ENHANCING DECISION-MAKING CAPACITY TO SUPPORT THE IMPLEMENTATION OF EMERGING ENERGY TECHNOLOGIES

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ABSTRACT

South Africa embarked on an ambitious renewable energy implementation plan in order to diversify energy supply, address environmental challenges linked to the coal-based energy economy and to stimulate local economic growth and job creation through the green economy. The programme aims to implement renewable energy projects with an overall capacity of 3 725 MW.

There is general agreement that the South African energy sector, and in particular the renewable energy sector faces severe skills shortages. A related challenge is that administrators, public sector officials and decision-makers also lack relevant technical skills pertaining to renewable energy, thus hampering decision-making processes. Projects experience delays due to the inability of decision-makers to process project applications and the implementation of emerging energy technologies may be at risk. From a theoretical perspective, this indicates a lack in system capacity and a requirement to enhance organisational systems and process together with role capacity of individuals.

Under the auspices of the South African German Energy Programme (SAGEN), 17 capacity building and training events, focussing on increasing the technical capability of non-technical decision-makers involved in the implementation of the South African renewable energy implementation programme, were implemented since 2012. The paper will provide an overview and analysis of participants' experiences regarding the value and impact of the capacity building events offered on their ability to perform their tasks. The paper will argue that providing targeted and appropriate technical training to non-technical decision-makers improves the implementation of innovative technology programmes and ultimately contributes to growth in relevant economic sectors.

Impact was measured at different time intervals after the events. Data was collected through a structured questionnaire, administered to all participants.

The results indicate that a small investment in technical capacity building aimed at decision-makers in the renewable energy sector yielded beneficial results in terms of managing the implementation of novel energy technologies. The experience and results may be of relevance to other sectors implementing new technologies.

Key words: capacity building, renewable energy, long-term impact, skills development

INTRODUCTION

Energy sustainability consists of three often conflicting goals: energy security, energy equity and environmental sustainability, dubbed by the World Energy Council as the 'energy trilemma' (World Energy Council, 2013). South Africa also has to deal with the energy trilemma, however, each component is further compounded by additional constraints and challenges, unique to the South

African situation. For example, energy security, defined by the WEC (2013) as "the effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of energy providers to meet current and future demand" or rather the lack of energy security in South Africa, has been identified as one the two major obstacles for economic growth in South Africa. The national electricity utility Eskom has warned that even with the commissioning of Medupi's first unit on 24 December 2014, electricity supply will be constrained for at least another 5 years due to the backlog in maintenance and infrastructure upgrade required in the South African network (Nicolaides, 2014). It can be argued that the lack of energy security is impacting negatively on economic growth, investor confidence and regional stability.

In terms of energy equity (described as the accessibility and affordability of energy supply across the population, WEC, 2013), South Africa has to address energy equality in one of the most unequal societies of the word. Economic growth and job creation has become overriding goals in Government policies to address poverty and inequality, yet the outlook remains bleak with an unemployment rate of 25.5% (Steyn, 2014) and an economic growth rate of just above 2% from 2008 to 2012 (Statistics South Africa, 2014). Poverty and inequality is reflected in energy consumption in South Africa where the poorest have to rely on fuelwood, paraffin, and coal and the rising cost of electricity has become a serious threat to small businesses – poverty therefore exacerbates energy poverty while energy poverty can be argued to increase poverty.

Environmental sustainability (defined by WEC (2013) as the achievement of supply and demand-side energy efficiencies and the development of energy supply from renewable and other low-carbon sources) poses a real challenge for South Africa with its coal-based energy economy which earned the country the 7^{th} place on the world's list of biggest CO_2 emitters (Davis and Caldeira, 2010). Breaking the reliance on cheap, accessible coal and diversifying the energy supply mix of the country, while addressing economic growth is a balancing act occupying Government's attention since the publication of the White Paper on Energy Policy in 1998.

In an attempt to address the challenges of energy security, diversifying the energy supply mix and reducing environmental impacts associated with the energy sector, South Africa embarked on an ambitious renewable energy procurement programme that has won international recognition and resulted in investment in the renewable energy sector of more than $5.5 billion in 2012, up from a $30 million in 2011 (Pew Charitable Trusts, 2013). The rapid investment growth over the past two years made South Africa the ninth-leading destination for clean energy investment among the Group of 20 (G-20) of the world's developed and emerging economies – this after occupying the last spot in 2011 (Pew Charitable Trusts, 2013). South Africa's leading position has been secured through a supportive policy environment, coupled with a secure investment framework established by the Department of Energy's (DoE) Renewable Energy Independent Power Producer Procurement Programme or REI4P.

