Challenging the State:

Renewable Energy opportunities and electricity in South Africa in 2015

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PREFACE

"Renewable Energy is Peoples' Power" is a call to action, directed not only at government or the captains of industry, but to all people who care about the social dimensions of electricity supply, from persistent energy poverty, to the intergenerational impacts of burning huge volumes of fossil fuels. It is an aspirational slogan, rather than a statement of fact or material conditions; it highlights the synergies between the use of available renewable energy and a wage-led low carbon development strategy with large job-creation potential, while recognising that the current highly centralised electricity supply system has developed primarily to provide power to business and industry.

This booklet explores what could be done to realise the potential for people to benefit directly from renewable energy; to be participants in the transformation that is, far too slowly, starting to move energy systems away from dependence on concentrated fossil energy. It provides a brief account of renewable energy technologies, the national energy system and key issues arising from its present form. It discusses issues affecting employment potential and a possible pathway for electricity supply, proposing a target of 40% to be generated from renewable resources by 2030, as the scale and pace most conducive to the development of local Renewable Energy industries.

The context of a national electricity crisis makes this a time of immense opportunity for change in South Africa's energy development pathway -- though not by design and with no transparent process for the deliberation of key choices that we face; a time of disruption and of innovation, in which decisions of massive public consequence are being made. Unless large numbers of people mobilise to make renewable energy their own power, and to demand that it becomes the foundation for all power supply, we are likely to miss great opportunities for both short and long term public benefits. Currently we are seeing more innovation and movement in the commodification of renewable energy than in the socialisation of renewable energy technologies or energy services in general.

There are some relatively simple strategic decisions that should be made at national level to set us on a low carbon path to a sustainable and more equitable energy future, single solution or top-down techno-fix. A more democratic energy sector is primarily a bottom-up project. The kind of programmatic roll-out envisaged in the final section of this booklet will involve many complex relationships, require concerted public education (including within the public service) and a large number of active citizens and social formations. There is much that government should be doing to enable social ownership in the

services sector and in the rapid growth of national industries in renewable energy technologies. Actively engaged people are the fundamental component of a just transition – persistent people patiently taking on responsibilities, enabled by competent, adequately resourced institutional support for the immediate future.

Renewable energy is, in various ways, more immediately challenging to utilise than fossil fuels[1], just as participatory local development planning and supporting community-based initiatives is more challenging for local government. It requires greater capacity and a wider range of skills, than contracting service-providers or procuring and on-selling electricity. It takes significant time and effort to become a participant in energy service delivery and/or, management of household or community energy service needs, but for many South Africans this is less of a challenge than gaining cash to pay corporate service providers. An increasing number of people eager for such opportunities, ranging from rural biogas production within a localised energy economy or participation through land ownership in commercial wind farms, to household solar PV systems or individual operators with micro-finance disseminating stand-alone solar appliances such as solar lights with cell-phone charging. A particularly valuable application of off-grid electricity, for which photovoltaic power is ideally suited, is for irrigation pumps to increase the productivity and reliability of yields for the many small-scale farmers currently relying only on rainfall.

The ideas presented here focus on advocacy for a decisive state-driven strategy and programme of institutional development to enable renewable energy development – with a clear political commitment (including an inter-departmental mandate) and mobilisation of resources and finance.

It is also recognised that realising the full potential benefits of freely available renewable resources requires removing subsidies for fossil fuel industries and planning now for a responsible phase out coal-fired power generation. South Africa has many minerals that will be needed in quantity for a low-carbon economy and the rest of the mining sector should think twice about coal continuing to ride on their more valuable and productive offering to society. Some targets are proposed for a clear and investment-mobilising political commitment, building on the One Million Climate Jobs Campaign:

One Million Climate Homes

Five million solar systems

40% of grid-based electricity supply from renewable energy in 2030

1 This is from a short term energy services perspective - not taking account of the massive challenges of dealing with the waste legacy of fossil fuel use; in the bigger picture, the challenges of using renewable energy are far more manageable and less costly than continuing to burn fossil fuels.

INTRODUCTION

South Africa is experiencing considerable upheaval in the energy sector and particularly in the electricity supply industry, some of which arises from global developments, but more from specifically South African dynamics. The Eskom crisis, within the broader crisis of climate change, is an indictment of an energy system that does not meet the needs of the majority and creates a terrible legacy of waste and ecological degradation – the antithesis of sustainable development. Huge investments are being mobilised for energy development that should be directed to initiate a just transition to a low carbon, inclusive and equitable energy system based on renewable resources, but may further entrench our dependence on concentrated energy (fossil and nuclear fuels) in a system that prioritises profits over providing energy services to people. RE is entirely compatible with economic development, as South African business, including mining, is increasingly demonstrating.

Kimberley was the first place in the world to install electric street lighting, with some supply to homes, at the end of the nineteenth century, using electricity available from generation equipment installed to power mining. While fuels like coal and diesel can be trucked anywhere with a passable road (and road development is often driven by extractive industries), electricity needs a continuous physical connection (wires) between the points of generation and use, so decisions to invest in the necessary infrastructure required predictable large-scale demand – particularly for the early forms of generation technology.

The subservience of electricity supply development to energy-intensive minerals extraction and primary processing has decreased, but still persists. The drawbacks of what is often referred to as the Minerals-Energy-Complex (MEC) are increasingly evident. Nonetheless, massive infrastructure investments continue to be made that assume more of the same, even though the structure of the national economy (particularly a reduction in the relative size of the mining sector) has shifted. This is exemplified by an insistence on the need for so-called ‘base-load plant’ - large-scale generation plant designed to operate around the clock, like the industrial processes that dominate electricity demand.

In South Africa the residential sector accounts for just 18% of total electricity demand, though it accounts for a much higher share of peak electricity use – during the period of highest demand, occurring in the early evening when most household electricity use is required. Designing electricity supply infrastructure

primarily to meet the portion of demand that is constant (the base load required at all times) has allowed for considerable economies of scale for investors, but creates barriers to resource-efficiency and the application of modern system management options. The abundance of cheap-to-deliver coal provided the foundation for the Minerals-Energy-Complex and a development paradigm treating electricity foremost as a means to 'monetise' this coal resource[2].

Post-apartheid governments have adopted a number of new objectives for the energy sector, as reflected in the White Paper on Energy Policy for RSA (1998), but these have at best been treated as add-ons, rather than driving a review of national energy strategy. Some attempts to transform the electricity supply industry, including a rationalisation of electricity distribution (shifting the mandate from local government to five or six Regional Electricity Distributors) and the institution of an Independent System and Market Operator (ISMO) were abandoned. While policy calls for integrated energy planning driven by detailed understanding of the demand for energy services, government has continued to focus on strategies for supplying fossil fuels and nuclear power.

The most significant change in the electricity industry since 1994 has been the introduction of long-term contracts for buying power from Independent Power Producers (IPPs), to implement policy providing for the use of renewable energy (RE) for electricity generation. This REIPP Procurement Programme (or REI4P) issues tenders for competitive bidding by project developers, run by a special new unit that was formed in place of implementing a policy to introduce Feed-in Tariffs[3] for RE. As Eskom's construction of new coal-fired power plants (Medupi and Kusile) has failed to deliver, this programme has been greatly expanded as the quickest way of adding new generation capacity, such that the growing role of private-sector generation is considered at least as significant as the accommodation of renewable resources.

2 Our energy strategy grew out of the coal industry strategy: As most of SA coal is low-grade, this involves high-volume domestic supply of low grade product earning a low rate of return and supporting the supply of high grade product to international markets at a high rate of return; thus electricity generation in massive plant able to handle low-grade coal and offer the lowest-priced electricity in the world (into the early years of the 21st Century) became a strong determinant of economic policy.

3 Feed-In Tariffs are an open-ended offer to buy any electricity supplied from specific resources or technologies at specified tariffs, at preferential rates – offering a price above the average costs of grid supply.

RENEWABLE ENERGY (RE)

Renewable energy resources are those that are constantly replenished by natural processes, whereas fossil fuels are geological deposits in which organic materials (biomass), containing energy that was taken up by plant growth over many millions of years, has been converted by high temperature and pressure to coal, oil or gas. Gas is the least-dirty-burning fossil fuel, while coal has the highest levels of impurities that are released as pollution when it is burned, but all fossil fuel use releases greenhouse gasses that cause global warming, in addition to local air and water pollution. Developing infrastructure to collect freely available renewable energy is not as profitable as the extraction and sale of fossil fuels, but RE involves far less cost to society as a whole over the long term, offering the only truly sustainable energy sources.

This booklet focuses on renewable energy in electricity supply and specifically opportunities for realising a range of public benefits through shifting generation from conveniently concentrated but polluting fossil fuels to the clean but dilute or dispersed energy in sunlight and wind. Currently RE provides a small addition to Eskom's existing but poorly maintained fleet of coal-fired plants, several of which are due for retirement in the 2020s. Choices facing electricity planning (as laid out in the Integrated Resource Plan - IRP2010) include whether to try to extend the life of some aging plants or replace them with new power supply, whether to prioritise RE or also develop a new South African industry in nuclear power and what role gas could serve.

Renewable resources include ocean power – drawing on the energy in waves, tidal flows and ocean currents – which can make a significant contribution in future, but the technologies are far less mature (have greater scope for improvement) than those for solar and wind. Geothermal energy – heat coming up from the core of the earth – is also a renewable resource, but there is little available in South Africa, unlike Kenya which is already using it to generate electricity. Biomass (e.g. wood, crop residues and cow dung) is a renewable resource when produced sustainably and can be used directly – as a fuel for heat and cooking or to generate electricity – or be converted to gas in bio-digesters, or to liquid fuels such as biodiesel. South Africa is a water-scarce country with little potential for hydropower, which uses the energy in the water cycle (usually caught in dams, though run-of-river installations are possible) to drive turbines for electricity generation and is a large-scale option in the region, particularly in the Democratic Republic of Congo.

The energy in sunlight can be used in a variety of ways and at different scales, from direct solar water heating (collecting the sun's heat in rooftop panels) and cooking (by concentrating heat at a central spot using reflectors), to generation of electricity from sunshine in photovoltaic (PV) panels, or in large heat-collecting installations that generate steam to drive turbines (like in a coal-fired plant, but using solar heat instead of fuel) called ***Concentrated Solar Power (CSP)***. A CSP plant can include thermal storage (in huge insulated tanks) so that electricity generation can continue for hours after the sun has set and could be designed to generate power around the clock. As PV requires sunlight on the solar cells in the panels to produce electricity it is often installed with battery packs to store electricity for later use, but there are losses in such storage systems, often as high as 20%, though storage technologies are improving rapidly.

Official statistics show that up to 8% of South Africa's total primary energy supply consists of traditional biomass use, which is generally inefficient and results in indoor air pollution with human health impacts, particularly on women and children, who are also tasked with collecting fuel. If biomass is not sustainably produced, its use also has negative ecological impacts such as desertification, while sustainable production at a scale that would displace some imported oil would compete with food production for agricultural land and water use. The potential for renewable biomass energy depends on local conditions and is far smaller in SA than countries like Tanzania, but small-scale applications can deliver good value at the local level.

Solar PV technology is well suited to achieving universal access to electricity as it requires very little maintenance and can be deployed at any scale, though the 50 Watt solar home systems that were offered in a large scale programme run by concessionaires around a decade ago were too small[4] to satisfy the beneficiaries and the programme was mostly abandoned before achieving the intended scale. A neglected opportunity for reducing poverty and dramatically improving rural lives with off-grid electricity is using renewable energy to pump water to supplement rain-fed farming. Mini-grid systems in areas remote from the national grid have considerable potential and in various areas wind power can complement solar or be the primary basis of supply, often being available during periods when the sun doesn't shine, and biomass may provide fuel for back-up generation. Wind power

4 The 'solar home systems' offered could run a few efficient light bulbs and "a small black-and-white television" and the roll-out programme did not include adequate public education or communication; it was not located within a broader programme addressing energy poverty; there were also problems with the cost-recovery model for concessionaires. There is still a successful programme providing 'solar home systems' – an off-shoot from one concessionaire in Kwa-Zulu Natal – operating at a small scale but demonstrating the real value of such systems when they are well understood and not perceived to be the state's entire energy service offering or a substitute for grid electrification.

is most cost-effective using very large turbines mounted atop towers up to 100 metres tall (roughly a 25-storey building), of more than 1 MW capacity[5] for grid supply - feeding into the transmission system. There is on-going innovation in the design of small-scale turbines (up to a few thousand Watts (kW) power rating) and costs continue to come down.

