Appendix A: Questions for considering employment data

Below is an initial list of questions aimed at assisting policymakers, planners and other users of employment studies to better understand and contextualise their findings:

What is the study design?

- What question is the study asking?
- Who is undertaking and / or funding the study? What might they want to show?
- What is the scale of the analysis?
- What is the timeframe?
- Are the scale, metrics, organisation methodologies, counterfactuals and data used appropriate for the question being asked?
- How broad is the study: can it consider future disruptive change in the power sector? Opportunities on the demand side? Structural economic change?

How should the findings be interpreted?

- Is employment reported as 'jobs' or 'person-years'?
- Is employment reported 'net' or 'gross'?
- Which dimensions of employment does the study consider, and which can it not comment on?
  For example:
  - Impact on electricity price
  - Capital investment requirements
  - Economies of scale for technology / resource
  - Localisation of indirect jobs
  - Sustainability of job (construction vs O&M)
  - Conditions of employment
  - Type of worker (skill level, vulnerability, previous disadvantage etc)
  - Pay and ability of job(s) to sustain a family, community
  - Potential for worker development and progression
  - Ownership potential
  - Spatial implications (where is the job?)
  - Are the jobs new or will workers move from other industries?
  - Does the job displace a job elsewhere (net or gross job)
- What assumptions have significant bearing on the employment findings?
  For example:
  - GDP growth
  - Electricity demand
  - Mechanisation
  - Technology learning
  - Future price of technologies, resources
  - Supply of skills.

Comparability of studies:

- Do the studies focus on the same or similar scales?
- What job categorisation methodologies do the studies use?
- Which technologies or suite of technologies are considered?

- What is the data source of each study and how do these differ in terms of timeframe, structure, detail and focus (i.e. are apples being compared with apples)
- Are the counterfactuals the same?
- How comparable are the assumptions used? (Including macro-economic indicators)?

Appendix B: Summary data

The research for the SAWEA briefing paper was undertaken in a very short timeframe, aimed at providing a helpful high-level overview rather than a comprehensive and detailed review of individual studies and reports. As has been conveyed in the main body of the paper, the subject matter is extremely detailed, complex and contingent. The reader is advised therefore to take the summaries below as brief guides only. Each study requires a deep read in the context of the discussion in the main report in order to fully appreciate its findings in terms of both contributions and limitations.

The studies were identified according to their focus on employment implications of the power sector transition. Whilst the intention was to identify all core studies in the field, some may have been missed due to the timeframes, and there may well be other relevant studies in other areas which could contribute to the overall picture. These areas include employment in energy efficiency and a reduction in energy intensity – the demand side of the picture; studies on green jobs and the green economy; and a literature critiquing the concept of employment, which interrogates this policy objective, and different ways of interpreting and understanding this.

Studies that re-state previous work directly without adding any new data, analysis or clarity of data / analysis presentation were not considered, neither were studies that have been widely discredited within the industry. The studies are grouped according to their scale of focus, determined by the scale of analysis of the main report.

Economy scale

Most of the analysis undertaken at this scale has been done by the University of Cape Town's Energy Research Centre: Energy Systems, Economics and Policy research group, using a linked energy (E-SAGE) and economy-wide (CGE) model (together called SATMGE). This model is being constantly developed to produce ever-more sophisticated analysis of various aspects of the country's energy sector. A number of modeling runs for various studies have delivered employment indications. Some of the more relevant ERC studies are covered below:

1. **Energy Research Centre: Coal transitions project (2016 to September 2018 i.e. ongoing)**

Description: The Coal Transitions National Report is being developed under an international project funded by the KR Foundation and implemented by a consortium of 8 organisations led by IDDRI and Climate Strategies. This is a transdisciplinary project to link and reinforce policy, research and advocacy efforts on coal transition in different countries. The project aims to fill the gap of international dialogue and learning on coal transition.