Despite the success of the REI4P, a number of challenges remain, amongst others, a recognisable skills shortage to service the nascent industry as well as a general lack of capacity in public sector institutions responsible for the implementation of the programme. The following paper will outline activities undertaken under the auspices of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) implemented South African German Energy Programme (SAGEN) to address the issues of skills shortages and capacity in the renewable energy sector in South Africa.

BACKGROUND

Daniels (2007) notes that 'skills shortages' is an amorphous concept that encapsulates many specific components, "but at the heart of the matter is the idea that the demand for certain skills exceeds the supply". Daniels, (2007), further emphasises that skills refer to both qualifications and experience. Scarce skills, defined in the South African situation, refer to occupations in which there is a scarcity of qualified and experienced people (Daniels, 2007). The scarcity can either be due to an absolute scarcity (suitably skilled people do not exist) or a relative scarcity (suitable people exist but are not available or do not meet employment criteria). Lastly, Daniels (2007) describes that there is a distinction between generic skills such as language, numeracy and working in teams for example, and particular skills required for performance within a specific occupation. Daniels (2007) argues that a shortage in particular skills often occur when" a firm experiences technological change or reorganises production methods". By extension, it can be argued that particular skill shortages will also occur when there is technological change in a sector (for example the energy sector, shifting from fossil fuels to renewable energy sources) or when a sector reorganises its production methods, again from generating electricity from coal to generating electricity from solar, wind, hydro and bio-energy sources.

Skills shortages for the South African renewable energy have been investigated by the International Labour Office (2010) based on available job creation estimates and the policy environment of the time as well as a study commissioned by GIZ in 2011 (Roux, 2011). Before skills shortages in the South African renewable energy sector can be analysed, the potential job creation capacity of the sector should briefly be examined. Bacon and Kojima (2011) explain that employment created in the energy sector can be measured as direct (those employed by the project itself), indirect (those employed in supplying the inputs to the project), and induced (those employed to provide goods and services to meet consumption demands of additional directly and indirectly employed workers). Bacon and Kojima (2011) further distinguish between employment for construction, installation and manufacture (CIM), and employment for operation and maintenance (O&M). These explanations should be kept in mind when reviewing the various studies investigating the potential employment of the South African renewable energy sector.

A number of studies have been undertaken in South Africa to determine the potential job creation capacity of the renewable energy sector, all with divergent results. An early study (Agama Energy, 2003) estimated the creation of 36 400 new direct jobs by the renewable energy industry with an additional 110 000 indirect jobs by 2020 should 15% of electricity production be from renewable energy sources. A 2010 study commissioned by Greenpeace (Rutovitz, 2010) utilised three scenarios of differing renewable energy end energy efficiency implementation scales and estimated between 46 000 and 78 000 (depending on the scenario) direct jobs to be created. A segmented analysis of the net direct job creation anticipated to emerge in the formal economy across a wide range of technologies and activities that may be classified as green or contributing to the greening of the economy was undertaken in a collaborative study between the Industrial Development Corporation, Development Bank of southern Africa and Trade and Industrial Policy Strategies (Maia *et al*, 2011). The study estimated that the formal green economy could generated 98 000 new direct jobs in short term, 255 000 jobs in the medium term and 462 000 employment opportunities in the long term (Maia *et al*, 2011). It was further estimated that green energy generation could provide 14% of the total jobs (or just over 13 500) in the short term while eventually providing more than 28% of the jobs in the long term when around 130 000 employment opportunities are expected to be associated with green energy generation (Maia *et al*, 2011).

Although the abovementioned studies produced very different results, compiling job creation estimates are important to argue the potential added economic value of the renewable energy sector. There is no doubt that the green economy and the renewable energy sector will create jobs and we may argue about exactly how many jobs will be created and how sustainable those jobs may be, however, none or very little of the potential would be realised if enough skilled people are not available to service the sector.

The renewable energy sector is critical to the South African economy, contributing around 15 % towards the Gross Domestic Product (GDP) and currently employing an estimated 76 000 people (Roux, 2011). There is however, an acknowledged lack of trade workers and technicians and in particular a shortage of engineers. Related skills shortages have been highlighted in the Sector Skills Plans (2011-2016) published by Manufacturing and Engineering Sector Education and Training Authority (merSETA) and the Energy and Water Sector Education and Training Authority (EWSETA) (Roux, 2011). Roux (2011) notes that the SETA's, private training providers, further education and training colleges and universities do not have a well-established history of demand-side skills planning and have been criticised as being slow to respond to market needs, concluding that "the numbers required by the renewable energy sector to green the economy will require significant focus and financial resources in order to meet targeted growth objectives".