Whatever merit they might once have had, arguments mounted against a strong commitment to renewable energy for grid supply, to avert short term upwards pressure on electricity prices, have been rendered redundant by the sharp increase in prices (at least doubling for most users) without RE, not to mention the burgeoning costs of unserved electricity demand. **There is no question whether South Africa *could* grow electricity generation capacity from renewable energy sources very rapidly to overcome supply shortfalls within a few years – this potential has been clearly demonstrated by the recent procurement programme for independent power producers (REIPPPP) that attracted far more projects, with secured financing, than have been accommodated in the bidding process because of the government's wary and incremental approach. The expansion of the REIPPPP announced by the Minister of Energy in June 2015 suggests that government is now resolved to realise this short term potential to end supply shortfalls.**

Many of our very best renewable resources are not located close to existing transmission and other infrastructure, but many locations with easy access to the grid have robust resources (far higher insolation than is being utilised in Europe). In the context of extensive ***unserved electricity demand***, the value proposition of new capacity that can be brought on line within one or two years means that we don't need to restrict ourselves to using the very best resource areas first. There should be a more coherent and transparent transmission planning process, but the relevant cost comparison for the PV system alone would be the cost of supply from new power plants or the daytime tariff, and for PV-via-storage it would be the cost of generation by peaking plant, or the peak period tariff (where time-of-use tariffs have been introduced).[6]

5 The capacity rating indicates power output when running at full capacity (for large wind turbines this generally requires wind speeds of 6 to 8 meters per second) – one million Watts (MW) running constantly would be sufficient to supply up to 100 affluent or over 500 low-income households.

6 For supply pathway in which CSP is a slower entrant, as a less mature technology, and wind is favoured in the short term, a reasonable mix for 2020 would be 6 900 MW wind; 6 693 MW of solar PV (both centralised and in residential and commercial sectors) and 690 MW CSP (the latter to grow a lot faster into the 2020s, commensurate with SA maintaining our leading position in this industry globally). This would generate 28 000 GWh (from a total 12 385 MW, with a further 1 898MW treated as reserve capacity, which if fully utilised would take the share of RE above 10%).

Photovoltaic (PV) solar as embedded generation

Aside from climate change and unemployment, the value proposition of PV systems in the household and commercial (shops, hotels etc.) sectors will depend upon when electricity is required and whether the distributor will accept the feed-in of electricity, so that the grid can be used as surrogate storage – instead of the PV system being connected to a dedicated battery storage system. The cost impact of including a storage system is not just through the purchase price, but also a loss of 10-20% of the electricity in conversions to and from chemical energy in the battery, compared to direct use or despatch of the electricity as it is generated (i.e. when there is sunlight); there is also more maintenance (PV panels just need occasional cleaning) as currently affordable batteries need to be replaced, perhaps every five years. If most electricity is required during peak periods (mostly after sunset) and the distributor is charging at a higher rate for peak period consumption, this could justify the cost of dedicated storage, even if the grid were available as a surrogate; whereas if a flat rate is paid for consumption and for feed-in to the network, the only advantage of storage is having electricity during load-shedding, for as long as the charge lasts, which will depend on the size of the battery pack.

In the current context it has been suggested that the billions of rands being spent by Eskom on diesel (to run open cycle gas turbines built as peaking plant) could better be spent installing millions of solar home systems connected to the grid, which makes a good point – it is ridiculous to be burning diesel in inefficient peaking power plant while the sun is shining – but, without state intervention, it is not a readily available choice. If we rapidly grow large-scale RE generation as we should, we will eliminate the shortage of supply in a few years and the requirement for peaking plant will return to what it was designed for, as a top-up during peak demand, preferably not running for much more than an hour a day. It still makes sense to support massive roll-out of PV systems, but **the relevant cost comparison for the system alone would be the cost of supply from new power plants or the daytime tariff. The relevant comparison for PV-via-storage would be the cost of generation by peaking plant, or the peak period tariff where time-of-use tariffs have been introduced.**

Feed-in Tariff (REFiT) for embedded generation

A Renewable Energy Feed-in Tariff (REFiT) is essentially an agreement (e.g. by a utility or system operator) to pay a fixed rate for electricity supplied from specified renewable resources, as an incentive to use RE. A different

tariff rate can be offered for different kinds of suppliers (e.g. commercial or household), technologies, or scales or times of supply. Differentiated tariffs for consumption are already used as a tool in demand-side management (to encourage energy efficiency and conservation or avoiding use in peak demand periods) and all distributors should be applying an incremental (or stepped) tariff to households that increases with the scale of consumption, such that those using a little pay proportionately less per unit of consumption.

A simple flat rate REFiT available to all would be most favourable to the affluent, who can afford to finance their own PV systems and could set themselves up as mini power plants, and there would be no incentive to avoid peak-period consumption[7]. If a REFiT is linked to improving affordable access to basic energy services, a higher feed-in tariff would be offered to poor households, in conjunction with subsidised systems, which might be provided with no up-front payment, with ownership of the system passing to the household over an extended period. Detailed analysis of electricity demand is required to determine the most cost-effective design of such an initiative, including the merits of including storage. Optimising the specifications of such a programme would also benefit from greater clarity on the government's commitment to providing Free Basic Electricity (FBE) to poor households.

Determining an appropriate size of PV system would logically be linked to the ability of a household to pay for electricity use over and above FBE (which should be substantially increased from the current level) and this needs to be determined by the household.. This can be done without a REFiT, with simple two-way metering (the grid serving as surrogate storage), but this would miss the opportunity to use the incentive for decentralised RE (which is likely to be introduced in some form fairly soon) to also support energy access, socialisation of electricity supply and demand side management. In the absence of an effective, large-scale education programme on climate change and social responsibility, having an option of selling unused household electricity means households are likely to closely monitor their demand and may find future opportunity to invest in upgrading their system.

Snapshot of the national energy system

At the point of use, electricity makes up less than one third of supply, while 58% of energy is used in the form of heat, primarily industrial process heat. According to a June 2015 presentation by the Director

7 Since distributors should keep a register of all users that may feed power into the network, a certain amount of storage could be compulsory for larger systems, and the metering system can be used to check if this is reflected in in- and out-flows.

General of Energy: 68% of primary energy supply is from coal and 19% from imported oil; the balance includes around 1.5% from nuclear, traditional biomass use is reported at 7-8%, natural gas (imported), and a little solar and wind power. South Africa is the only country that converts coal into liquid fuels – a dirty and resource-intensive process undertaken by Sasol – to provide about 30% of total liquid fuels used nationally. 'Primary energy' includes all energy entering the system, before losses in transformation (e.g. in power plants and refineries) and is thus considerably higher than energy demand, which is equivalent to energy supply at the point of use.

For a long time renewable energy has been regarded by the status quo as appropriate only for limited applications making a minor contribution to over-all energy supply, but this attitude has recently been changing as the potential and value proposition of renewable energy becomes harder to deny. This is evident in the key findings of a recent study by the Council for Scientific and Industrial Research[8] of macro-economic impacts of the 600 MW of wind and 1000 MW of photovoltaic (PV) capacity that has been feeding electricity into the grid:

> "This study addressed the questions how much fuel costs the first 1 600 MW of wind & PV have saved during the year 2014, by reducing utilisation of diesel-fired gas turbines and the expensive part of the coal fleet, and how much of "unserved energy" they have avoided that would have been necessary without them. In 2014, renewable energy generated financial benefits in the form of fuel-saving and macroeconomic value of R 5.3 billion (which is 2.42 R per kWh of renewable energy), while they costs only R 4.5 billion in tariff payments to the IPPs (2.08 R/kWh)"

Issues arising from the energy system

(a) Externalisation

Human health impacts of pollution are among many negative impacts often referred to as the externalised costs of energy supply and use – costs that are incurred outside the chain of commercial transactions and have traditionally been ignored in energy planning. These range from immediate impacts, such as local air and water pollution and loss of fertile land through coal mining, to long term and cumulative impacts such as climate change and the build-up of toxic materials in the environment (bio-accumulation).

8 Bischof-Niemz, Dr T., (2015) *Financial benefits of renewables in South Africa in 2014,* CSIR Energy Centre, Pretoria, 14 July 2015

The externalised costs of nuclear power are highly contested, with the industry claiming that they have mostly been internalised and that routine emissions have no significance impact. While the short-term externalised costs of routine operations (excluding accidents) may be lower than those of coal and oil, the legacy costs are extensive and difficult to quantify, ranging from mostly low-level but wide-spread health impacts to the challenge of containing extremely hazardous waste for many centuries. **A little-known but increasingly significant levy is charged on non-renewable electricity supply to cover some externalised costs, such as damage to roads by big coal trucks and the health costs arising from air pollution.**

Climate change is the global effect of the increased concentration total greenhouse gas[9] in the atmosphere. Emissions over a long period of time, regardless of where on earth they are released, trap more of the sun's energy within our atmosphere and heat up the global climate system, the results of which are different in the various climatic regions. Air pollution consists of substances that are directly harmful to life where they are encountered, such as microscopic particulate matter, SO_x and NO_x (various sulphurous and nitrous oxides), heavy metals and volatile organic compounds. Air pollution is primarily a problem for people close to the sources (unlike GHGs), though it continues to be a problem when it returns to the ground, e.g. in acid rain.

Externalised costs are borne mostly by the poor, particularly those close to sources of pollution, or deferred into the future, which applies not only to the worst impacts of climate change[10], but also the bio-accumulation of heavy metals (e.g. mercury and uranium) and volatile organic compounds released during combustion, and legacy impacts such as acid mine drainage. Attempts to assign a monetary value to life and natural resources are a form of or potential pathway to commodification, but putting a monetary value on negative impacts provides a way of integrating them in energy planning and macro-economic analysis of options. This does not assure that externalised costs will be avoided or minimised – it is just one tool for a more inclusive assessment of value propositions. Full-cost accounting should be applied to the entire life-cycle of energy options,

9 The greenhouse gasses (GHG) most responsible for climate change are carbon dioxide (CO_2), mostly from fossil fuel combustion (which also forms the GHG nitrous oxide - N_2O) and methane (natural gas – CH_4) released from coal mines, as well as rotting biomass e.g. in landfills, or leaked from gas supply systems. Other GHGs covered under the UN Framework Convention include sulphur hexafluoride (SF_6) and two groups of man-made gasses; HFCs (including HCFCs), and PFCs.

10 Many communities are already suffering from impacts ranging more extreme weather events (e.g. floods) to shifting rainfall patterns, water shortage and increased prevalence of diseases like malaria, but the impacts of changing our atmosphere unfold slowly and continue long after the emission of greenhouse gasses, most of which remain in the atmosphere trapping heat for generations. This lag in the climate system means that we have to cut emissions now to avoid catastrophic changes that would only fully manifest decades after the GHGs are released.

unlike the practice of the nuclear industry, which is particularly adept at disassociating the activity and site of power supply from upstream impacts of uranium mining and fuel production [11].

Internalising all the costs of current energy supply (even at conservative valuations) would make electricity prohibitively expensive for many households, and various industrial uses, so we cannot rely only on market mechanisms to drive the changes needed in the electricity supply industry. Energy investments must be directed by long-term, holistic and integrated planning at the national level that rules out new projects or investments with unacceptable impacts, as well as local integrated development planning to support decentralised options. Such planning should also seek synergies in meeting the various objectives of energy development, rather than assuming that "trade-offs", e.g. between social and environmental imperatives, can deliver acceptable outcomes.

(b) Balance or Faulty Oppositions

The National Framework for Sustainable Development recognises the inter-dependence of social and environmental well-being (and that economic activity is embedded within and dependent upon both), yet in energy planning the framework of three "pillars" is commonly used to propose a balancing of social, environmental and economic objectives. This serves to set up the social and environmental as competing objectives and to obscure real sacrifices being made in these spheres in the name of 'economic growth', as supposedly measured by gross domestic product (GDP). As argued by the One Million Climate Jobs Campaign, a low carbon RE-based economy overcomes these competing objectives while simultaneously creating much needed jobs. The real compromise being pursued in practice, but not acknowledged, is between long term sustainability and short term outcomes, between improving the well-being of all life versus return on investment, while current market conditions and expectations of profit are treated as inviolate.

(c) Work Opportunities

We are only beginning fully to appreciate all the linkages in supplying energy, water and food and the extent to which all have become dependent on the use of fossil fuels. Different people draw different conclusions from this dependence, with the establishment (those whose interests are most vested in doing more of the same) claiming that we have to increase fossil fuel use for well over a decade if we want to reduce poverty. Most of civil society is calling for breaking this dependence as a matter of urgency. This

11 In South Africa the impacts of uranium mining are masked by it being mostly a by-product of gold mining, while the product (yellow-cake uranium) is exported for enrichment and fuel production processes.

includes using ecological alternatives to industrialised and input-intensive agriculture and prioritising water conservation and catchment management over more infrastructure-intensive water transfer schemes.