Through this project, the ERC team has developed SATMGE's coal sector, including detail on coal sector supply such as cost structures and coal contract information at a station and tied mine level. Data used includes that from previous studies and from fieldwork. The model outputs will provide employment impacts at national, net energy sector and coal mining, per skills level, and at an

electricity generating plant level.

The study considers two power sector scenarios to 2050. The first is least cost. The second is a scenario which is constrained to meet the lower range of South Africa's peak plateau and decline GHG emissions trajectory. A sub-scenario is run under this carbon constrained scenario, which forces Sasol's Secunda plant to remain open for the full length of its economic life, to 2040. Energy demand is calculated endogenously. The second scenario optimises for the most cost efficient decarbonisation which is found in the power sector. This application of the model does not consider structural economic change. The study uses coal mine employment data from Quantec (Chamber of Mines).

Key findings: Not yet publically available. *Information provided by Jesse Burton, Tara Caetano and Guy Cunliffe of the ERC modeling team, via personal communications*.

2. **(Burton et al., 2016). The impact of stranding power sector assets in South Africa: Using a linked model to understand economy-wide implications. Paper written for the MAPS Programme.**

Description: This research uses the SATMGE to explore whether South Africa can meet emission reduction targets without stranding assets, and also what the implications of stranding these assets are. It models a structural change in the economy to stimulate agricultural exports as per Altieri et al (see below).

Model details include: Secunda is allowed to run to the end of its life (2040) (not a least-cost option under carbon constraints). There is some detailing of the coal supply side. The model does not consider potential growth in industry able to switch from coal to natural gas, and corresponding employment implications. Only the impact of higher electricity prices on employment in the rest of the economy is reported. Employment impacts appear to be translated from GDP growth. Although the modeling is capable of providing employment figures (Caetano, personal communication), none are reported in the paper itself.

Key findings: The paper highlights the importance of structural economic change in achieving both decarbonisation and a reduction in unemployment. 'Without (this) structural change, the challenge of growing the economy to address high levels of unemployment and poverty would increase substantially if stringent mitigation targets were required in the electricity sector' (Burton et al., 2016, p. 25).

3. **Climate Policy article: Achieving mitigation and development objectives through a decarbonisation development pathway in South Africa. Altieri et al. 2017 (based on a 2015 working paper)**

Description: Using a version of the SATMGE, this study considers pathways to achieve employment and decarbonisation (aligned with a 14GT CO2e cumulative target) in South Africa to 2050. By changing the model's assumptions around regional trade, enabling conditions for the growth of the agricultural sector were forced in, as a low carbon, high employment generating sector. A carbon constraint was applied. The IRP 2013 provides the basis of the power sector trajectory. There is a high RE penetration and no new fossil fuel powered generation. Economic structural change is therefore the driver, and significant unemployment reduction and decarbonisation results. There was no detailing of the coal sector.

Key findings: From 2010 to 2050, the model results in the national unemployment rate increasing off a base of 25% in 2010 until it peaks in 2030 at 30%, and then declines rapidly to 12%. The initial increase is a result of the youth bulge joining the workforce. Coal decreases its capacity contribution from 90% to 63% by 2030 in line with the 2013 IRP. Coal is completely eliminated by 2050. There is no new nuclear build.

4. **Caetano and Thurlow (2014). The socio-economic implications of renewable energy and low-carbon trajectories in South Africa.** In Conference proceedings, Forum for Development and Mitigation (Jooste, Tyler, Coetzee, Boyd, & Boulle, 2014).

Description: This paper uses an economy wide dynamic-recursive CGE model, extended to include a highly disaggregated renewable energy sector, to evaluate the potential implications of a carbon tax and investment in greener energy options for economic growth, emissions, employment and inequality in South Africa to 2050. The IRP 2010 is used to model the power sector trajectory, with coal, nuclear, hydro, PV, CSP, wind, waste, gas and diesel considered for power generation. Employment data (total, and absolute numbers of highly skilled) is based on REIPPPP reporting for bids round 1-3. The data disaggregates between O&M, construction and indirect ('manufacturing').