The International Labour Office (2010) stated "South Africa currently faces an enormous lack of skills in many sectors, which may not bode well for green skills, new green skills and for greening of existing skills". It is estimated (ILO, 2010) that South Africa is short of approximately 12,600 industrial and mechanical engineers and technologists; 5,000 electricians; and 7,000 specialist managers (including environmental, arts and culture, office and quality managers) while there is also a serious shortage of professionals in the training and development, and human resources sectors.

Addressing and solving the entire skills challenge in the renewable energy sector in South Africa was beyond the scope of the South African German Energy Programme (SAGEN). The programme's primary aim was to support South African public institutions to increase investment in renewable energy and energy efficiency. During the course of the programme's implementation it was recognised that the majority of decision-makers and officials dealing with renewable energy lacked a thorough technical understanding of renewable energy technologies and their potential impact. The lack of technical knowledge impacted negatively on the ability of decision-makers to support the implementation and roll-out of the renewable energy programme. Recognising the need for targeted capacity building interventions, SAGEN devised a small programme component aimed at increasing technical expertise, capacity and know-how for decision-makers, planners and policy-makers in the South African renewable energy sector.

A HIERARCHY OF CAPACITY BUILDING NEEDS

Potter and Brough (2004) state that capacity building is at the heart of international aid and that the very concept of development implies independence – emphasising the notion that as development workers, we should actually all be trying to work ourselves out of a job. Despite capacity building being the objective of many development programmes and a component of most others, Potter and

Brough (2004) note that the concept is so broad and used in such varying ways that too often it becomes merely a euphemism referring to little more than training. For example, in everyday use, the term is employed frequently to refer to people who do not know how to discharge their functions properly (to be solved by training), to denote that there is a lack of time, money or authority to do the things expected (to be solved by extra staff) or that there is a lack of institutional capacity, implying more equipment, bigger budgets or greater devolution of powers.

Instead, Potter and Brough (2004) argue that it is more important to address systemic capacity building and to adopt a systemic approach than to attempt to develop an encompassing definition for the concept. Nine separate but interdependent components make up the unitary concept of capacity building. These are:

- Performance capacity which refers to the tools, money, equipment, consumables etc. available to do the job. A person, however well trained, without the required equipment will be of limited use.
- Personal capacity, referring to level of which staff has sufficient knowledge, are skilled and confident to perform properly.
- Workload capacity which addresses the question if enough staff with broad enough skills is available to cope with the work load and if their skill mix is appropriate.
- Supervisory capacity, concerning the systems in place to ensure accountability, for example are there reporting and monitoring systems in place and are there clear lines of accountability.
- Facility capacity which deals with questions around facilities serving the industry, for example, are training centres big enough, are there testing and verification labs that can test technologies and equipment, is the sector supported by adequate research facilities, and are there enough workshops, warehouses and offices to support project implementation.
- Support service capacity, referring to the availability of service providers and auxiliary services that are required to perform effectively.
- Systems capacity, dealing with the flows of information, money and managerial decisions in a timely and effective manner. It also refers to external links and communication with role-players in the sector.
- Structural capacity, referring to decision-making forums where inter-sectoral discussions can be made.
- Role capacity, which applies to teams and individuals and questions if they have been given the authority and responsibility to make decisions essential to effective performance.

Emphasising systemic capacity should improve diagnosis of sectoral shortcomings, improve project/programme design and monitoring and lead to more effective use of resources. Potter and Brough (2004) propose the use of a pyramid which form a four-tier hierarchy of capacity building needs, namely:

- Structures, systems and roles
- Staff and facilities

- Skills
- Tools

The capacity pyramid is illustrated in figure 1, below:

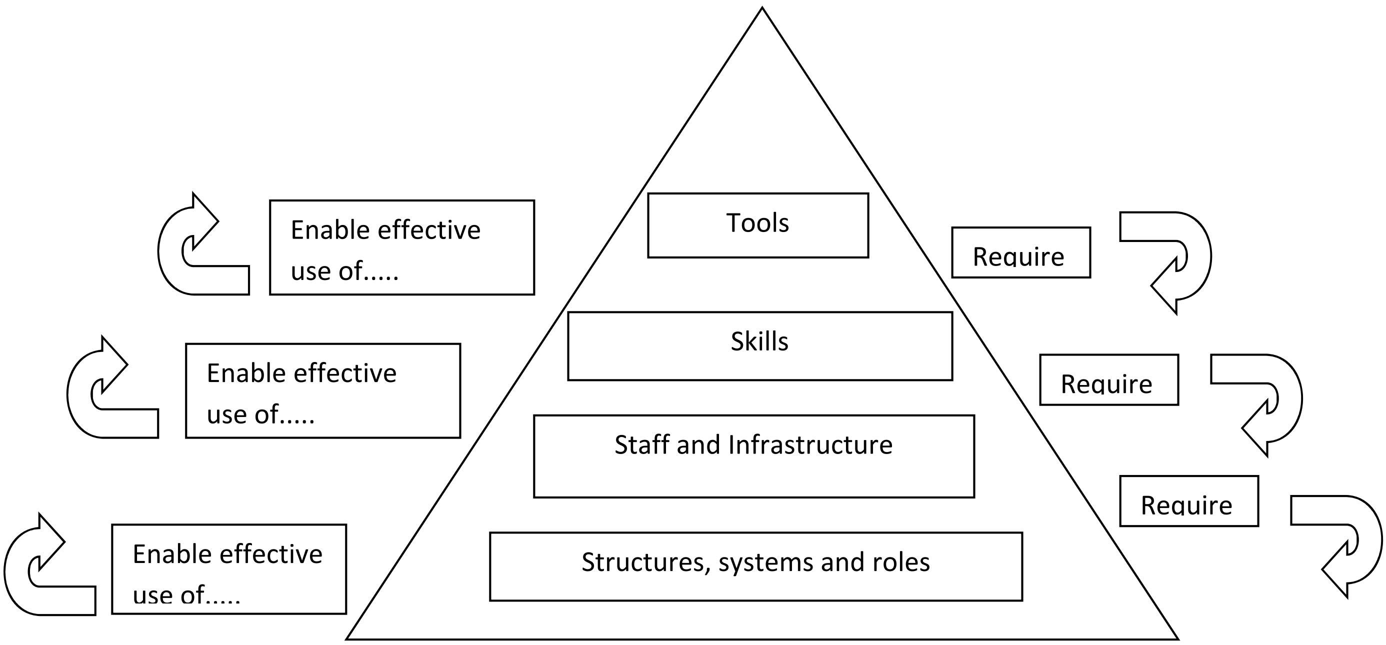


Figure 1: Capacity pyramid (Potter and Brough, 2004).

Potter and Brough (2004) conclude that developing countries (and sectors) suffer primarily from a lack of system capacity, i.e. organisational systems and processes, linked to too few people being allocated role capacity, rather than a mere lack of training or institutions. "It is surely time for governments and development partners ostensibly trying to support their efforts, to move beyond the mantra of 'lack of capacity' and the ineffective placebos of equipment, training and construction. By addressing systemic capacity building as a hierarchy of components in which the less tangible are the most important, significant improvements could come about in the way development aid resources are used (Potter and Brough, 2004)".

Again, noting that it would be beyond the scope of the SAGEN programme to embark on capacity building at all levels of the proposed capacity pyramid, the programme aimed its activities to enhance the technical skills and understanding of staff in decision-making positions in organisations dealing with the implementation of renewable energy, thereby addressing the personal capacity and workload capacity of decision-makers, ultimately enhancing their role capacity to ensure effective decision-making.

DESCRIPTION OF ACTIVITIES

Based on the argument of Daniels (2007) that skills refer to both qualifications and experience, and the proposition of Potter and Brough (2004) that system capacity require enhancement through the increase of role capacity of people in the system, the GIZ SAGEN programme devised a small intervention to attempt the increase personal- and workload capacities of decision-makers which would increase their role capacity in the renewable energy sector in South Africa. Recognising that the SAGEN programme will not be able to provide enough technical training to decision-makers to turn them into mini engineers, GIZ used the following instruments as part of their capacity building activities during the period 2012 – 2014 to increase basic technical knowledge about renewable energy technologies:

- Study tours: Participants were exposed to working examples of renewable energy technologies or projects and exchanged knowledge and experience with experts and leaders in the field. SAGEN supported study tours on grid integration of renewable energy, grid operation, interdepartmental coordination of renewable energy permitting processes, solar research coordination as well as go-generation technology.
- Medium-term training courses: SAGEN supported two training courses in Germany for a period of 3 months for prospective wind energy technicians. The aim of the training courses was to train selected participants, employed by private companies from the wind energy sector as wind energy technicians. SAGEN also supported a 6 week training course for prospective wind energy technical training lecturers in Germany.
- Short-term experiential skills development courses: In cooperation with the Fraunhofer Institute, SAGEN designed a three week experiential skills development course on technical aspects of wind, solar and bio-energy.