Transformational change to current practices requires strong government intervention, with improved capacity to enforce regulations and support localised resource management, as well as international progress in removing perverse subsidies (e.g. for mega-projects and short term productivity gains at the expense of land and water quality) and scaling up funding for climate change mitigation and adaptation.

The issue of the job creation potential of energy development choices is dealt with separately below, but there is also great potential for creating work opportunities, with skills development, within initiatives primarily focused on improving access to and affordability of energy services. A more programmatic and pro-active approach to Working for Energy, under the Expanded Public Works Programme, should offer widespread opportunities for community-based projects to develop and retain value locally. Support for sustainable biomass production and use for energy would also have knock-on benefits of incentivising and enabling community-based natural resource management.

(d) Gender

Gender issues also arise across the energy value chain, particularly in poorer households, where females – women or girls - are frequently responsible for securing most household energy, and are the most exposed to pollution from household fuel-burning. The shift to less centralised and more sustainable energy options offers significant opportunities for empowering women, but does not assure advancing gender equity and in some situations would have the potential to entrench inequality (e.g. if a cooperative requires a mandate or land from a patriarchal leadership). In developing the institutional capacity to support localised energy access initiatives and dissemination of renewable technologies, as envisaged below, gender dynamics should be considered from the design phase.

Access to energy services

Energy access is another area where major shifts in cost-benefit propositions have occurred as a result of the lower costs of solar technologies. Highly efficient LED lighting has further reduced the cost of solar lighting, which is now available in self-contained units with integrated storage and cell-phone charging capability[12]. South Africa has several successful community-

12 In some communities or 'markets' the cost of such systems is about the same as one year's supply of lighting fuel,

based pilot projects[13] using bio-digesters to produce gas from biomass (a range of organic material is suitable, from crop residues and kitchen waste to most animal waste – not chicken manure), to provide clean heat in the home, including for cooking.

Meeting peoples' energy service needs should not be reduced to electrification with some free basic provision, but start with an understanding of the various energy services required, from power for light and electronics to heat for cooking and water and space heating (though in decent housing the need for heating would be much less than in the majority of South African homes, so reducing the demand for heating, with ceilings and appropriate building materials, is usually the most sensible place to start on the service of avoiding frost-bite in winter). This is recognised in the 1998 energy policy, which elaborates the case for 'energisation', and a subsequent policy on Free Basic Alternative Energy, but is not reflected in energy planning or service delivery.

In South Africa, given our coal-based and ailing electricity generation system, it makes sense to consider all options for supplying various forms of energy as and where they are needed. The case for mass roll-out of solar water heating has been accepted by government and programmes are underway to make it happen; they are in some disarray and the Department of Energy has not excelled itself in this regard, nor has Eskom, but that is beyond our scope in this booklet. Electricity has long been undervalued and rather indiscriminately used. It is not very efficient or cost-effective for cooking and the alternatives that may be appropriate and affordable will depend on local circumstances, e.g. if a community has land for sustainable wood production, the latest small-scale biomass gasifiers[14] may offer a better value proposition than buying or generating electricity for cooking.

Access to some electricity is regarded as a basic right, but dependence upon Eskom is not without challenges and a policy provision of just 50 kWh per household per month is not satisfactory. In the 1990s the number of households connected to the grid tripled and the official electrification figure is usually given as 85%, though some research puts the figure below 80% and recently electrification does not appear to be keeping pace with the increase in household numbers. With the latest technologies and cost trends, universal access to an electricity grid is no longer the imperative it

and the systems have a 5-year guarantee.

13 There appear to be no South African case studies available, though the Working for Energy programme has supported a few of projects and a pioneer in the field- Agama Energy – refers to operational experience in promoting their equipment offerings and the Council for Scientific and Industrial Research have a substantial biogas digester programme.

14 Gasification involves partial combustion of biomass under controlled conditions to get combustible gasses that burn cleanly; the technology is used at a large scale for electricity generation (e.g. in several European countries) and recently small versions have become more affordable, at a scale to serve a few households.

was. Electricity remains a basic service that should be available to all and mini-grids[15] independent of the national transmission network are now viable at the small scale. Smart grids are an essential component of a sustainable energy economy and empower citizens to use energy responsibly.

There is enormous opportunity for upgrading the electricity supply systems while greatly increasing constructive interaction between energy service providers and service users (as well as for transcending this separation). Many municipalities are facing disruptive change to their traditional financing model due to the sharp increase in electricity prices, such that raising revenue through a mark-up on the Eskom price (greater than the cost of operating the distribution network) is no longer viable. Most municipal distributors also have maintenance back-logs and the extensive work needed should integrate the most user-friendly technologies available, with direct outreach appropriate for a modern utility and effective local government.

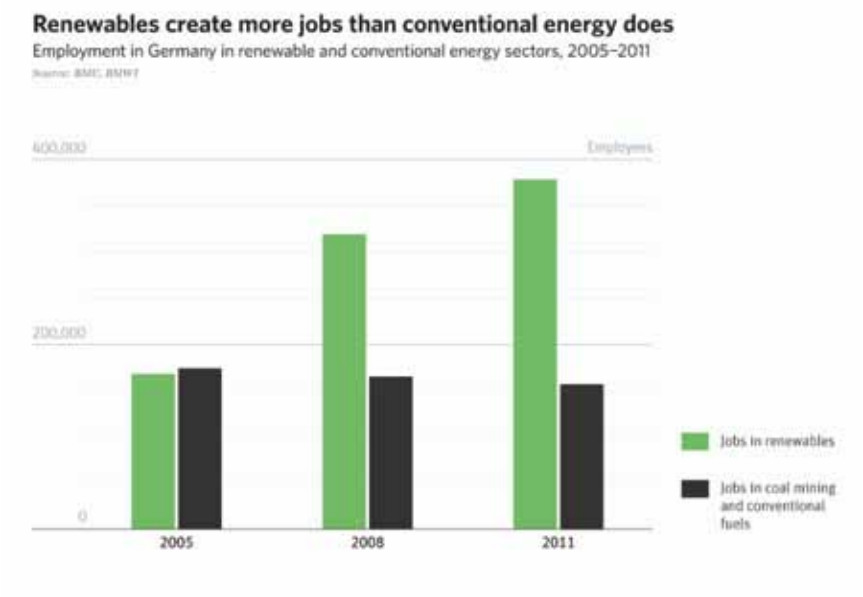
Jobs / employment impacts

The employment impacts of energy development choices, particularly of specific energy projects, programmes or technology choices, are dependent upon a wide range of variables and cannot be reliably predicted at a national level. However, employment trends related to broad technology and resource options are well-established across the energy sector internationally. The extent to which these trends could be realised in South Africa can strongly be influenced by policy and energy planning, particularly through choices of the scale (and to a lesser degree the pace) at which to pursue particular options.

A clear trend documented in international studies is that the utilisation of diffuse renewable energy resources is more labour-intensive than the utilisation of the highly concentrated energy in fossil fuel resources. Germany, with far weaker solar resources than South Africa, has clearly realised the job creation potential of renewables, as illustrated in the graph below.

Labour intensity used to be widely recognised as an impediment for renewables, including a barrier to investment by way of more extensive costs of labour making renewable options less profitable than stock energy options (fossils and nuclear). Employment in coal-fired electricity generation, including associated mining, declined fourfold between 1980

15 A 'mini-grid' is a local electricity system including generation and distribution (with the necessary equipment for load and voltage management); it will typically include some storage (batteries) and some back-up capacity – usually a diesel-powered generator.



and 2000[16] and the labour-intensity of coal mining has continued to decline. Since creation of employment has become the major political imperative for all parliamentary parties, proponents of fossil and nuclear energy projects increasingly resort to 'multiplier effects' to claim high job-creation numbers for specific projects or programmes, with very generic projections of indirect jobs. This practice of promising jobs has become commonplace, but, in the energy sector, the fossil fuel proponents rely far more than their RE counterparts on projected and speculative downstream impacts.

A major challenge to assessing the employment impacts of energy choices is the impact of employment within the energy sector relative to the impacts of resulting energy prices on job-creation potential within the economy as a whole, particularly as anticipated over the short term. The potentially negative economy-wide impacts of an increase in price of electricity is more pronounced within an energy-intensive economy like South Africa's. This is allied to the dominant assumption that cheaply converting abundant coal into electricity for energy-intensive industries provides global competitive advantage for the foreseeable future, with this in turn presumed to deliver higher employment, though manifestation of this has not been borne out by experience. There is some basis for the argument that coal is positive for

16 AGAMA Energy. 2003. Employment Potential of Renewable Energy in South Africa published by Earthlife Africa Johannesburg.

quicker economic growth, when this is equated with rising GDP, however the downstream factor, which has long been used to justify broader efforts to keep energy prices low, has not been decisive or even demonstrably conducive to addressing South Africa's unemployment crisis.

To assess the employment impacts of energy development options with any degree of confidence requires a more holistic approach than project-by-project projections, with the exception of smaller biomass and decentralised energy access options with almost entirely local impacts. In the grid-based electricity supply industry, the most reliable way to ensure positive employment impacts will be to work with the well-established trends and consider how best to capitalise on the positive ones at a national and even at a regional level. On this basis, South Africa should have clear policy and plans to deploy renewable energy technologies at a scale that justifies a very high level of localisation, as well as a more programmatic approach to procurement than just the incremental and serial bidding approach that has been developed to successfully initiate the uptake of renewables.

The greatest social benefits that are available through renewable energy development are in off-grid applications where there is inadequate access to energy services, but responsible 'energisation'[17] will require a bottom-up approach with choices strongly determined by local circumstances, thus defying generalisations about technologies that are valid for grid-based or purely commercial supply. A fast-track approach is not appropriate to sound practice in energisation, where key factors for success are effective local government and participatory Local Integrated Development Planning. There are huge potential socio-economic gains available through energisation[18] and here too a programmatic approach is desirable, especially for building public awareness of energy options and developing relevant capacity in local government, but community-based initiatives should not be required to conform to national targets. The prospects for realising this potential will be greatly enhanced if thriving local industries in RE technologies are driven, or rather their localisation is pulled, by strong demand in the commercial and grid-feeding sectors.

Decentralised deployment of RE technologies will be more labour-intensive than centralised projects designed to serve the grid, with or without using the grid for surrogate storage, but more so where dedicated storage is required. Solar PV technology is already being used as a substitute for

17 See 1998 White Paper

18 This is an area where it is easy to justify very high numbers in projections of work opportunities, which may be a necessary precursor to decent jobs within such a nascent industry; one can conceive of municipal and / or community-based enterprises; a people-centred approach to meeting energy service needs may in various contexts or circumstances not need to be premised on the generation of cash-flow, or may embrace concepts like local currency.

grid dependence, sometimes in defiance of government regulations. The value proposition for PV integrated within distribution networks is currently determined mostly by the reliability and the pricing of centralised supply, while in the medium term it will be determined more by the regulatory regime and local government dynamics (including financing models). The pricing of PV panels - especially relatively small units – has recently been quite volatile and a state-supported or publicly owned facility or programme of large-scale local production would greatly enhance the prospects for localisation.

To have confidence in positive employment impacts arising from energy development choices requires an active role for the state, not just imposing terms on IPPs, such as the requirements for local economic development (LED) under the REIPP programme, but pro-active engagement, with on-going and iterative planning and the enabling of decentralised development. To realise the benefits of higher labour-intensity of renewable energy options in South Africa requires clear commitment to high levels of deployment as well as other measures contemplated below.

Climate Change and South Africa's emissions

South Africa is ranked around 12th amongst the world's highest emitters of carbon dioxide, however rankings sometime change as a result of improved data collection rather than actual changes in emissions – and within the top 15 when all GHGs are taken into account. We have the most carbon-intensive of the world's top 20 economies. Emissions per capita – i.e. total national emissions divided by the total population, ignoring massive differences in individual carbon footprint and how much of our emissions may be embodied in exported product - are similar to industrialised countries like the United Kingdom. South Africa claims to play a leading and progressive role in international negotiations under the United Nations Framework Convention on Climate Change (UNFCCC), championing the Adaptation agenda, insisting upon equitable contributions including developed country support for developing countries and supporting the Africa Group position calling for stabilisation of global temperature at no more than 1.5°C above the pre-industrial average, but this positioning has not translated into ambitious domestic mitigation action.