Key findings: The introduction of renewable energy has a positive impact on direct employment in the electricity sector, although indirect job losses, mostly by low-skilled workers, drown out this effect and lead to a very slight decrease in overall employment. RE is found to be more labour intensive per GWh of electricity in comparison to baseload coal, and also requires a higher proportion of skilled labour. Coal mining has a high labour multiplier, and absorbs low skilled labour. Reporting includes jobs per MW in construction and then GWh for O&M. Economy-wide, direct and indirect jobs are reported on, and a distinction is made between skilled and unskilled workers.

Energy sector

1. **Department of Energy (DoE) (2016) Integrated Energy Plan (IEP).**

Description: The DoE uses a scenario planning approach to both project energy demand (taking into account different assumptions around economic development and structure). The impact of key policies such as environmental, energy efficiency, transport and industrial are considered. The planning then determines the optimal mix of energy sources and technologies to meet energy needs in the most cost-effective manner for each of the scenarios, covering wind, solar CSP, solar PV, nuclear, petroleum, gas, coal.Uranium extraction, shale gas extraction, residual underground thermal coal. The associated environmental impacts, socio-economic benefits and macroeconomic impacts are also analysed.

Four scenarios are presented in the IEP: Base Case, Environmental Awareness, Resource Constrained and Green Shoots. The 9.6GW nuclear fleet is included in all scenarios, as are optimistic assumptions around shale gas, although sensitivities are run to test both of these. There is no detail on the nature of the modelling methodology included in the report therefore it is difficult to situate the findings (this study may actually be relevant at the economy wide scale). For example it is unclear whether the intra-energy sector employment interactions are considered. Assumptions around job creation in the electricity sector are drawn from a 2014 McKinsey Analysis and are contained in an Appendix to the IEP which is discussed below. This report focuses on localisation. Multipliers are used to estimate the indirect and induced jobs.

Key findings: Job potential is presented by scenario over the timeframe to 2050. The 'Base Case' scenario presents the greatest job creation potential over the period, with 'Green Shoots' the lowest. 85% jobs are localisable across all scenarios, and there is detail relating to different localisation assumptions. When the nuclear build assumption is relaxed, the resulting scenario performs better at an economy-wide level than the Base Case in terms of jobs. Including an aggressive solar water heater roll out in the scenarios results in equivalent jobs to the Base Case. However, when these sensitivities are only considered for the power sector, the job implications are similar across both of these sensitivities and the Base Case. A scenario excluding shale gas yields the greatest number of jobs in the electricity sector. At a technology level, solar has the highest potential for job creation, followed by nuclear and wind. Natural gas and coal make smaller contributions. Primary energy extraction is found to have the highest potential for job creation and localisation efforts. Further job specific findings are reported in the discussion of the McKinsey study below.

2. **DOE (2016b) IEP: Annexure B: Macroeconomic assumptions.**

Description: The power generation employment figures in the Appendix are based on a study on the potential for localization and job creation by McKinsey, which is the focus of this summary.

A methodology was created for the assessment of job creation across power generation technologies, together with primary energy fuel extraction. They have 4 categories: direct, supplier, indirect and induced. 'Supplier' would generally seem to equate to other studies 'indirect'. In this study the indirect is 'supplier to suppliers'. Direct can also be direct in the mining industry, which is not necessarily aligned with other studies. The technology split is determined from the IRP (date unspecified, assumed 2010 or 2013). The job data appears to have been identified bottom up from power generation project spend on employment. However, it is not clear from the report where this cost data comes from. Direct and supplier jobs are determined from this data and aggregated according to technology. Indirect and induced jobs are determined by technology specific multipliers, again based primarily on spends across industry. A detailed job localization methodology is developed for the study which includes some spatial and regional considerations. The study assumes a minimum of 50,000MW installed capacity of any particular technology in order to compare job and localization implications.