In total, SAGEN supported 20 capacity building events between 2012 and 2014, attended by 317 participants of which 113 (or 36%) were women. For the long-term impact assessment, only 17 measures were included as the other measures could not be evaluated in the same manner.

IMPACT ASSESSMENT

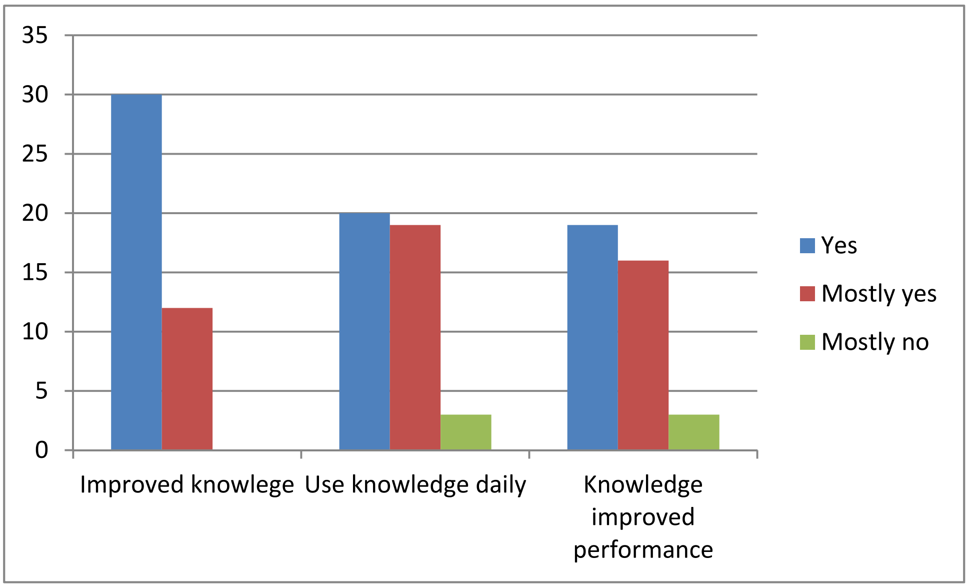
To enable some understanding of the longer term impact of the SAGEN capacity building events, a questionnaire was sent to all 234 participants of selected 2012/13 events. The questionnaire asked respondents to specifically look back at the event and reflect on its impact in the light of the time elapsed between the event and the evaluation. The questionnaire was only sent to 234 participants out of 260, since at least 6 months had to have lapsed between the event and the evaluation and due to the timing of the last four events in 2013, they were not included in the survey. A total of 43 questionnaires were returned, a return rate of 18%.

Respondents had to answer 3 questions related to the content of the capacity development event:

1. Was their knowledge improved through their participation in the event?
2. Are they using their knowledge gained on a daily basis in their course of work?
3. Did knowledge gained improve their performance at work?

Form the analysis it was clear that the majority of respondents (98%) felt that they improved their knowledge through their participation (if yes and mostly yes responses are counted together). 64% of respondents indicated that they use the knowledge gained on a daily basis, while 56% reported an improvement in their performance at work due to the knowledge gained during the capacity building event. The results further indicate the 90% of respondents experienced the effect of the capacity development event as positive. The results for the responses to all three questions are illustrated in table 1 below.

