

RESEARCH REPORT

AFRICAN PHOENIX RISING: RENEWABLE ENERGY PRODUCTION AND ENERGY SECURITY IN LOCAL GOVERNMENT – A CASE STUDY OF CAPE TOWN

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“Out of the ashes of a phoenix
A new African phoenix is born
As black and as famished as ever
Carrying the same loads of thorn
The same batches of infamy
Of disease, of wars, of hunger
The same scars in the horn
As politicians to each other whisper
Sweet lies; with no conscience to scorn
As they exhale and praises inhale over dinner
And more ranks to their siblings adorn
Africa stands aloof as distant as ever
As unique as an alien unicorn
Writhing in mounds of litter
Burdened, broken and outworn”¹



¹. Goth, Bashir African Phoenix Written, July 11, 2002, in response to the much touted birth of the African Union. Available at <http://www.poemhunter.com/poem/african-phoenix/>; Image Rochebrune from Deviant Art, 'African Phoenix,' May 2011. Available at <http://rochebrune.deviantart.com/art/African-Phoenix-202041231>

Introduction: A Note on Methodology

This report is a companion volume to Project 90 by 2030's Energy Smart Local Governance Report.² That work was in turn developed as a follow up to the Smart Electricity Planning report.³ The Smart Electricity Planning Report can be conceived of as a 'People's Budget' approach to electricity planning at a national level. It looked at aspects of the national Integrated Resource Plan, and proposed ways in which this major planning tool could be more climate-friendly as well as more socially just. When the Smart Electricity Planning report was presented to community organizations, one of the responses we received was that energy planning at a national level was too far away from ordinary people, who generally felt they had no say or insight into how planning was done and implemented. This struck us with stunning force, the more so since most of the electricity consumed in South Africa is distributed through municipalities. We accordingly decided to try and do some similar to the Smart Electricity Planning report but at local government level.

In its turn, the Energy Smart Local Governance Report is the outcome of three years spent working in eight communities in four provinces at local government level, looking at what the contours of energy supply and demand looked like to the people who used it. The work also extended to informing people on how to use renewable energy and energy efficiency technology to help address the problems of energy poverty we encountered. In the process we discovered that ostensibly 'pro-poor' energy policies often do not work like that on the ground. The reason for this is that too often energy planning is done in the absence of the people who pay for it and are the end users. We attempted to take a walk on the other side. It was a tremendous experience, rich in learnings and strong in solidarity with the wonderful people we met and had the privilege to work with. While the Energy Smart Local Governance Report focuses mainly on demand issues, sharing an understanding of how energy use works on the ground, this report looks more specifically at the planning and supply side. Also, while the Energy Smart Local Governance Report deals extensively with the problems encountered by impoverished citizens of local governments, this report seeks to propose just solutions in the context of global warming and climate change. In order to be able to do this in depth, we look at only one case study, the City of Cape Town. However, the analysis is informed by research in all the communities studied in the Energy Smart Local Governance Report.

² . Abrahams, Yvette, Thando Lukoko and Gray Mcguire Energy Smart Local Governance Report: Fast-tracking Our Transition to a Healthy, Modern, Affordable Electricity Supply For All Project 90 by 2030, Cape Town, 2017. Available at https://90by2030.org.za/wp-content/uploads/2017/10/EU-SMART-Report_final-version_website-ready_12Oct2017.pdf Last accessed May 2018.

³ Atkins, Peter and Brenda Martin (eds.) Smart Electricity Planning: Fast-tracking Our Transition to a Healthy, Modern, Affordable Electricity Supply For All Electricity Governance Initiative of South Africa, Claremont, 2013. Available at <https://90by2030.org.za/wp-content/uploads/2018/02/Smart-Electricity-Planning-March-2013.pdf> Last Accessed May 2018.

At the outset it should be explained that this research throughout considers the food/water/energy nexus as linked and partly interchangeable entities.⁴ To grasp this concept we can use food as embodied energy an entry point into the discussion. Plants are, after all, the best solar power collectors ever invented, with the efficiency of photosynthesis exceeding that of photovoltaics by an order of magnitude. This point becomes even more obvious when considering the concept of industrial farming, because under such a system food is indeed incorporated fossil fuel energy, using land and water to enable the incorporation. Thus, for instance, it is possible to conceive of a hamburger as being embodied energy of between 7.3-20 MJ.⁵ We could burn it and that way convert it back to energy. We could compost it and then use the energy provided by composting to produce another hamburger. Thus food/water/energy nexus analysis views the flows of these things in the landscape as interconnected. It makes no sense to analyze any one of them in isolation because that will lead to planning that is needlessly expensive and not very smart.