Key findings: Jobs are reported per technology, and divided into construction jobs (per MW installed capacity) and jobs per TWh for operational jobs. The extent of these jobs are heavily dependent on assumptions around localization. Nuclear is reported as providing the greatest number of overall jobs (with aggressive localization assumptions), at 70181 jobs years per GW installed. CSP comes next at 59679, followed by coal at 45682. Shale gas performs the strongest in terms of operational jobs at 409 annual jobs per TWh, followed by solar CSP (251) and then wind (225). When coal and coal mining operational jobs are combined the total comes in at second at 274. Coal power generation has the lowest weighted multiplier, with shale gas the highest, followed by coal mining. Nuclear performs better than all renewables, which are much alike in terms of multipliers. Data is reported 'net' (ie systemic interactions are not considered).

3. **SA Coal Roadmap: Outlook for the coal value chain: scenarios to 2040. Technical Report (2013).**

Description: This study emphasizes the limitations of the Chamber of Mines coal mining data used for the modeling in the report. In particular: 'The data does not distinguish between employment on opencast and underground mines; No data on employment intensity of beneficiation was found.

As such, this is assumed to be included in the employment intensity of coal mining; Data excludes employment in mine construction phases as no data was found; Data is assumed to include contractors; No data on indirect employment could be found; and The models assume that employment intensity does not change over time. The impact of increased mechanisation could reduce employment intensity over time, and hence employment in mining could be over estimated.' (pg 48). In terms of coal fired power generation employment the report found that 'no consistent data sets could be found to provide an indication of employment for operation and maintenance of the coal-fired power station fleet' (pg 49). There has subsequently been updated information for both Chamber of Mines and Eskom data for employment at coal mines and power stations. Employment is reported in terms of 'employees', with the qualifier 'FTE' sporadically applied. The Roadmap uses Maia et al (2011) data for RE. Four scenarios are modeled: 'More of the Same', 'Lags behind', 'At the forefront' and 'low carbon world'.

Key findings of the scenarios: Between 31,000 and 35,000 jobs are lost from 2020 to 2040 in the Central Basin coalmines. Waterberg coal-mines increase employment to between 21000 and 50000 by 2040, or decrease employment. Employment in power stations is not disaggregated to coal, but includes all generation technology types. Generally, operational employment throughout the system is highest for 'low carbon world' and 'at the forefront', with no clear trend for construction employment over the timeframe.

Power sector

1. COBENEFITS project (ongoing, Report due, August 2018):

Description: This ongoing programme is led by the Institute for Advanced Sustainability Studies (IASS), Potsdam, Germany, and is conducted in close cooperation with the Council for Scientific and Industrial Research (CSIR) as COBENEFITS focal point for South Africa. Four projects sit under this programme, one of which deals with employment and is being undertaken be a collaboration of CSIR (macro-economics group), and the Energy Research Centre. The project will assess future development of employment and skills requirements in SA power sector.

The CSIR are focusing on providing RE jobs, based on their 2016 study (see project description in the RE section below) but augmented with stakeholder interviews. Employment reduced in coal is being considered by ERC. The SATMGE will be used to analyse the data. 4 Scenarios are being used across the four COBENEFITS projects: 1) A scenario based on IRP 2016 shares of different technologies projected forward (to 2030). 2) The CSIR optimistic RE cost scenario to 2050 3) Least cost CSIR scenario. The lower trajectory of the DEA's Peak Plateau and Decline GHG emissions range may also be considered. The study will undertake qualitative research of employment implications at specific mines and power plants, and case studies of international historical experiences (China, UK, Germany, US) to explore what could happen in a coal sector decline. The study will consider skills levels, age profiles, location / spatial, cultural issues in coal employment through a survey of coal companies. Work on the Coal Transitions study discussed above will inform the COBENEFITS study. Embedded generation is not a focus. Structural economic change is not within the ambit of the research. Jobs will be reported annually to 2035, and then in years 2040 and 2050. Some specific mining and power generation project data may be included in order to augment and support the modeling results.