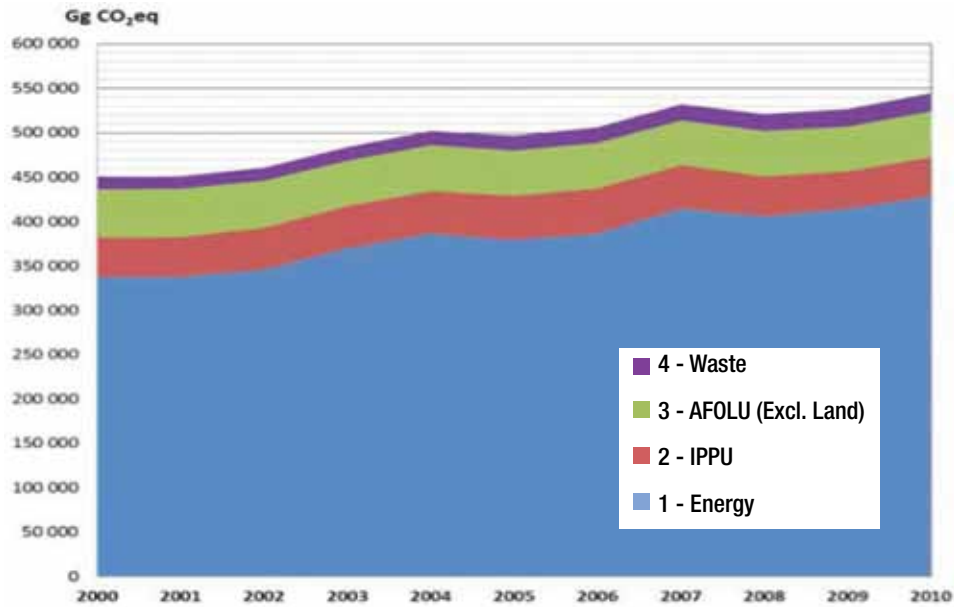
The National Climate Change Response White Paper (NCCRWP) was promulgated in November 2011, just before SA hosted the 17th Conference of Parties (COP) to the UNFCCC, and lays out a somewhat ambitious programme of work that has been slow to materialise. On Mitigation the policy stipulates a wide range within which our national emissions trajectory

should remain to 2050, known as 'Peak, Plateau and Decline' or the PPD range, which is consistent with the international commitment made in 2009: to bring national emissions below a 'Business-As-Usual' (BAU) trajectory by 34% in 2020 and 42% in 2025. The original BAU trajectory was developed by the Long Term Mitigation Scenarios process that started in 2006 and anticipated emissions growth much higher than has actually occurred.

Towards the end of 2013 the Department of Environmental Affairs (DEA) published an elaboration of the PPD Range, stipulated in policy, which included absolute annual emissions figures for Low, Mid and High PPD, accompanying the following graphic depiction – the vertical axis (line) represents annual emissions, in Mega tonnes, with the graph showing a range for the entire period of 2010 to 2050 (see graph below).

This suggests a plateau in emissions from 2025 to 2035, anywhere between 400 and 614 Mt per annum, but to be consistent with the global goal our emissions should be declining strongly in this period, to be well below 400 Mt by 2035. The bottom of the range in 2050 is given as 212 Mt, which would be roughly 3 tCO_2e per capita for the projected population of 70 million, when global average annual emissions should be no more than 1t per capita. The cumulative total emissions of the Low-PPD (the bottom of the range) is 14 830 Mt – just under 15 Gt – which some might consider a fair share for South Africa of an acceptable global carbon budget ***consistent with keeping global warming within 2°C***.

In November 2014 DEA published a revised and official National GHG Inventory 2000 – 2010, which records net national emissions in 2010 as



Energy accounts for about 80% of emissions – with the remainder being emitted by Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and from Waste. The graph shows total annual emissions over the decade in the unit Giga gram, which is the same as a kilotonne.

518 Mt CO_2equivalent (all the GHGs are rendered in this unit, based on global warming impact equivalent to carbon dioxide). The Inventory reports total emissions in 2010 of 544Mt, as in the graph above, with the difference to net emissions being the amount of CO_2 taken out of the atmosphere through forestry and other land use.

Since electricity generation accounts for about half of total national emissions (almost two thirds of the emissions shown for energy), shifting to renewable energy offers by far the largest mitigation opportunity, other than nuclear power, which is not an acceptable option. A study published by DEA, The Mitigation Potential Analysis (MPA – November 2014) provides in-depth analysis of a large set of "abatement options" – actions to avoid anticipated emissions – with modelling to 2050 of the socio-economic impacts of implementation[19].

Adaptation requires developing resilience to the impacts of climate change and here too renewable energy can make a contribution, within a package

19 The MPA does not cover the full scope of national mitigation potential; in particular it considers mitigation or abatement of less than 50% of electricity generation emissions, though we could completely decarbonise electricity supply by 2050. It also does not consider even half of the mitigation potential available through electrification of transport.

of actions for localised development, but this has not been assessed as yet and is fairly marginal relative to the role of renewables in mitigation. At a local level the value of decentralised power supply is significant and resilient communities need to understand the full range of energy options available to them. Thermal power plants that generate steam to drive turbines need a great deal of cooling, which requires large volumes of water, thus in a water-scarce country the early retirement of coal-fired plants using wet-cooling would help to adapt to diminishing and more erratic rainfall. ('Dry cooling' as applied at the most recently completed mega-plant and Medupi uses far less water, though still significant quantities.)

There is a lag in the climate system between when emissions occur, and the impact of the increased atmospheric concentration of GHGs is fully manifest. This means that the impacts we are experiencing today are driven mostly by the emissions of the previous generation, while the benefits of halting emissions growth and a subsequent decline will take some decades to manifest. Some components of the climate system have more of this inertia than others, thus expansion of the oceans due to warming, which takes decades to penetrate the depths, will continue for centuries no matter how steeply emissions are reduced. Uncertainty regarding the rate of response is why different global emissions pathways or cumulative totals are rated with different probabilities of keeping global average warming below 2 degrees let alone staying below 1.5 degrees.

The publication in 2014 of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) provides a high degree of confidence regarding the atmospheric GHG concentrations that will result from further emissions and the amount of warming that will follow. Therefore we can determine what amount of total emissions, or global carbon budget, would give us a strong probability of staying within 2 degrees. Such calculations have been carried out by many institutions, including the International Energy Agency (once better known for scepticism of climate change). It is clear that humanity needs to become carbon neutral well before the end of this century, i.e. to ensure that all our GHG emissions adding to atmospheric carbon are balanced or off-set by activities that take carbon from the atmosphere, such as reforestation and ecological agriculture. The longer we take to make global emissions start to decline, the sooner we will have to achieve carbon neutrality, for a given probability of achieving the goal.

Using well-rounded or 'ball-park' figures, to have more than half a chance of staying below 2 degrees, a global carbon allowance or budget for 2010-2050 will be well below 1000 Gt CO_2e – thus less than 20 years' worth at our current rate of emissions - and this leaves very little budget for after 2050.

Some industrialised countries are already reducing their emissions, while virtually all developing countries expect their emissions to continue growing for some time. Allocation of an acceptable amount of global emissions amongst nations should be based on their responsibility (total emissions to date) and capability, but international negotiations are not seeking agreement on a methodology for this. In the meantime we have to consider allocation of a possible national allowance within the economy, regarding which the National Development Plan (2011) states: "The carbon budgeting approach to mitigation must efficiently and appropriately apportion carbon space to the sectors and activities that add the greatest value, using a transparent set of indicators that include development indicators."

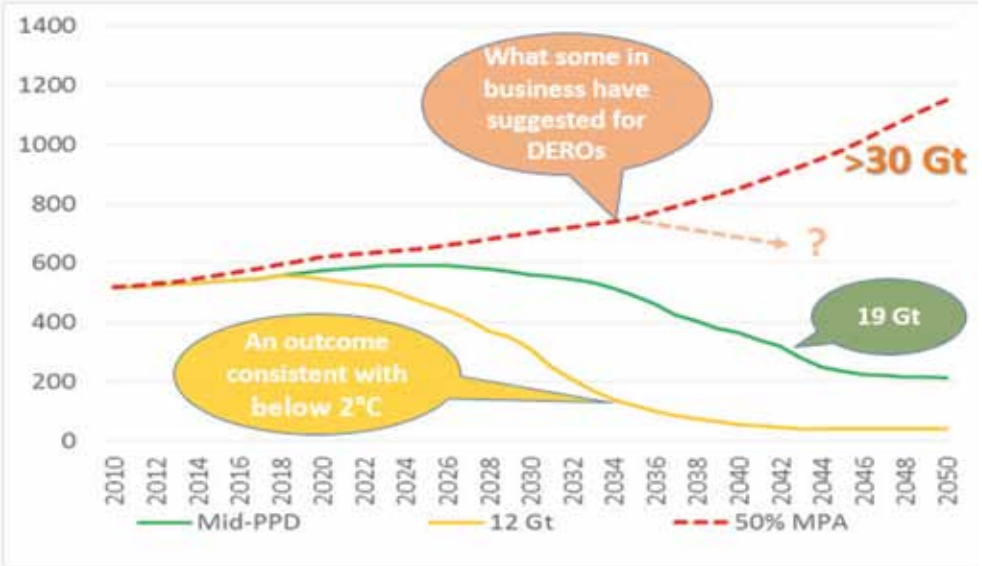
South African long range emissions intentions

The PPD Range is not helpful in considering an optimal emissions trajectory for South Africa. If all countries' mitigation efforts were on a par with the High-PPD for South Africa (which has a cumulative total of 23 Gt), we'd be heading for 4 degrees of global warming, which involves about double that in much of the inland area of Southern Africa. There is no consensus amongst civil society on an appropriate national trajectory (emissions pathway) or a target carbon budget (cumulative total of emissions) to 2050, though it is common cause that the PPD Range is too high. The determination of what should be considered a fair contribution is an intensely political issue involving class interests, as are broader questions of climate change response priorities nationally and globally, as different strategies will have different impacts across the social spectrum.

On the issue of climate change mitigation (avoidance and reduction of emissions and absorbing carbon dioxide from the atmosphere, e.g. through reforestation), there has been extensive international analysis of what could or should be expected of different countries, some of which is available in the form of on-line tools, such as the Climate Equity Reference Calculator[20] (CERC). Review of such analyses indicates that a carbon budget for South Africa that is consistent with some chance of stabilisation at 1.5 degrees and a strong prospect of keeping warming below 2 degrees would be about 12 Gt[21] for the period 2010 to 2050

20 The Climate Equity Reference Calculator (CERC) was developed by EcoEquity (building on their Greenhouse Development Rights approach) with the Stockholm Environmental Institute: http://calculator.climateequityreference.org/

21 Relating a national emissions trajectory or budget to a global warming outcome requires making assumptions about what all other countries will be doing, which requires consideration of countries' responsibility for emissions to date and capability for mitigation. To equate a national emissions trajectory or budget with a global outcomes assumes equivalent effort on the part of all countries, based on their responsibility and capability, which can be assessed against a range of criteria, with different criteria producing different reckonings for a particular country. The proposal of



The Department of Environmental Affairs has proposed Mid-PPD as the point of reference for setting Desired Emissions Reduction Outcomes (DEROs - as provided for in policy), but does not explain how to reconcile this trajectory, depicted as 473 Mt in 2010 to 480 Mt in 2015, with reported emissions of 512 Mt in 2010. One approach is to plot a trajectory starting at reported emissions and reaching the same cumulative total by 2050, which is how the 'Mid' pathway shown below, with a cumulative total just short of 19 Gt, was generated (see graphic above).

The upper trajectory is very broadly indicative of propositions mooted by some industry stakeholders with reference to the Mitigation Potential Analysis, though organised business has not tabled any formal proposition for DEROs and there has not been opposition to emissions starting to decline from 2035, as suggested by the PPD Range.

The DEA has a 2050 Pathway Calculator for SA, an on-line tool available via their website that allows users to experiment with 38 levers for mitigation actions, which are applied to a reference case projection of energy demand and supply and GHG emissions. This is offered as an educational and not a planning tool and it is very useful for developing familiarity with the big picture and range of necessary interventions, particularly the full scope of mitigation potential in electricity supply, but even with all levers set to maximum

an emissions outcome for South Africa of 12 Gt is based on criteria applied by the Climate Equity Reference Calculator and is lower than what such criteria suggest would be a 'fair share' for South Africa. It is an emissions outcome that is proposed will be achieved with international support, since the most developed countries are responsible for more mitigation than they can possibly achieve domestically (as their 'fair shares' will be used up well before 2030) without substantial changes to the political economy of the major industrial powers.

mitigation it is not able to create an emissions trajectory significantly lower than the extrapolation of Mid-PPD above. This paper does not propose a 12 Gt pathway as South Africa's fair share of global emissions (taking into account our national responsibility and capability relative to other countries), as this may imply further compromising the rights of the poor, if assuming little change to the current political economy. Some organisations address this by advocating a 12Gt budget that should be conditional on mitigation supported by 'developed' or more industrialised countries, additional to bringing their national emissions close to zero before 2040.