Currently, the dominant food production system is heavily energy intensive: “[o]n average in the U.S., about 2 kcal of fossil energy is invested to harvest 1 kcal of a crop.”⁶ This is incredibly wasteful and inefficient. This is because farming is practiced in the most energy-intensive way possible. Coal is mined and oil is imported (for most countries), used to drive tractors and machinery, and used in the production of fertilizers, herbicides and pesticides. Where necessary, fossil fuel energy is also used to produce the electricity which drives irrigation. Standardized uniform plant hybrids cover vast areas of land, consuming all these inputs and producing food. Not surprisingly, it has been estimated that worldwide, food production and distribution constitutes about one third of total energy consumption.⁷ If we could work out a way to produce food with less energy, therefore, we would immediately cut energy use and carbon emissions. This has been done, of course, and it has been estimated that converting to organic food production would cut fossil fuel energy consumption by anything from 31%-50%, depending on the crop.⁸ If combined with small-scale farming, where most of the work is done by hand, energy use could be reduced even further, while of course if the remaining energy used were produced through renewable methods carbon emissions from food production could be cut to very close to zero.

⁴ . Cf. Prasad, Gisela, Adrian Stone, Alison Hughes, and Theodor Stewart. *Towards The Development Of An Energy-Water-Food Security Nexus Based Modelling Framework As Policy And Planning Tool For South Africa*. In Strategies to Overcome Poverty and Inequality Conference, University of Cape Town, Cape Town. 2012; Baleta, Hannah and Guy Pegram *Water As An Input In The Food Value Chain Understanding the Food Energy Water Nexus*, WWF-SA, Stellenbosch, South Africa, 2014; Goga, Sumaya and Guy Pegram *Water, Energy And Food: A Review Of Integrated Planning In South Africa Understanding the Food Energy Water Nexus* WWF-SA, Stellenbosch, South Africa.

⁵ . Carlsson-Kanyama, Annika, and Mireille Faist Energy Use In The Food Sector: A Data Survey Swedish Environmental Protection Agency Stockholm, Sweden, 2000, pp. 12.

⁶ . Pimentel, David Impacts of Organic Farming on the Efficiency of Energy Use in Agriculture: An Organic Center State of Science Review, The Organic Centre, Ithaca, 2006, pp. 5.

⁷ . *Energy-Smart Food For People And Climate Issue Paper* UN Food And Agriculture Organization, Rome, 2011, pp. III.

⁸ . Pimentel Impacts of Organic Farming, pp. 34.

The reason why food production consumes so much energy at present is because commercial agricultural practices are essentially a method of mining the soil of humus. Trees are cut, soils are denuded of vegetation, and no compost or manure is returned to the land to replace the food which is taken. Essentially this is a linear model of farming, where the local ecology is reduced to little more than an open air food factory. The more the soil is depleted of humus, the more fertilizer is needed in order to get plants to grow well. Every year, instead of getting richer through natural processes of humus accumulation, the soil gets poorer. For instance, the loss of nutrients on South African soils amounted to about 14 kg nitrogen, phosphorous and potassium (NPK) per hectare per year in the 1990s. In other words, South Africa's farmers were taking almost twice as much nutrients out of the soil as they were putting in.⁹ Five hundred years of these practices have the effect of driving up the price of food. The poorer our soils get and the more expensive energy produced from fossil fuels becomes, the higher the price of food. If we liked we could convert the nutrients provided by food to energy equivalents, and that would give an indication of the extent to which the current economic system is mining finite energy as if the process could go on indefinitely. Obviously it cannot, and (as will be discussed in the next section) we are hitting the limits of this system round about now.

The same logic of interchangeability obviously applies to any form of energy, not just fossil fuels. Although this report looks at how to re-plan the energy supply system on Cape Town municipality, it does so in the context of food and water flows. Cities are here seen as entities where the three flows are interrelated and to some extent interchangeable. You need energy to clean and pump water. You need energy to distribute and cook food. Therefore, when looking at how to convert urban systems of production and consumption to reduce carbon emissions (and other environmental pollution), energy production and consumption has to be looked at in the context of the overall food/water/energy flows in any particular location. Energy planning cannot be done in the absence of some consideration of the other inputs and outputs. People, here, are viewed not just as consumers but as assets in restructuring system flows.

The Global Context

The world economy is slowly sinking into a shambles from which, despite occasional optimistic predictions from neo-classical economists, it does not appear that it will ever emerge. Explanations for this situation abound. The most convincing argument is simply that an economy which is based on indefinite growth is going to come a cropper sooner or later against material reality.

⁹ . Julio Henao and Baanante, Carlos “ Nutrient Depletion In The Agricultural Soils Of Africa” 20/20 Vision, International Food Policy Research Institute (IFPRI), 62, 1999, pp.2.