Expected outputs: Employment effects and skills requirements of RE, and losses in the coal sector. The project is anticipated to generate an open publically available database platform intended to support the RE industry.

(Information: sourced from Cunliffe, Burton, Caetano, Nkosi personal communications).

2. CSIR comments on the IRP 2016.

Description: Two alternative scenarios to the 2016 IRP were run by the CSIR modeling team in order to inform their lengthy comment; a Least Cost Scenario, and a Decarbonisation Scenario, both to 2050. The study is a very detailed depiction of the power sector, including consideration of changes in demand triggered by storage (EV plus batteries). The assumptions around the contribution of newer technologies generally are described as 'conservative', whilst assumptions relating to incumbent technologies are more progressive. The McKinsey IEP study job figures were used for RE and the lower values for the coal industry. The higher value is based on 'CSIR assumption with more jobs in the coal industry' pg 61.

Key findings: The study finds that the CSIR Least Cost Scenario delivers the greatest number of energy sector jobs (between 380 and 392,000 by 2050). The IRP 2016 base case performs least well on 252-295,000. The Decarbonised scenario provides 331,000.

3. **Maia, J., Giordano T., Kelder, N., Bardien, G., Bodibe, M., Du Plooy, P., Jafta, X., Jarvis, D., Kruger-Cloete, E., Kuhn, G., Lepelle, R., Makaulule. L., Mosoma, K., Neoh, S., Netshitomboni, N., Ngozo, T., Swanepoel, J. (2011).** Green Jobs: An estimate of the direct employment potential of a greening South African economy Industrial Development Corporation, Development Bank of Southern Africa, Trade and Industrial Policy Strategies.

Description: This pre-REIPPPP study is often cited as a robust analysis relating to renewable energy. It also significantly includes energy efficiency employment opportunities in that it considers 'green' jobs more broadly. The study considers energy generation as one of four areas where green jobs will be generated. It has three timeframes: short term (2011-12), medium term (2013-17) and long term (2018-25). Data is sourced from a wide range of largely international studies, adjusted to local circumstances, the methodology being 'bottom-up' as opposed to a sector or economy level model. Jobs are therefore 'net', not economy-wide. There is a lot of detail in the study on the data and assumptions made. The IRP 2010 is used as a reference case, but the actual build used in the study is constructed by the authors. The study focused on wind, solar, marine and hydro-power. Direct and indirect jobs are reported, but not induced. Construction and O&M jobs are distinguished. There is no consideration of structural change per se. There is a comparison between different technologies.

Key findings: By 2025, 22,280 FTE direct jobs created by wind, solar, marine and hydro power, with an additional 11,278 indirect jobs in manufacturing. For wind power, the manufacturing jobs are 41% of the direct jobs, for CSP, 5%. Relatively PV contributes the lion's share of the jobs at 22,004, with manufacturing jobs as high as 62% of direct jobs.

Technology scale

Renewable energy

1. IPP office data

Description: The IPP Office publishes data on the REIPPPP in two forms. The first is the projected number of jobs contained in the individual bidder forms. These are announced at https://ipp-projects.co.za/PressCentre. The second is a retrospective evaluation of how the projects are performing (for example, IPP Office (2017): The IPPPP. An overview. As at June 2017). These can be found at https://www.ipp-projects.co.za/Publications.

The IPP Office holds a detailed database developed from the bidder documentation. However in that this information is of competitive value it is not publically available. Researchers have gained access to this for limited time periods (Stands, personal communication), and find that the IPP-database information allows comparison of technologies, provinces, bid window rounds, differentiating employment along a number of dimensions including according to black citizens, women, local communities, and skills (Stands, 2015). The IPP office reports jobs in job years; 'The equivalent of a full time employment opportunity for one person for one year' (REIPPP Overview, June 2017), although sometimes person-months are also reported. The IPP data tracks citizenship, the number of black SA citizens and local community as job-holders. Data is also collected on numbers of youths, women, people with disabilities and rural communities. Eberhard and Naude (2017) note that employment metrics have changed between the REIPPPP Bid Rounds.