Energy Development pathways for SA

A number of global scenarios for moving entirely to renewable energy have been produced; some highly theoretical, including a plan for doing this by 2030, some more detailed and pragmatic, with regional or country-by-country scenarios considering physical resource constraints, spacial development patterns, etc. What was once widely renounced as idealistic and unachievable is increasingly being embraced by mainstream institutions: human civilisation running entirely on renewable energy. There is still wide-spread scepticism about achieving this by 2050, but arguments invoking "realism" increasingly rest on the inertia of the global economic system and vested interests (essentially a geo-political value judgement) rather than any technological or resource constraints.

The real debate has shifted from whether it is possible, to how best it would be achieved (e.g. determining the potential for sustainable biomass energy supply without compromising food and water security), with a *just* transition away from the fossil fuels upon which so many are currently heavily dependent. The balance of analysis shows that phasing out fossil fuels is not only possible, but offers practical opportunities for people-centred, bottom-up development with more equitable access to natural resources, and indeed will have to incorporate reversing the growth of inequality.[22]

South Africa and our region's vast renewable energy resources are orders of magnitude greater than even the most optimistic estimations of our fossil resources and include a large share of the world's best solar resource. The land required to harvest all the renewable energy we could need is well below 1% of our total land area, and is less than the total footprint of meeting our needs with fossil fuels, when considering entire life-cycles of supply and use[23]. The material requirements (such as for steel and various less

22 For further reading, see This Changes Everything, Naomi Klein (2014)

23 Those denying the potential of RE like to compare the physical footprint of power plants / generation facilities, on

common metals) for all of the extensive infrastructure necessary to collect RE have been studied at a global scale and found to be manageable, though international planning and cooperation will greatly enhance the prospects for mobilising required resources both rapidly and responsibly. In the area of the material requirements of sustainable energy solutions, South Africa has a very generous endowment of a majority of relevant materials.

Moving electricity generation to RE will be easier than shifting from fossil-based liquid fuels, predominantly used in transport as petrol and diesel. This will require reducing the use of internal combustion engines to only their most appropriate niche applications, while increasing the share of electricity in the SA mix of energy carriers to replace liquid fuels wherever feasible. The remaining liquid fuel requirements could then be supplied from biomass. There are some specialised applications of fossil fuels, e.g. of high quality coking coal, for which we do not yet have alternatives, but how we will meet the final 5% of the transition to 100% RE is not pertinent to the choices we currently face. The essential initial step is a clear decision to do all we can to develop renewable energy industries and stop putting new money into the old paradigm and wasting scarce resources on infrastructure that will have to be retired early, i.e. is likely to become stranded assets.

Integrated Energy Planning (IEP) is, as detailed in policy and legislation, the appropriate forum and necessary process to assess the big decisions for energy development. Theoretically this is in progress, with a stakeholder engagement process having been launched by the Department of Energy (DoE) in May 2012 and a Draft Report serving as the basis for provincial workshops in the latter part of 2013, but there is no evidence of this project having real traction on decision-making. For electricity supply the DoE still uses the Integrated Resource Plan (IRP) 2010 (having rejected the IRP 2010-2030 Update Report) and appears to have abandoned any commitment to public engagement on developing the next iteration of this plan, which is supposed to be an on-going process with a 2-year cycle. Currently there is no meaningful public deliberation of our long term energy strategy.

The ailing state of many existing coal-fired plants has led to proposals for major refurbishments, under the banner of 'life-extension' as a supply-side strategy, but the value proposition of such a strategy cannot be publicly debated as the condition of the plants is treated as proprietary information (trade secrets) in case the state may choose to sell off any such assets. Long term plans or strategies have been developed for liquid fuels investments and gas utilisation, though they have not been officially finalised, while a Coal Road Map (SACRM) released in 2013 is being used by the industry

which basis using concentrated fossil fuels requires less space than collecting dilute renewable energy, but this ignores the land footprint of fuel supply, waste management etc.

to motivate on-going growth in domestic coal consumption into the 2030s. It remains to be seen whether response to the current electricity crisis will be confined to shoring up the existing system or take the opportunity to embrace a sustainable energy paradigm.

A 2008 research study[24] established the viability of renewable energy providing 15% of electricity supply by 2020[25] with long term cost savings. Subsequently the costs of RE technologies have declined far faster than assumed in that study. From our present situation we are unlikely to achieve much more than 10% by 2020, at least if seeking a decent balance between speed and maximising socio-economic impacts, particularly the potential for job creation. This would be sufficient to provide a good foundation for an industry-driving objective of 40% electricity from RE by 2030 as illustrated in the projection on page 21 below:

One of the successful projects in the fourth bidding round of the REIPPPP sets a positive precedent, the Just Energy project with social ownership in a wind farm at Wesley, in the Ciskei. Just Energy is the first not for profit project developer to successfully compete in the bidding process to secure a power purchase agreement for connecting a renewable energy project to the national grid and the first such project in a former 'homeland' area. Just Energy's business model was designed to create project opportunities incorporating social ownership and keeping some of the income created in the local economy, so it provides for re-investing a substantial portion of the revenues it earns from the project back into equity for the local community to own.

How much RE generation capacity do we need?

At present in South Africa we need all we can get as quickly as possible, up to a point - until the two very large (6-pack) coal-fired power stations Medupi and Kusile[26] are mostly operational - and then we may have more than we need, for a while. Beyond grid-based supply, we need as much as can responsibly be delivered – the rate of dissemination on the ground will depend on energy end-users (households and businesses) and the institutional support and finance available to them, rather than on availability of the renewable energy technology hardware.

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24 '50% by 2030 – Renewable Energy in a Just Transition to Sustainable Electricity Supply' – WWF-SA Report, 2010

25 As above, this refers to the proportion of GWhr despatched, rather than to the rated capacity of generation installed (MW), which is the unit preferred by government, e.g. in publicising IRP2010 concession to RE, but does not take account of different availability factors for different technologies.

26 There is a case to be made that Kusile should be stopped, or down-scaled to fewer units, but not enough is known in the public domain regarding what has been committed to or constructed, or about the status of the ailing older coal-fired power stations, to be able to assess the merits of such a proposition.

Energy demand is generally inferred from supply, while there is more than enough supply, but in South Africa there have been electricity shortage conditions since 2008 and we have no reliable indication of short term demand growth as we begin to catch up and establish a reserve margin – the target is to have 15% more rated capacity than the peak demand level, which is currently around 36 Giga Watts (GW). While the nominal national capacity available is about 42 GW, including peaking plant, the overall availability of the existing fleet of power plant has recently been below 70%, primarily due to inadequate maintenance. The prevailing plan for electricity supply is to roughly double existing capacity[27] by 2030.

A wide range of demand projections have been offered recently and there is a long history of South Africa / Eskom failing to align electricity supply with demand. This amplifies a key advantage of renewable energy technologies: they can be deployed at any scale, with a short lead time. In the south west of the USA there are solar fields that are as big as mine dumps, or rather covering as much land. Given the ailing state of many of our dirty old coal-fired plants, if we build renewable energy capacity ahead of demand and their due retirement dates, early retirement may be a better value proposition for society than trying to get them compliant with air quality standards - early retirement will become a by-word in the coal industry sooner or later.

The Department of Energy is considering bids from Independent Power Producers (IPPs) for 2 400 MW of coal-fired plant (additional to the 4 800 MW each of Medupi and Kusile) and several projects are being assessed for fluidised bed combustion of low grade coal at the mine mouth. The coal deposits concerned could only be economically viable with this technology, applied at the end of conveyor belts, and it is not clear if they will be with all the pollution control equipment and water and materials supply that will be required to comply with air quality standards. This is in a regional context where several mines are switching their electricity supply to renewable energy (in place of diesel generators) and coal mining companies are investing in REIPPs.

The following graph shows an electricity supply ‘scenario’ for South Africa in the energy unit PetaJoules (PJ), with total supply growing from just over 900 PJ in 2006 to about 1 330 PJ by 2030, which assumes aggressive implementation of energy efficiency and demand side management measures. This projection,

27 Plant capacity ratings indicate the maximum output, so the electricity supplied per MW installed depends on plant availability, which is different for different resources and technologies; coal-fired plant is designed for 85% availability, while new solar and wind power generally has availability of 30-35% (the electricity supplied per annum is about one third of the rated maximum capacity multiplied by the 8760 hours in a year), thus total installed capacity numbers need to be higher for renewable energy technologies than plants running on fuel

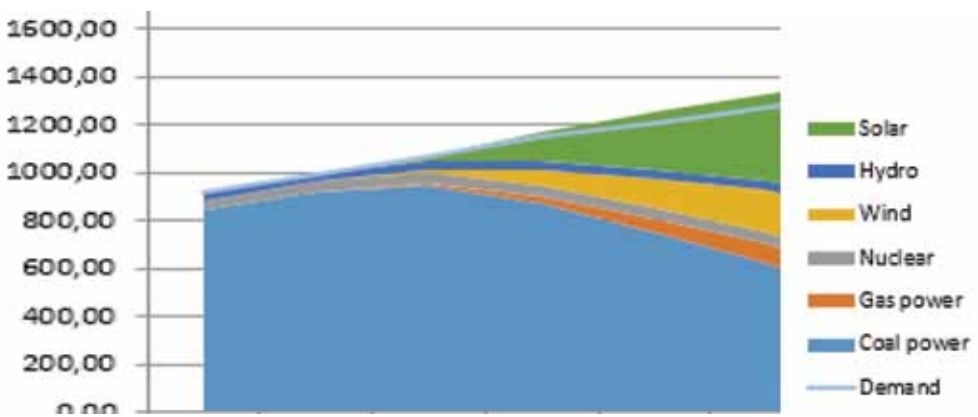
produced with the 2050 Pathway Calculator[28] looks at a possible future that has not been considered in our energy planning and urgently should be. In this projection, supply from Medupi and Kusile are included earlier – closer to their planned availability dates – than is actually happening and some existing coal-fired plant would be phased out ahead of its planned retirement date, from around 2020, which may be rather optimistic.

In reality things will not run as smoothly as this – we can expect a spike in supply starting as the latest renewable IPP projects and one unit of Medupi come on line, as well as much lumpier shifts within the supply mix as old plant is retired. The growth of gas-fired power may be contentious, while the decline in coal-fired power is slower than desirable from an environmental perspective and is predicated on a relatively gradual growth path for domestic renewable energy industries, avoiding a rush to import the cheapest available hardware.

The electricity supply mix in 2030 would be made up as follows: Solar and Wind 40% (535 PJ in 2030 out of total 1327 PJ); Hydro: 2.8%; Nuclear (Koeberg): 3.6%; Coal: 47%; Gas: 6%; with Demand: 1273 PJ (54 PJ available to export, as the modelling of capacity incorporates a reserve margin).

28 There is a full and detailed model of the national energy system that generated this picture, with the latest economic growth projections, which is freely available in a simplified format as a series of Excel spreadsheets and where all the input data and assumptions can be examined.

Pathway for 40% Electricity from RE by 2030



The role of gas

Natural gas (methane) burns cleanly at the point of use[29] providing an efficient use of fossil energy for cooking and heating, though the over-all efficiency of the fuel cycle will depend on the details of the supply chain. Where gas is readily available it offers an environmentally friendly option relative to coal or oil-derived products and is thus widely seen as a major step in a transition to sustainable energy. Conventional gas production involves little more than drilling into a field and collecting gas already under pressure, while 'enhanced recovery' usually refers to pumping air (or carbon dioxide) into the field to keep driving gas out. 'Unconventional gas' requires a far more intrusive and resource-intensive process to extract, such as hydraulic fracturing – fracking – of deep shale formations, the impacts of which may render the entire fuel cycle just as damaging as using coal, potentially more so.

Greenhouse gas emissions from gas-fired electricity generation in large combined-cycle plant (a lot more efficient than the open-cycle turbines that can be turned on and off quickly for peaking power supply) are generally about half those of coal-fired plant, per unit of electricity supplied, but the emissions of the fuel cycle include leaks from the extraction and supply chain. Methane (CH_4) is a more powerful greenhouse gas than CO_2, causing warming at a rate usually given as 23 time greater (in the short term the impact is more significant[30]) and a leakage at a rate of about 3% from source to use is sufficient to off-set the lower emissions at the point of generation. For long-haul transport natural gas is piped or converted under very high pressure to a liquid (LNG), which must be re-gasified to be used or fed into supply chains, and these conversions involve some fugitive emissions, though there is little robust data on general trends.