Table 1: Combined responses regarding the use of knowledge gained (relevance of content)



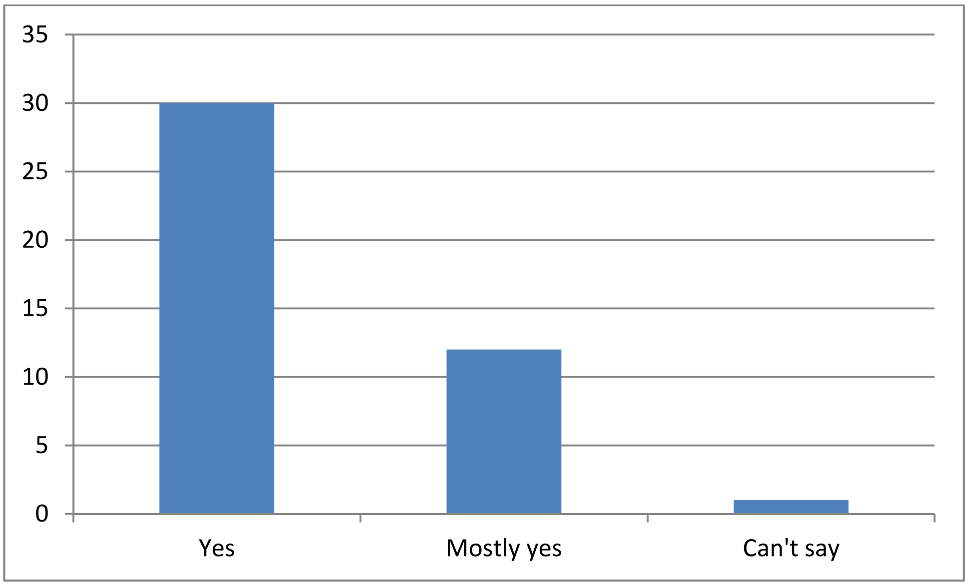
On the mostly no responses, it should be noted that the wind energy Train-the-Trainer course was presented in 2013 while the South African wind energy training centre where it is envisioned that they will provide training, is not yet operational. The fact that lecturers cannot yet use the knowledge they gained, could be the explanation for the “mostly no” responses. Secondly, the study tour on the operation and management of wind energy training centres was attended by decision-makers that do not necessarily work with wind energy on a daily basis in their work, again explaining some of the “mostly no” responses.

From SAGEN’s perspective, it can be argued that the training events were effective as it assisted to obtain our objective of improving technical knowledge and skills of decision-makers in the renewable and energy efficiency sectors, thereby improving role capacity in the sector. The attainment of SAGEN’s goal is further substantiated since the majority of participants indicated that they improved their knowledge through their participation, as illustrated in table 2 below.

In looking at the effectiveness of the training (where effectiveness is taken as a measure of the extent to which an activity meets its objectives), the following detailed responses can be argued to illustrate the effectiveness of the training for participants:

- “Before attending the event our anaerobic digesters were not used to generate electricity. We are now using gas from anaerobic digesters and converting it to electricity”.
- “After this study tour I had a much clearer idea of what facilities were needed and what type of courses required to train wind energy technicians. I could refine the application for the funding for the SARETEC centre which was subsequently approved”.
- “The study tour had a very positive impact on the SA policy application of Energy Performance Certificates (EPCs) in South Africa”.

Table 2: Participants who improved knowledge through participation



The value of the knowledge gained is further illustrated by the high number of participants that indicated that they use the knowledge gained on a daily basis in their work (table 3) and that they were able to improve their performance at work due to the knowledge they gained during the training event (table 4).