Because the REIPPPP employment data is contractually relevant, it is audited, and as such comes with a high level of accuracy (Gibson, 2017). However, another perspective found that the REIPPPP figures contradict each other, particularly at a provincial vs national level. Only the REIPPPP bid-holder technologies are considered (solar PV and CSP, wind, landfill, hydro, biogas, biomass). Data is publically available to June 2017.

Key findings: The REIPPPP had created 32532 jobs for SA citizens, 29046 in construction and 3486 in operations (REIPPPP, June 2017). This was 64% more than was planned in the construction phase. Construction jobs for black SA citizens and the local community were up to 242% higher than anticipated. (At the time 57 IPPS had completed construction and started commercial operations, with an average operating duration of approximately 26 months. O&M data is therefore limited).

2. Eberhard and Naude (2017) The SA Renewable Energy IPP Procurement Programme: Review, lessons learned and proposals to reduce transaction costs.

Description: In reviewing the REIPPPP, the authors have constructed a table of projected jobs for local citizens, by technology and divided into construction and operation. These include all four REIPPPP bid windows, based on the REIPPP data.

Key findings: REIPPPP Bids 1-4 Onshore wind is anticipated to deliver 11355 construction jobs and 32041 operational person years of jobs. Solar PV will deliver 13355 and 33791. CSP: 8400 and 7212. Biomass: 245 and 2187. Land fill gas: 6 and 240. Small Hydro 439 and 173. A total of 109444 jobs, and 17.3 jobs per MW awarded. This study also speaks to some of the implications of the employment metrics used in various bid windows for incentivizing employment.

3. CSIR, 2017: solar and wind energy jobs study 2017:

Description: The study was undertaken using the I-JEDI international excel based model adapted for South Africa. This tool estimates the economic output and jobs supporting by the construction and operation of electricity generation plants. Only solar PV and wind were considered, using a scenario based on the IRP 2016 split of technologies project to 2050. The study only considered new jobs in the RE sector, not job losses in other sectors. It uses regional data and considers localization of labour and inputs, sourced from Bloomberg New Energy Finance, directly related to South Africa. A 20 year lifespan of the RE power plants is assumed based on the REIPPPP PPA period. A regional social accounting matrix was used. The results do not consider economies of scale, project economic feasibility or levelised cost of electricity. A gradual increase in local context it assumed.

Outputs are only available in the form of two power point presentations (SATRI symposium on energy choices and the protection of workers interests, 17 May 2017; and International jobs and

economic development (I-JEDI) impact model, modeling the renewable energy jobs potential of the draft IRP 2016 for the Just Energy Transition Roundtable. 28 November, 2017). No report was written for this work (Personal communication, Ntombifuthi Ndluli, CSIR). The source data was supplied by Ntombifuthi via email. Findings are reported in job years

Key findings: Construction phase job-years in wind are 470000 (direct), 515000 (indirect) and 523000 (induced) (A total of 1.5million wind construction jobs). O&M Wind jobs are 185000 (direct), 198000 indirect and 383173 (induced) over the period to 2050 (a total of 766,173 wind O&M jobs). It is assumed these are job years. For solar PV, construction job-years range between 20-30000 per annum between 2025 and 2050. O&M jobs range between 500,000 and 800,000 per year over the same period.