Gas-to-liquids (GTL), is only less polluting and water-intensive than coal-to-liquids (CTL, undertaken by Sasol), with such a poor life-cycle efficiency and extensive ecological footprint, worse than conventional oil production and refining that it is seldom presented as part of a potential transitional role for gas. A low carbon economy requires restricting the use of inefficient internal combustion engines requiring liquid hydro-carbon fuels and for the remaining liquid fuels needs to be met with sustainably produced biofuels, so new investment in GTL cannot be reconciled with sustainable development. The conversion of conventional vehicle engines to run on gas is a relatively cheap and simple retrofit (available through SANEDI)

29 It does not produce significant quantities of local air pollutants, though combustion does emit carbon dioxide, at a lower rate than other fossil fuels.

30 The latest Assessment Report of the IPCC has revised the climate forcing factor to be applied to methane to 35 times that of carbon dioxide, over the standard 100-year timeframe used for CO2 equivalence

that offers an interim measure for improving over-all energy efficiency and reducing local air pollution, as well as having lower GHG emissions.

The most appropriate role for gas in a just transition to a renewable energy future in South Africa will be smaller than in countries that have already invested heavily in gas infrastructure and/or do not enjoy the world-leading solar resources that we have. Mozambique has recently confirmed very large conventional gas reserves in the far north and is developing liquefaction facilities to be able to supply the global market and the country also has extensive coal resources, as do Botswana and Zimbabwe. The value of natural gas as a "bridging fuel" or "transitional" option is especially context-specific for South Africa, as there are believed to be large unconventional gas deposits in shale formations about 3 km below the Karoo, which would require fracking (hydraulic fracturing) to extract – a practice banned in several countries due to the impacts and risks. Some investors and other vested interests believe the prospect of shale gas offers an attractive alternative to importing oil, which provides 19% of primary energy. The risks involved just in exploration of the resource are considered by some stakeholders to be unacceptable and from a climate change perspective investing in development of possible unconventional gas in South Africa would be counter-productive. Oil importation can be reduced without shale gas and if some gas-fired electricity capacity is considered necessary as back-up for renewable capacity, perhaps this should be built in Mozambique.

For Southern Africa the main question regarding gas is how large a commitment to make to gas for electricity supply to compliment the shift to renewables and to avoid new coal-fired electricity investments, and in South Africa perhaps facilitating the early retirement of existing plant. There is a real risk that enthusiasm for gas will present a barrier to the timely take-up of renewables, rather than being constrained to a supportive role, which is one of many reasons that we should be developing energy strategy (and notions of energy security) on a regional basis, as well as ensuring that renewable energy technologies are readily available and affordable. Mozambique may be an instance where government revenues from gas are required and play a pivotal role in financing renewable energy infrastructure, if there were a coherent strategy backed by strong political will.

In South Africa the minerals-energy-complex should be investing in renewable energy (and a lot more in energy efficiency), but the way this is addressed in the National Development Plan is vague with no assurance that further investment in fossil fuels will be anything but competition for renewable options. The question of whether South Africa should import LNG to replace diesel in peaking plants should be assessed in light of the

infrastructure costs (and realistic timing) of delivering gas to the plants, compared to the prospects for radically reducing their use as renewable generation capacity is built. Government has been considering the development of an LNG import terminal at various coastal locations and there is also the option of procuring or leasing a floating regasification plant, involving less lock-in to fossil fuel infrastructure. The recent expansion of the RE procurement programme (to a total of 12.6 GW) may be sufficient to avert unnecessary investment in massive LNG infrastructure.

Energy Security

The notion of energy security is often invoked to justify continuation of the status quo, for fear that disruptive change would result in major discontinuity of supply. While there is growing acceptance that there must be international constraint on the burning of fossil fuels, at a national level there is still an assumption that coal is the mainstay of energy security, not least as this concept has not been well distinguished from energy sovereignty – being free of the need for importing energy. Nuclear power, despite major discontinuities and a diminishing role internationally, is promoted in the name of energy security on the basis that South Africa has substantial uranium reserves and thus a theoretical potential to develop a domestic industry covering the entire nuclear fuel chain, though not surprisingly those hoping to sell us a fleet of nuclear reactors would prefer to also supply the fuel.

As we have seen, continuity of electricity supply has a lot more to do with timely planning and good maintenance of existing systems, than with exploiting an endowment of concentrated energy. Energy security has also been invoked to support building more very-large-scale generation plant in the name of ‘base-load capacity’, when in practice it has been the failings of such plants, compounded by delays in delivering more of these plants (Medupi and Kusile), that are responsible for extensive energy shortages. Furthermore, with the on-going globalisation of markets, there are now calls to forego export earning on coal in favour of keeping domestic prices artificially low, thus further entrenching our dependence on coal.

The variable nature of renewable resources, which are to varying degrees dependent on weather patterns, is commonly referred to as ‘intermittency’, but the resource availability does not stop and start randomly and can be predicted with increasing accuracy to facilitate optimal utilisation. The challenges of meeting constant baseload demand with an increasing share of RE are understood and manageable, so there is no inherent energy security benefit to

avoiding variable resources, while there is a benefit from using natural resource endowments that are freely available, constantly replenished and not subject to the volatility of global energy markets. In a global transition to sustainable energy, a desire for national energy sovereignty will, for some countries, be at odds with sustainability or regional energy security. This makes international cooperation a necessary component of energy security, but South and Southern Africa are in the enviable position of having plentiful RE resources.

The local dimension of energy security is generally ignored at national level. Nevertheless, it is a significant issue for the majority of South Africans, for whom it is bound up with the issue of affordability, as the poor spend a far higher proportion of household income on energy services than the affluent. Decentralisation of energy supply will be positive for energy security in moving to a more robust, flexible and inter-active system, but for the poor to benefit will require concerted efforts at local government level, supporting active engagement by households and local resource utilisation.

Renewable Energy & Trade Agreements

RE is both a national response to the short-term energy crisis created by Eskom and the international response to the long-term crisis of climate change. South Africa's various trade agreements, however, are, potentially, a major impediment to what would otherwise be the government's active promotion and protection of a local RE manufacturing industry that is required to meet both crises, along with a third one: the crisis of unemployment in South Africa.

In the words of the then Minister of Finance, Trevor Manuel

> ***The problem is not that international trade is inherently opposed to the needs and interests of the poor but that the rules that govern it are rigged in favour of the rich.***[31]

The following are some of the ways in which a South African RE industry would have to confront the rules 'rigged in favour of the rich':

- Foreign 'intellectual property' rights are the first obstacle. These are so central to maintaining the dominance of the world's already established Trans National Corporations (TNCs) that they are protected by their own specific trade agreement, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). TRIPS covers, amongst other things, copyright, industry designs, patents, the layout and design of integrated circuits and even undisclosed information such as trade

31 Mail & Guardian 21/1/05

secrets and test date. This is to say, TRIPS makes much of the technology and science an infant industry would need subject to very expensive licence fees, which, in turn, would make the local products uncompetitively expensive.

- Closely related to TRIPS, is TRIMs, Trade Related Investment Measures. TRIMs bans measures such as local content requirements that have traditionally been used to promote the interests of domestic industries
- A local RE manufacturing industry requires initial subsidies to local producers and/or import tariffs to help make foreign products uncompetitive. Both the subsidies and the tariffs would be non-compliant with a host of trade agreements because they discriminate against foreign companies and investments.
- Government procurement that favours local companies would also be in danger of being challenged
- Renewable energy requires the mining of a range of exotic minerals, many of which are available in South Africa. To prevent or discourage their export and to promote (and thereby necessarily protect) their transformation into more finished products – beneficiation – will require subsidies and or export tariffs that are trade-proscribed
- Even measures that don't discriminate against foreign companies are inconsistent with some trade agreements. Public sector preference, for instance, would be challengeable even though it would affect local and foreign-owned businesses equally.

There are already many cases from around the world making it clear that neither climate change nor national sovereignty takes precedence over the sanctity of trade agreements. Perhaps the most relevant ones in this context is, first, the case brought by the EU & Japan against the Canadian Province of Ontario. The WTO's appellate body confirmed, in 2013, that Ontario's program to encourage the development of the local manufacture of wind and solar components discriminates against foreign firms.[32] The second case is the one concluded as recently as August this year brought against India by the US. The WTO ruled India's subsidies to promote its local solar energy industry by requiring minimum local content 'unfairly' discriminated against US suppliers.[33]

None of this means that government can do nothing, if it wishes to act. There is, however, no merit in denying the trade barriers to national sovereignty or to effectively addressing climate change. These barriers remind us of the

32 : http://www.wto.org/english/tratop_e/dispu_e/412_426abr_e.pdf

33 WTO rules against India in solar dispute with U.S - http://in.reuters.com/article/2015/08/27/usa-india-solar-idINKCN0QV2FD20150827

interconnectedness of things and that addressing the electricity crisis in any substantial and integrated way unavoidably means addressing a range of other big issues.

We can take encouragement from the Treatment Action Campaign's success against the transnational corporations that sought to maximise profit out of the HIV/AIDS pandemic. A mobilised population, aided by international solidarity, can force Governments to say NO to unjust trade agreements.

Finance

There have been significant changes in public and political understanding of the financing of energy development, at least at an international level, as reflected in a recent reports from several mainstream institutions recognising that subsidies benefitting fossil fuel industries, often so entrenched as to have become 'invisible', far exceed more explicit subsidies to renewables. The International Energy Agency has concluded that "in 2014 fossil fuel subsidies exceeded US$500 billion: four times the subsidies for renewable energy."[34] Addressing the many ways in which the existing system is subsidised, to the detriment of sustainability, is a complex long-term challenge that requires a dedicated programme of subsidy reform in parallel with on-going energy planning. Nonetheless, there is no shortage of available finance either nationally or globally.

In September 2014 The Global Commission on the Economy and Climate issued the report: *Better Growth, Better Climate* – The New Climate Economy Synthesis Report, which estimated "the infrastructure capital needed for a low-carbon transition would be only 5% higher than in a business-as-usual scenario, helping to limit future climate impacts and adaptation costs." The report highlights the shortcomings of analyses that assert that action to tackle climate change would inevitably damage economic growth: "There is a perception that there is a trade-off in the short- to medium-term between economic growth and climate action, but this is due largely to a misconception (built into many model-based assessments) that economies are static, unchanging and perfectly efficient. Any reform or policy which forces an economy to deviate from this counterfactual incurs a trade-off or cost, so any climate policy is often found to impose large short- and medium-term costs."

34 Executive Director of the IEA, Maria van der Hoeven, quoted in A Briefing Note of the Side Event on "Fossil Fuel Subsidy Reform and Investments in Clean and Affordable Energy", published by the International Institute for Sustainable Development (IISD), Volume 172, Number 23, 27 May 2015: http://www.iisd.ca/climate/fossil-fuel-subsidy-reform/

Ways can be found to finance renewable energy within any energy system. However the absence of a coherent and decisive vision for energy development and financing, or objectives for pricing and market structure, while detrimental to all energy project financing, is most particularly a barrier to alternatives to the status quo.

Creating confidence or policy certainty to support mobilisation of finance is a key strategic consideration of the propositions below for advancing renewables and energy democracy, including a motivation for setting explicit and ambitious targets and establishing a dedicated industrial programme and institutional home for solar energy options. As the costs of capital are typically one third of the total cost of renewable energy projects (having no fuel costs, they are very capital-intensive) there is need and opportunity for innovation in making very-low-cost capital available to community-based initiatives and SMMEs, including micro-finance.

Immediate context

In mid-June 2015 the DoE made what should have been an historic announcement: an expansion of the procurement programme for renewable energy (RE) from independent power producers (IPP), effectively doubling the determination, bringing the total short term commitment to contract for 12 600 MW of capacity from solar and wind. The vast majority of such capacity could be operating within three to four years, to provide roughly 10% of total grid-based electricity supply from renewable resources before 2020. While it is a pity that such commitment was not the response to the 2008 electricity supply crisis, we should not overlook the opportunity it provides as a platform for scaling up renewable energy more broadly.

To realise this opportunity will require a concerted state initiative to develop manufacturing capacity in RETs. This has already been considered under projects of which little has recently been heard, namely the Solar Park and the South African Renewables Initiative (SARi- -focusing on mobilising domestic and international finance), which were both internationally ‘launched’ in Durban in 2011). The Solar Park idea became a less centralised corridor, which has been somewhat eclipsed by the REIPP programme, while some of the intent has been taken up in the Strategic Environmental Assessment (SEA) being undertaken by DEA to facilitate the consideration of location of solar facilities and wind farms. It is understood that recent studies have identified areas providing the best overlap of RE resources and access to the transmission system.

