category of international action, which would contribute the most to developing large-scale CSP in South Africa:

Policy and institutional capacity building

Financial support

Technology development

Which category of international support actions is most valuable? Please explain your choice.

Policy-related support	Financial support	Technology development

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Appendix 2: List of Participants

Government

- Peter Lukey – DEAT
- David Mahuna – DME
- Mark Gordon – DPE
- Amanda Luxande – SANERI
- Brian Jones - City of Cape Town

NGOs

- Peet du Ploy – WWF
- Tasneem Essop – WWF
- Saliem Fakir – WWF
- Stefan Raubenheimer – SSN
- Liz McDaid – SAFCEI

Industry

- Robert Aitken – Restio Energy
- Linda Newton-Thompson – Genesis Eco-energy
- Alan Drew – Mainstream
- Frank Spencer – Alt-e Technologies
- Tristan Bergh – Ride the Ray
- Simon Haw – AP Solutions
- Bjorg Rode – NordPool – Principal Advisor (SAPP)
- Des Muller – GroupFive
- Thomas Garner – Exxaro
- Dieter Matzner – Hatch
- Michael Goldblatt – PDG
- Gillian Sykes – PDG
- Septimus Boshoff – PSD
- Dave Crombie – Arcus Gibb
- Quinton Uren – Jendamark
- Tim George – 3lawscapital

CSIR

- Thomas Roos
- Brian North
- Louis Waldeck
- Monga Mehlwana

Centre for Renewable and Sustainable Energy Studies, Stellenbosch

- Tom Fluri
- Theo Von Backström

Energy Research Centre, UCT

- Harald Winkler
- Andrew Marquard
- Max Edkins
- Thapelo Letete
- Warren Morse
- Simisha Pather-Elias

UCT

- S.P.Chowdhury
- S.Chowdhury
- Paul Olulope
- Rethabile Melamu

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