4. **McDaid L. 2016. Renewable Energy Independent Power Producer Procurement Programme Review 2016: a critique of process of implementation of socio-economic benefits including job creation.** Report for the AIDC, sponsored by the Rosa Luxembourg Foundation:

Description: Job numbers are based on Eberhard (2014) and also on REIPPPP publically available documentation, triangulated against site level interviews. The study uses multipliers from the McKinsey study underpinning the DoE's IEP Appendix B, and includes an appendix with some indicative solar PV rooftop numbers. The focus is on REIPPPP technologies. The results distinguish between construction and O&M jobs. Direct jobs are the focus and some indirect job figures are provided.

Key findings: The authors found that construction job figures tended to agree across government and community. The report identifies 'wide agreement that the number of operational jobs as being very few'. Pg 21. The report finds that across bid windows 1-4 there are 43,749 job years of construction jobs, and 55,277 operational jobs. Based on the IEP multipliers, they estimate a further 20,697 indirect sustainable jobs, and then 29,074 induced jobs. Further, using a job calculator against a scenario of 50% RE by 2030, they estimate 281,500 construction job years and 66,100 operational job years per year (1,322,000 over a twenty year operational life), with an additional 1,110,480 indirect jobs in associated industries over twenty years.

5. **Stands, S., 2015. Utility-Scale Renewable Energy Job Creation: An investigation of the South African Renewable Energy Independent Power Producer Procurement Programme (REIPP).** Unpublished Masters (MPhil) Thesis. Stellenbosch: Stellenbosch University.

Description: This academic research Is based on data from the REIPPPP first 3.5 bid rounds obtained directly from the IPP Office online database (the researcher spent time in the IPP Offices to obtain the data under a Non-Disclosure Agreement. This data was expanded with qualitative data from interviews with stakeholders. The thesis critiques how metrics are currently used within the REIPPPP programme and its contribution to 'meaningful' employment creation. The limitations of individual metrics in their ability to understand this highly complex issue ('meaningful employment') are set out. The work argues for more disaggregated and alternative metrics to be used alongside those currently employed by the REIPPPP programme to fully reveal the 'meaningful employment' aspects of the REIPPPP. The thesis talks about different commitments across the demographics from each technology. Stands concludes that the REIPPPP employment results only begin to reveal quantitative outcomes and trends, but cannot yet conclude if jobs are entirely meaningful. The results are net jobs only, no economy-wide implications were considered. Both Construction and O&M jobs are reported. Direct and indirect jobs are reported with some qualitative indications of induced jobs. The timeframe is the 20 year PPA period of the REIPPPP. The data is

disaggregated at a provincial level and reports citizen, black, female, unskilled and local community jobs.

Key findings: Because the study reports across many dimensions of employment, the findings are too many to cover here. A few include: The REIPPP (up to and including Bid Window 3) creates 33,701 person years of employment over the 20 year lifetime of the projects. Relatively, wind contributes the most citizen jobs (93%), then CSP (86%) and then PV (85%). In absolute terms PV contributed the greatest number of jobs (81,247 in construction and 209,258 in operations), resulting directly from PV achieving the greatest installed capacity for the first three bid rounds. CSP creates far greater number of jobs in construction than operations, whilst PV and Wind generate a greater number of jobs in operation. This is potentially due to the long lead time of CSP construction. Economies of scale are not considered in the bid documentation, potentially skewing employment creation opportunities towards smaller projects. The study's fieldwork found that local communities perceive IPPs to create good employment opportunities, with a reputation for paying a better wage and as being preferable to mining employment. The study concludes that publically available data and the REIPPP documents are insufficient to understand job creation outcomes in the programme. The combination of IPP database information and the researcher's own fieldwork still returned an inconclusive result in terms of the REIPPP's impact on meaningful employment, with further study recommended. The study calls for standardization of key terms including 'direct, indirect, induced, skilled, unskilled, semi-skilled and highly skilled labour', and greater transparency including a central communication platform around employment.