The Minister of Energy has promised an ‘Energy Master Plan’, while an IEP Final Report is being considered for approval by Cabinet clusters before it

is released and work is underway in an IRP2015, which could be released with an IEP in 2015. Procurement of a large fleet of nuclear power plants (government also wants to develop fuel production capacity) was given a mandate through the IRP 2010 and a more cautious approach recommended in the IRP Update Report has seen this document side-lined. Providing for the enormous capital costs of a nuclear fleet procurement, which one way or another must be underwritten by the state, would present an insurmountable barrier to renewable energy development at a scale conducive to localisation.

The crisis within Eskom as well as in financing the electricity supply industry, after many years of under-pricing electricity, particularly to heavy industry, means that realising the potential of renewable energy to provide peoples' power requires institutional innovation additional to what has been achieved with the special unit established to administer the REIPP programme. The prospects for realising the full potential of renewables in South Africa should not be contingent upon the outcomes of currently contested 'restructuring' of Eskom or its finances. Some separation of the management and functions of generation, transmission and distribution would greatly enhance the prospects for municipal distributors taking a more proactive and forward-looking role in energy access (off as well as on grid) and the adoption of smart grid technologies

Eskom's mandate already includes renewable energy, but this has to date been to the detriment of RE development in South Africa. Initial consideration of whether this should or could rapidly change, or how any reform of Eskom may deepen or loosen lock-in to coal dependence, involves too much speculation to develop a coherent opinion. The immediate issues of whether Eskom could or should be 'rescued' or transformed as a public-benefit-oriented state-owned entity and how that may be financed, are not the focus of this booklet, which makes a case for fast-tracking localisation of RE industries that takes the crisis into account and advocates interventions that avoid speculative assumptions. A number of these interventions will need firm institutional and political grounding and might be packaged as an innovative 'socially-owned' enterprise or special purpose vehicle - an idea that is explored in annexure A.

The option of raising municipal revenue through the on-selling of electricity supplied by Eskom, with a mark-up greater than the costs of distribution, is not an appropriate or viable model for municipal finance under current conditions and trends or for the long term. It is also, in many instances, a regressive form of revenue raising that unduly impacts the poor, who anyway pay a far higher proportion of their income for energy services, as well as frequently higher rates per unit of energy.

What must be done?

An Operation Phakisa on Mining – an intensive and multi-stakeholder exercise in strategic planning for fast implementation, as undertaken first for the oceans economy - is expected to get underway this year, under a new Minister of Mineral Resources. The coal industry has been pushing the SA Coal Road Map and will seek to retain dominance, claiming a social license in the name of poverty and economic growth that is not valid in 2015. Oil and gas have direct support through the 'Oceans Phakisa', but coal (additional to its emissions crowding out other industries in terms of local pollutants as well as greenhouse gasses) is starting to become a liability for the mining sector. Our economic and industrial strategy should wake up to the greater value that can be derived for society as a whole from a minerals sector that is not beholden to the dirtiest mineral that delivers the lowest net value over its full lifecycle.

In the first section of the booklet we have outlined what we think are compelling arguments showing that it is technically possible to move much faster to an energy sector dominated by renewable energy. This is vital for four key reasons – it will increase supply and so deal with the electricity supply crisis we are now dealing with; it will contribute to a reduction in greenhouse gasses; it will increase access to electricity and it will increase the rate of employment in energy supply.

If we agree that more renewable energy, fast, is necessary, then we need to start looking at important questions about how the renewable energy should be generated and distributed; where ownership and control should lie; and how social justice imperatives of reducing inequity, poverty and unemployment can best be met.

In this section we set out a range of possible answers to these questions. We hope that organisations will take up these issues, discuss and develop them and so create a campaign which builds energy democracy and renewable energy as a publicly driven, owned and controlled sector.

A national strategy and social programme needs to be developed with a long-term commitment to supporting active citizenship and reducing inequality, with dual objectives of eliminating energy poverty and developing domestic (and regional) industries in renewable energy technologies; various elements are enumerated below, starting with actions required of government:

A: Clear commitment and strategic direction

1. **Government must make a clear national commitment to maximise the use of renewable energy as rapidly as can be done with a high**

level of localisation of manufacturing; details such as which coal-fired plants should retire rather than be refurbished will need to be informed by both integrated resource planning and trade union and affected community consultations. However, no further study is needed to support **setting a target of 40% electricity from RE by 2030**; similarly South Africa can comfortably aim for full decarbonisation of electricity supply, preferably by 2050[35]. A corollary of this is a parallel commitment to transition away from fossil fuels, but this begs questions of timing that should be deliberated within transparent and participatory Integrated Energy Planning. (see 11 below)

2. **Procurement of nuclear power must be set aside** for prioritisation of renewable energy development.

B: Programme of Action

3. **An urgent, coherent, comprehensive and ambitious state-driven programme, that includes input from civil society, to develop manufacturing capacity in a range of solar technologies** – a specially designed entity, inter alia raising finance based on procurement commitments[36], for a very large-scale solar PV production facility, and for accelerated research, development and deployment of concentrated solar power (CSP) and storage technologies, including a strategy to remain a world leader in this field; - this is envisaged as the core of a new Solar Social Enterprise, as sketched below.
4. **An energy access programme for socialisation[37] of household-scale roof-top PV for low-income households** with an initial commitment to at least one million systems with electricity storage, as part of a more comprehensive intervention for 'Climate Homes' (See Box p.28) and several million 'entry-level' grid-connected PV systems (designed and installed to be compatible with adding storage and additional PV capacity); this programme must learn from and avoid the mistakes of the original SWH programme (suspended at the time of writing) and include public educational outreach on energy service options.

35 This timing would not accommodate the operation of Medupi and Kusile as planned for 50 years

36 For example an executive decision to procure several million systems of at least 400 W capacity (within a set period of time) for use in advancing access to energy services, could be matched by a Treasury budget allocation (some of which may come from or substitute for disbursements to local government) and a contractual commitment to purchase at a particular minimum price (subject to meeting SABS standards)

37 Socialisation here has two dimensions, avoiding commodification of energy services and developing collective social understanding of and responsibility for energy supply and use – it includes developing public participation in energy supply and management.

5. **A programme of support to local government** for improving capacity (internally – see also section D below) to enable and facilitate energy access initiatives, including the option of municipal power generation, and encourage public participation in local integrated development planning, working with local government to communicate and engage directly with communities;
6. Adopt and finance **a programmatic approach to enabling localised energy development through the Working for Energy programme** – specifically the biomass component for biogas production in small-scale digesters - that will enable social ownership, as well as community-based natural resource management;
7. **Package a national programme of renewable energy interventions that could be presented for international financial support** - this could be in the form of climate finance or energy subsidy reform: Quantify the climate change mitigation contribution (emissions avoided)[38] of a concerted set of renewable energy interventions, so that we can get the polluters with an ecological debt to pay, e.g. for the PV systems, or a portion of them, as a means of meeting the mitigation responsibilities they have beyond what they can achieve domestically,
8. **Introduction of a national Feed-in Tariff that pays a premium for small-scale embedded RE** generation, administered by distributors, but financed at national level to avoid negative impacts on municipal revenue; this should be designed primarily to benefit poor households and small businesses and include preferential arrangements for cooperatives, with appropriate criteria restricting eligibility[39] – for example to PV systems up to a maximum size per connection (perhaps 2000 Watt power rating per household) or a cap on the amount of power for which the premium will be paid;
9. **Modernisation of the grid**: A dedicated national plan must be developed for modernisation of the electricity grid utilising smart grid technologies[40] and conducive to decentralisation, incorporating education of the public and relevant local government officials.

38 This does not require or endorse the commodification of carbon or market mechanisms for carbon trading.

39 This measure is intended as a means for socialising ownership of energy infrastructure, with a potential source of finance for households to upgrade systems provided by the state; given the potential for Feed-in Tariffs to entrench commodification of energy services, the system should be designed to avoid profiteering by the affluent.

40 Grid modernisation must not be used as an excuse or means for imposing unjust electricity metering systems or associated tariffs and not be premised on liberalisation of the electricity supply industry, but optimal operation of national electricity networks as a public good/service.

C: Complementary and supportive actions

10. **Campaigning for both the rejection of the REI4P model** beyond the 12,600 MW set by the Minister and its application to fossil-fired power plants. Whether by design or effect, the IPP procurement model manifests the government's neoliberal abdication of both its developmental and climate change responsibilities. Handing over South Africa's entire renewable energy programme to (overwhelmingly) Trans-National Corporations (TNCs) driven by the imperatives of profit maximisation and the expectation of guarantees over capital security and the free flow of profit out of South Africa cannot be in the best, long term interests of most South Africans. A publicly-owned renewable energy programme should be initiated to take forward scaling up beyond the most recent Ministerial determination of a total of 12 600 MW of RE capacity to be procured in the short term.
11. **Revise the weighting of criteria** applied in any energy procurement programme, to support labour intensity and better recognise the value of social ownership - amongst workers, land owners, service-providers - recognising that the existing IPP procurement programme is not an ideal or sufficient mechanism[41] for enabling the scaling up of renewable energy, and that the rationale for state 'underwriting' of private sector finance by way of power purchase agreements is not justifiable or appropriate for fossil fuel projects.
12. **The South African Coal Road Map** (SACRM) should be recognised as a self-serving product of the corporate coal lobby that is not an appropriate foundation for integrated energy planning and is not consistent with the National Climate Change Response Policy and the over-arching goal of keeping global warming below 2 degrees; transparent and holistic scoping of the long term prospects for domestic coal use (to 2050) is required, including development of a scenario for domestic coal consumption bound by a carbon budget from 2010 of less than 8 Gigatonnes CO_2; a comprehensive strategic assessment of the expansion of coal mining must be undertaken to identify areas to be declared off limits to coal mining, such as in crucial water catchments and prime agricultural land.
13. **Institutionalise proper planning**: Implement the provisions of the National Energy Act (2008) with regard to Integrated Energy Planning (IEP) on an on-going and iterative basis, including accounting for externalised costs, recognising the value of labour intensity and

41 For details of how the REIPP programme is not conducive to developing local industries, see Baker, L and Wlokas, H L. (2015) South Africa's renewable energy procurement: A new frontier? Energy Research Centre, University of Cape Town, available at www.erc.uct.ac.za

improving transparency and public participation; this also applies to Integrated Resource Planning for electricity;

14. Undertake **a national review of the subsidisation of fossil fuels** (including indirect subsidisation through provision of infrastructure e.g. railways and water transfer schemes) **and implement subsidy reform**, including introducing support measures for truly alternative[42] basic energy services for all, that empower and enable participation of households/communities in energy service delivery; this should be linked to consideration of the reindustrialisation requirements of a low carbon economy and how to shift the bulk of investments away from concentrated fossil or nuclear energy.
15. Reintroduce provisions for **prescribed assets** in which various investors are required to hold stakes; this should be complemented by development of ecologically sound incentives to encourage or reward labour-intensity.

D. Municipalities:

16. Local government must re-establish public works departments and reverse the normalisation of outsourcing, developing dedicated competence in energy planning and facilitating the creation of climate jobs;
17. Local Integrated Development Planning must be used to encourage and enable an active citizenship and explore and utilise the synergies between energy access and climate change response;
18. Municipalities that distribute electricity should prioritise a utility approach to energy services, with an emphasis on the value and functionality offered to end users – a utility[43] that delivers electricity from a range of public /not for profit suppliers and potentially own generation capacity (and where appropriate other energy carriers, such as gas and biomass) – ensuring access and delivering on the right to free basic energy services for its constituency, including providing interactive access to an electricity grid.
19. Municipalities must recognise that the practice of raising municipal revenue through the on-selling of electricity supplied by Eskom, with a mark-up greater than the costs of distribution, is not an appropriate or viable model for municipal finance under current conditions and trends – a 21st century financing model must be developed. It is also, in many

42 There is a Free Basic Alternative Energy policy (2007) that has had very little impact; no provision was made for resourcing the actions required of local government; only four alternative fuels are listed for municipalities to consider: Paraffin; Liquid Petroleum Gas (LPG or 'bottle gas'), Coal (processed for cleaner burning) and Bio-Ethanol Gel.

43 This must not be confused with an approach that is driven to generate profit; the term 'Utility' is increasingly applied to corporate entities engaged in delivering services, where the core mandate of public utility (usefulness) becomes secondary to the interests of the corporate entity.

instances, a regressive form of revenue raising that unduly impacts the poor, who anyway pay a far higher proportion of their income for energy services, as well as frequently higher rates per unit of energy[44]

20. Local government must undertake direct outreach and public education regarding all options for energy service delivery, including undertaking participatory local resource analysis.