Table 3: Participants using knowledge gained on a daily basis

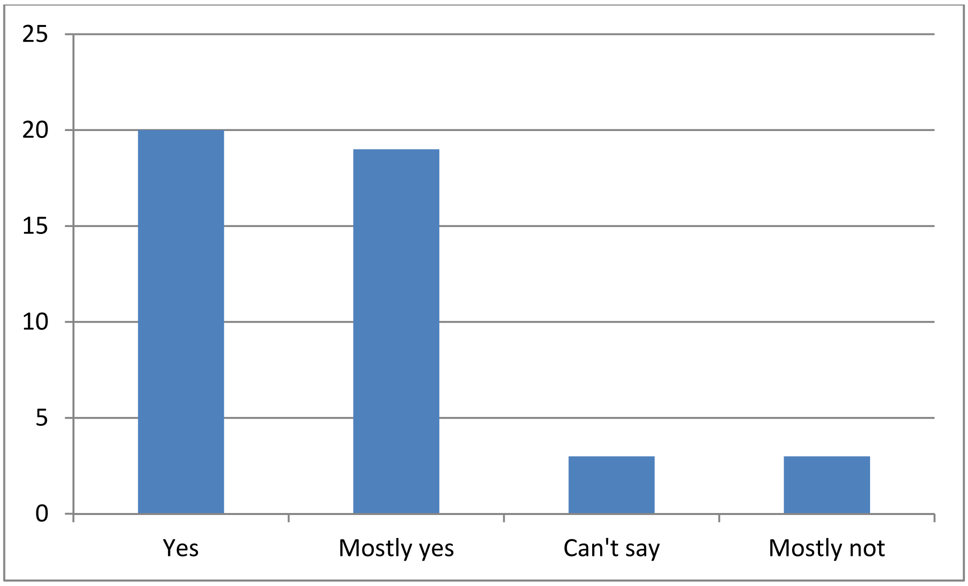
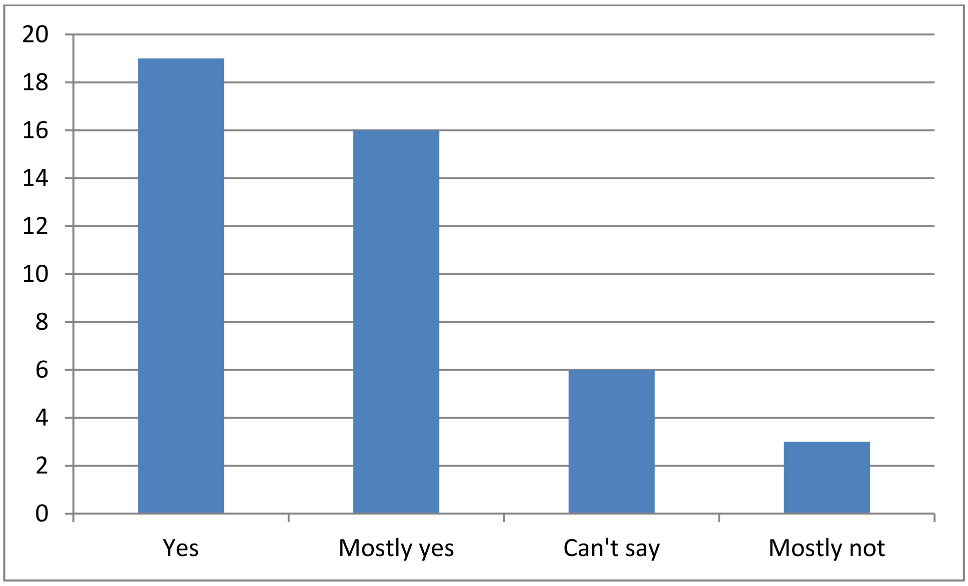


Table 4: Participants who improved performance through knowledge gained

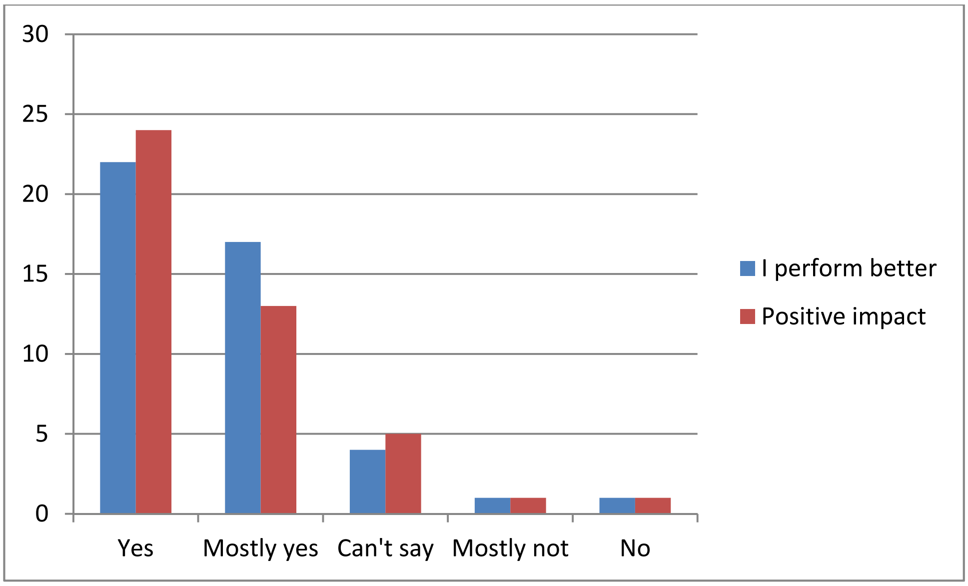


Based on the result of the abovementioned analysis, it can therefore be concluded that the capacity building events hosted by GIZ SAGEN had *high relevance* to the participants (relevance referring to the extent to which the activity is suited to the priorities of the target group). Some detailed responses from respondents in the form of comments are presented as proof of the high relevance of the activities for the participants:

- “The solar tour has directly influenced my involvement in the solar technology roadmap process. I have more insight into the solar technology future from the perspective of what is working internationally”.
- “Knowledge gained regarding the wind energy industry in Germany has been invaluable in assisting me in planning future curricula to include some of its content”.
- “I consider my participation in the event as a great privilege and one of the most enriching experiences of my career. The study tour came at a time when I just started a career in RE and it allowed for an accelerated learning experience and I could not have asked for a better springboard”.
- “In my responsibility for vocational curriculum development, I am much better able to steer the process for a learning programme in renewable energies and energy efficiency”.
- “Both events provided strategic direction in positioning SETA interventions in the sustainable green skills context”.
- “The technical training improved my understanding of the construction of solar plants and I improved my knowledge and can now perform my M&E tasks better”.
- “I am currently assisting in reviewing the use of PV technology in our mining operations”.

From SAGEN’s perspective, we are also interested in the impact of our training activities and respondents were asked to rate the impact of the event on their performance of their work. Utilising the Development Assistance Committee (DAC) criteria definition of impact, impact is viewed as the changes produced by the activity. The impact of the training was measured by asking respondents to indicate if they could perform better due their participation and if their participation had a positive impact on their overall performance at work. In total, 86% of the respondents indicated that the training event they attended had a positive impact on their performance and table 5 below illustrates the responses:

Table 5: Impact of the training on performance



Participants were asked to name specific examples of how the training had a positive impact on their daily work:

- "I have been able to look and review the technical risks on six projects that obtained preliminary approval for DBSA funding post attending the course".
- "We evaluated and implemented a net-metering tariff to enable consumers to generate electricity and to transfer surplus energy to the municipal grid which can be offset against energy supplied".
- "There is a constant drive to implement alternative sources of energy and the knowledge that I have gained is of great assistance to evaluate and to provide advice where and when required".
- "The projects I work with on a daily basis benefitted through the introduction to other research institutions during the study tour and brought me in direct contact with a number of industries, government bodies, suppliers of technology and centres of excellence".
- "With the knowledge gained I could advise decision-makers with confidence".
- "I gained a better understanding of the overall requirements and equipment needs in training Wind Turbine Service Technicians. This assists in my work to establish the SARETEC centre".
- "The wind energy training institutions we visited provided context and detail of how the government has supported the institutions to develop skills".
- "Evaluation of solar technology reports for solar park feasibility study".

From the above, it can be argued that due to the high level of impact of the training, some level of sustainability has also been achieved (sustainability referring to measuring whether the benefits are likely to continue after the activity). The following detailed comments can be argued to indicate an acceptable level of sustainability.

- “the value of networking during the tour has proved valuable in future collaborations”
- “the networking during and after the programme was and still is extremely valuable”

In general, it can be concluded that participants benefitted in a meaningful way from the SAGEN supported training activities, that the activities had high relevance to their work and that they experienced positive impacts from their participation. The general comments below enforce this conclusion:

- “I found the training very useful and learned a lot from both the theoretical classes as well as the field trips. One of the better courses I ever attended and certainly one of the best organised courses”.
- “The study was very positive and brought together most of the role-players in EPCs in SA. Christian Borchard is to be complimented on organising and facilitating the tour, which provided the necessary insight into EPCs for the study group”.
- “The course was really good, we enjoyed it and the trainers were open and willing to help as much as the can. Learnt a lot and it was also a good experience to be in another country”.
- “The course opened my eyes to the need for alignment between national, provincial and local efforts around renewable energy”.
- “Thanks to GIZ for a great opportunity and well organised study tour in beautiful Germany! I have learnt so much and am very grateful for the wealth of knowledge and experience I gained”.

CONCLUSION

The renewable energy sector in South Africa faces a critical skills shortage. Activities supported by SAGEN will not be able to eradicate the shortage and do not even significantly contribute to formalised training efforts to address the skill requirements of the sector. It can however, be argued that skills development is required at different levels and intensity and that exposing key role-players and decision-makers to well-structured capacity building events, does enhance personal capacity as well as over-all effectiveness of the individual to support a very new and complex industry such as the renewable energy sector in South Africa. It can therefore be argued that the capacity enhancement activities implemented by SAGEN improved personal and workload capacity of decision-makers and, ultimately it improves role capacity of decision-makers in the renewable energy sector in South Africa.

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