6. **Greenpeace Energy revolution documents (2009-2011): Rutovitz, J. 2010. South African Energy Sector Jobs to 2030: How the Energy [R]evolution will create sustainable green jobs. Prepared for Greenpeace Africa by the Institute for Sustainable Futures, University of Technology, Sydney, Australia; Rutovitz, J with input from Kuno Roth. 2011. More jobs and progress for South Africa: The Advanced Energy [R]evolution scenario and its impact. Prepared for Greenpeace Africa by the Institute for Sustainable Futures, University of Technology, Sydney, Australia.**
   Available: http://www.greenpeace.org/africa/en/News/news/More-Jobs-and-Progress-for-South-Africa/ Greenpeace. 2011.

7. **The Advanced Energy [R]evolution: A sustainable energy outlook for South Africa. Available: http://bit.ly/ERevolution**

Description: The report discusses an alternative energy development scenario for South Africa, one dubbed the Energy [R}evolution Scenario, which has a focus on RE & EE. This scenario led to significantly greater job creation than the reference (or Business as Usual) scenario – almost 30% more jobs in the energy sector in 2020;

8. **AGAMA (2003): Employment benefits of RE in SA.** On behalf of Sustainable Energy and Climate Change Partnership (SECCP), a partnership comprising Earthlife Africa (Johannesburg) and Worldwide Fund for Nature (Denmark).

Description: The study quantifies and characterizes the direct jobs that could be created in South Africa through implementation of wind, solar and bioenergy for both electricity generation and thermal/transport energy services. The study draws comparisons with employment associated with conventional energy sources such as coal, nuclear and natural gas. Also reported is an analysis of the range of skills required in producing and servicing RETs, and health and safety factors. The study also considers the issue of a shift in employment levels in the coal industry and the renewable energy

industry.

Coal

1. **<u>Eskom:</u> (2017) response to a PAIA request from the Centre for Environmental Rights.**
Key findings: The total number of employees at 15 of its power stations is 7,928 (Information from the Centre for Environmental Rights.)

2. **Chamber of Mines:** 87500 employees http://www.mineralscouncil.org.za/sa-mining/coal accessed 14 June 2018).

NB: No significant data was found for employment associated with power plant decommissioning, coal mine rehabilitation or coal transport.

Gas and Nuclear

Only the IEP (DOE, 2016) focused particularly on these technologies, but the estimates for employment associated with these fuels are difficult to assess given the unknowns of model parameters. Additional studies for these two technologies were not explored.

Other related work (forthcoming)

1. **Tendering sustainable energy transitions (TENTRANS).** April 2018 – Sept 2020
Description: The overall objective of the project is to contribute to a transition toward sustainability in the energy sector of emerging economies, including sustainable development of local communities and local industries. The project will analyse the developmental implications of the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) implemented in South Africa (SA) with a focus on the effects of wind power projects on local industrial development and socio-economic development in local communities. The project will contribute to enhance the research capacity of the younger researchers involved. It will build upon and contribute to significantly advance the literature on sustainability transitions in developing countries through an innovative combination of complementary perspectives on institutional change, global value chains and infant industry development. It will draw on in-depth fieldwork carried out in SA based on qualitative research methods, such as interviews, documents, direct observations and project inventories. Through direct engagement with key policy makers and stakeholders, the project will seek to ensure that local developmental impacts are prioritized and ensured in renewable energy tendering schemes currently being implemented in SA, other countries in Sub-Saharan Africa (SSA) and internationally. The project will contribute to socially inclusive models of implementation by private companies involved in large-scale wind power projects by cooperating with the wind industry associations in Denmark and SA and through direct consultations. Finally, the project serves as a pilot research for a subsequent five year research programme, which will be up-scaled to include solar PV, concentrated solar power (CSP) and hydro-power, and additional countries in SSA, such as Ethiopia, Kenya, Ghana and Malawi.

2. **ERC study for SANEDI (forthcoming) (Alison Hughes, personal communication**). This study will consider the potential for electricity demand from industry, using the linked model (SATMGE). The Linked model in general currently uses a very conservative assumption around availability requirements of energy demand (by industry), and this study will explore the implications of relaxing this.