A 'Climate Home' intervention would, for example, include education in energy management (as well as recycling and water conservation), with a household energy needs assessment; energy efficiency upgrades, including ceilings and insulation; a solar water heater (this may fall under a separate SWH programme); provision of a solar PV roof array of perhaps 400 to 800 Watt power rating with dedicated battery storage (providing on average roughly 3 to 6 kWh per day). Full transfer of ownership of the embedded household PV systems (e.g. installed by a social solar enterprise) would take place over a period of perhaps 5-7 years. Including storage, while it requires more maintenance, adds the public benefit of reducing peak demand. Over time households could choose to augment these systems at their own cost (assuming we reduce poverty and affordable finance is made available) in preference to buying from the grid – the programme design should anticipate potential upgrades.

Some principles

Employing synergies: energy access and climate change response should be treated as an integrated social welfare value proposition that warrants investment in people (knowledge and skills development) and financing the up-front capital costs of renewable energy technologies, requiring institutional innovation to enable the poor to participate in low carbon development.

Transparency and accountability: Public interest must be allowed to over-ride private commercial interests – more robust burden of proof requirements should be applied to those claiming a right to protection

44 Unit costs for households that use little more than their free basic allocation of electricity (for those who get it), staying within the first tier or block of consumption of the incremental tariff rates, will be lower than for affluent households, though higher than the rates secured by 'contestable customers' (large-scale industrial users with long-term contracts). Fuel costs are generally higher for small-scale users buying at local outlets.

of proprietary information. The Public Access to Information Act should be strengthened to improve access to information, including information held by the state, particularly where such information is relevant to local integrated development planning or the rights of communities.

Pro-active communication to communities: Information regarding energy development prospects, such as gathered for the Strategic Environmental Assessment being undertaken for solar and wind power projects, the potential for sustainable biomass production and plans for the development of transmission and distribution networks, should be pro-actively and accessibly communicated to the public.

Energy security: Solar energy should be recognised as the appropriate cornerstone of national, regional and local energy security over the medium term and long term;

Note: All the items listed above are predicated on a full engagement with civil society, including trade unions, faith-based groups, community organisations, energy & environment-linked NGO's, research institutions and universities

Trades Unions:

Unions' investment vehicles and pension fund managers and trustees should prioritise investments in renewable energy and other opportunities conducive to a just transition to a low carbon economy and preclude investments in fossil fuel and nuclear power projects;

The creation of climate jobs should be explicitly addressed in internal planning and in all negotiations;

Organised labour should develop specific and detailed propositions for giving effect to a just transition to a low carbon economy and energy democracy, including scoping and planning for the phasing out of coal-fired power generation in the medium term, with practical provisions for workers who are displaced - an issue that should be pursued with the Sectoral Education and Training Agency - the Energy and Water SETA;

Communities / households:

Communities should organise around energy and climate issues, assessing opportunities for local energy development and creating climate jobs (without waiting for IPPs or local government to call for the formation of cooperatives or committees), including demanding support in this regard that is enabled by a dedicated national facility with a mandate to advance social ownership in the provision of energy services;

Participation in Local Integrated Development Planning (LIDP) should be utilised to secure sustained engagement with and accountability of local government and access to resources for community-based initiatives; in many localities this requires concerted pressure for meaningful implementation of LIDP, which is a fundamental requirement for inclusive development and good governance.

Participation in social/community movements, ratepayers associations, etc. should encourage their taking initiative and playing leading roles in community owned renewable energy

What can be done to advance this agenda

These issues and ideas need to be promoted as widely as possible to build popular support, with a view to formulating a concise campaigning platform for mass support.

Once civil society develops this agenda, advocating strategy and actions such as the above should be taken to local as well as national government, promoted to SALGA, amongst organised labour and through mass mobilisation…etc.,

Civil society public outreach work on energy services options and climate jobs should be scaled up, inter alia with funding from the National Lottery, which should have a dedicated window to support bottom-up initiatives including energy cooperatives.

Demanding action for divestment from fossil fuel assets should be advanced by all in our individual, social and professional capacities.

The items under B above could be the basis of a proposal that is presented under a single banner, without insisting that they should all be accommodated in a single institutional home, and as a proposition and a programme that should not be limited or entrusted solely to the Department of Energy. The Department of Economic Development would logically be an appropriate platform for such a programme; the Department of Science and Technology have relevant expertise and partnered with DoE on the Solar Technology Road Maps; the Department of Trade and Industry should drive the development of an industrial strategy for solar manufacturing and the Department of Cooperative Governance should elaborate the roles of different levels of government, oversee the allocation of resources and facilitate the development and sharing of relevant skills and information (e.g. on energy technologies, resource availability and maintenance needs and capacity)

REFERENCES:

AGAMA Energy. 2003. Employment Potential of Renewable Energy in South Africa published by Earthlife Africa Johannesburg.

Ahlfeldt, C. (2013). *The localisation potential of photo voltaics and a strategy to support large scale roll-out in South Africa.* SAPVIA, WWF, DTI.

Baker, L and Wlokas, H L. 2015. South Africa's renewable energy procurement: A new frontier? Energy Research Centre, University of Cape Town

Banks, D.I. & Schäffler, J.L. 2006. The potential contribution of renewable energy in South Africa, 2nd Ed, Prepared for Sustainable Energy & Climate Change Project, Earthlife Africa Johannesburg, February 2006.

Bischof-Niemz, Dr T., (2015) *Financial benefits of renewables in South Africa in 2014,* CSIR Energy Centre, Pretoria, 14 July 2015

Burton, J & Winkler, H. 2014. South Africa's planned coal infrastructure expansion: Drivers, dynamics and impacts on greenhouse gas emissions. Energy Research Centre, University of Cape Town, Cape Town, South Africa.

Ferroukhi, R. et al (2013) Renewable Energy and Jobs, International Renewable Energy Agency (IRENA)

Klein, Naomi (2014) *This Changes Everything*: *Capitalism vs. the Climate*, Allen Lane, Penguin Group, London

National Planning Commission (2011) National Development Plan – *Electricity produced and available for distribution,* publication released 5 February 2014

Stats SA: Statistical release P4141: Electricity generated and available for distribution (Preliminary) June 2015

The Global Commission on the Economy and Climate issued the report: *Better Growth, Better Climate* – The New Climate Economy Synthesis Report - September 2014

ANNEXURE A

The following is an attempt to package many of the above suggestions under a single banner or conceptual framework, as a national undertaking to advance people's power through renewable energy.

Sketch of the proposition

a. To be initiated as a state-owned enterprise, with participation of local government (to support an energy services approach to the local government mandate on energy services), to drive the development of local industries in solar energy technologies.

b. Finance for the manufacturing arm of such a Social Solar Enterprise, or public utility, is to come from a combination of taxes on both carbon emissions and financial transactions amongst a range of other possible sources, including prescribed assets.

c. To advance opportunities for South Africa in concentrating solar power (CSP) technology with thermal storage, both for domestic supply and to maintain a global leadership position; this requires dedicated long-term support and should include consideration of a social enterprise becoming a technology vendor in this field.

d. To be empowered to implement / enable implementation of a feed-in tariff for embedded generation such as rooftop PV installations, that is centrally financed (preferably integrated into municipally managed service delivery, but financed from the national fiscus) and is recognised as an avenue for the reform of fossil fuel subsidies.

e. Local governments that are electricity distributers must improve their capacity for upgrading and maintaining the relevant infrastructure and improving service delivery working off an asset base (perhaps as a partner in such an enterprise) large enough to support a sound long term investment and modernisation strategy, including adoption of 'smart grid' technologies that support all users' participation in demand-side management and the adoption of renewable energy options.

f. To draw upon useful foundational work, including that undertaken for SARi - the South African Renewables Initiative launched in Durban in December 2011 - and learning from the shortcomings in implementation of the Working for Energy and Integrated Energy Centres programmes for further innovation in pursuing universal access to adequate, appropriate and acceptable energy services.

Some pertinent contextual developments:

Solar PV electricity supply – at the point of generation – is becoming cheaper than new coal-fired power generation, even before implementation of the carbon tax, while large-scale wind power in resource-rich areas is already cheaper. Installed PV power supply as embedded generation (within the distribution system, e.g. at businesses and households) is approaching 'grid parity' in South Africa, at least for some tariff rates (e.g. being cheaper than peak tariffs for high-use consumers).

The electricity supply industry globally and nationally is already in a state of upheaval[45]. Transition from a traditional centralised supply model, with one-way electricity flow, to a services-oriented and decentralised approach; this provides opportunity to avoid further lock-in of the status quo through massive generation plant and to be more responsive to evolving demand and to public-interest regulations (from air quality standards to mandated fuel-switching and price regulation).

We need local government to adopt more of a utility approach to energy services – as long as this is not confused, or treated as synonymous, with an approach that is driven to generate profit. A utility that procures electricity (and potentially other energy carriers, such as biomass, eventually perhaps also hydrogen) from a range of generators, delivers energy services to a user base and provides interactive access to an electricity grid, with the concomitant responsibility of delivering on the right to free basic energy services.

Popular perceptions of solar power, as well as of the pros and cons of grid-based power supply, are gradually changing, with stakeholders who were previously only focused on grid electrification now starting to call for renewable energy for peoples' power and exploring community-based project development; the Soweto Electricity Crisis Committee has been actively exploring the potential of solar PV for poor households. While the previous attempt to roll-out solar home systems, through concessions to big energy companies (incl. Sasol and Total), was not a popular success, the relative value of solar home systems has increased considerably even as costs have declined, improving the prospects for a programmatic approach that is not dependent on or beholden to big energy corporations.

International initiatives to address energy poverty in Africa (such as the UN SE4All) has largely been the preserve of large international players and too often premised on large-scale infrastructure designed around anchor customers (industrial users), with little attention to the detail of the "long value chain" that

45 See for example *PwC's Africa Power and Utilities Sector Survey 2015*, published by Price Waterhouse Coopers

is supposed to support universal access. Shortcomings of this approach are increasingly recognised and renewable energy options have been embraced at the level of SADC – the Southern African Development Community.

The social license of coal has run its course - the only rationale for using coal is our current dependence (including infrastructure lock-in through mammoth projects) - even the World Bank has renounced the argument that new coal-fired power is required for development, rejecting any claim that new coal projects would make a net positive contribution to reducing poverty. With various mining operations across Africa starting to invest in renewable energy for their own energy supply, a forward looking mining strategy would anticipate coal being a diminishing sour of revenue and a disproportionate use of ecological carrying capacity.

How to proceed

Whether or not the current government and institutional capacity is well placed and capacitated to innovate or initiate such a social enterprise, it will be needed as a key participant. The uncertainties around the future and structure of the electricity supply industry, as exemplified in the shelving of the Independent Systems and Market Operator (ISMO) Bill, urgently need to be addressed and the potential, mandate and arrangements for such a vehicle should be considered within deliberations on the industry as a whole.

The foundational rationale should be:

- The state should provide the majority of households with PV systems as a way of socialising (de-commodifying) energy services as part of extending access and extracting the maximum social value from the technology – optimising the public benefits of solar power with prioritisation of reducing inequality.
- There is immense opportunity and need for a national programme that has the dual objectives of moving to RE electricity generation (particularly embedded generation) and reducing poverty, while enabling active citizenship, including engagement with service delivery and Local Integrated Development Planning (LIDP).
- While the above should not be conditional on foreign funding, a massive social programme should be formulated and presented for financing from international climate change mitigation funding (DEA and DIRCO must be tasked with finding a way of mobilising funding, under the Green Climate Fund GCF or similar). This should be linked to a national manufacturing initiative, such as might be undertaken by a special purpose vehicle (with majority public/government ownership, including local government distributors).

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Other AIDC booklets available on request

- Challenging Apartheid's Foreign Debt
- Climate Change & Climate jobs – Easy Answers to 56 Important Questions
- One Million Climate Jobs – A just transition to a low carbon economy to combat unemployment and climate change
- Youth Wage Subsidy – Difficult Questions with Easy Answers
- Personal Income Taxation and the Struggle Against Inequality & Poverty – Tax policy and personal income taxation in South Africa since 1994
- The National Development Plan: 7 Critical Appraisals
- Green Economy: The Long Suicide – The different worlds of green jobs and climate jobs
- Wages, Profits &Unemployment in Post-Apartheid South Africa
- The State of Labour 20 Years After Democracy
- The Bermuda Connection: Profit shifting, inequality and unaffordability at Lonmin 1999-2012

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