As stated by the economic advisor to President John Kennedy, Kenneth Boulding: "Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist."¹⁰ Wendell Berry put the same problem from an agro-ecological perspective when he said:

"We have allowed, and even justified as 'progress', a fundamental disconnection between money and food. And so we are led to the assumption, by ignorant leaders who apparently believe it, that if we have money we will have food, an assumption that is destructive of agriculture and food. It is a superstition just as wicked, and hardly different from, the notion that the world is conformable to our wants and we can be whatever we want to be."¹¹

In other words, a number of well-informed observers have suggested that our dominant economic theories have been concocted by people whose modes of thought are irrational and who, apparently, have convinced our political leaders to believe in what cannot be justified by observable fact. Therefore the current recession is not in itself something which needs to be explained. It was built into the current economic system and was bound to come sooner or later.¹² What really needs to be explained would be why this was a surprise to mainstream economic theorists and political decision-makers. At root our problem is a cognitive problem. Dominant discourse are not reflecting reality accurately and there are forming policy prescriptions, not just in the absence of the people who must suffer from bad policies, but also in the grip of a fundamental misunderstanding of what the real world looks like.

Though at first sight outrageous, this argument is substantiated when one compares the accuracy of economic forecasting to the science which tells us that unrestrained growth is a physical impossibility:

" ..the accuracy of past climate change forecasts from the IPCC [Inter-Governmental Panel on Climate Change] are comparable to some of the commonly used economic indicators in public policy, indicators that are published without criticism by newspapers and mainstream economic organisations. *In many cases, they have even outperformed them.* Uncertainty is not a real reason for the resistance to action on climate change.

¹⁰ . As cited in Schwartz, Judith Cows Save The Planet and Other Improbable Ways of Restoring Soil to Heal the Earth, Chelsea Green Publishing, White River Junction, Vermont, 2013, pp. 185. For the original zero growth theories cf: Schumacher, Ernst Fritz Small Is Beautiful: Economics As If People Mattered: 25 Years Later...With Commentaries Hartley & Marks Publishers, Vancouver, 1999; Illich, Ivan The Energy Crisis Energy and Equity Harper & Row, 1974. For reviews of more recent debates cf. Trainer, Ted The Radical Implications Of A Zero Growth Economy real-world economics review: a journal of the World Economics Association Issue no. 57, 6 September 2011, pps. 71-8; Wijkman, Ander and Johan Rockström Bankrupting Nature: Denying Our Planetary Boundaries, Routledge, New York, 2012.

¹¹ . Berry, Wendell Money Versus Goods in What Matters? Economics For a Renewed Commonwealth, Counterpoint, Berkeley, 2010, pp. 16.

¹² . For an extensive demonstration of this theory, see Satgar, Vishwas (ed.) The Climate Crisis South African and Global Democratic Eco-Socialist Alternatives Wits University Press, Johannesburg, 2018.

Rather, it is being used as cover for entrenched interests as our response to climate change requires significant system redesign."¹³

The proximate reason for the crisis has been considered to be, first, fossil fuel depletion. This argument can be summed up as the theory that new economically viable fossil reserves are not being developed as fast as the old are running out. The theory itself, though internally complex, is perfectly lucid. As cheap sources run out, the world prices of fossil fuels go up, this in turn plunges the world into recession, whereupon the price of fossil fuels fall to a point where new finds become uneconomic to extract.¹⁴ A more textbook prediction of what exactly is happening today could not be found.

Second, fossil fuel depletion has been exacerbated by the nature of finite resources, which is to be used up. The deeper extractors have to go to bring a resource to market, the more energy it costs per unit of resource. When this logic applies not only to the resource being mined, say gold, but also the energy itself, say coal, you have an economic crisis in the making. Sooner or later the cost of the amount of coal it takes to produce the energy needed to produce an ounce of gold is going to exceed the amount people are willing to pay for the gold. When this begins to occur system-wide, you have a crisis. Neo-classical economics does not have a theory which can deal with this eventuality. As an investment banker puts it:

"The quantity of capital that's being sucked in to keep the resource machine grinding is reducing the ability of the world to grow...The problem is, capitalism can't handle shortages. There is no economic model, according to the OECD, that takes the finiteness of resources into account. Economists just assume; they reach out and take what is necessary, simple supply and demand. But it just ain't so. We live in a finite world and we've got to start thinking about developing alternative models that recognise that that is the case."¹⁵

The outcome, at the level of implementation, is that we therefore do not have economic policies which speak to material reality.

The third and final causal factor behind the current economic crisis which deserves to be highlighted is that fact that by taking a finite resource from where it exists in the ecosystem (say, below ground), burning a small proportion of it and releasing the rest (say, into the atmosphere), the fossil fuel economy has set off a host of changes to the ecosystem which are proving to be costly in themselves.

¹³ . My italics. Carpenter, Griffin Model Behaviour: Comparing Climate Science With Economic Forecasts, New Economics Foundation, London, 2014, pp. 6. Available at http://b.3cdn.net/nefoundation/4123dfede3cc510b13_hym6bhfp2.pdf

¹⁴ . Heinberg, Richard The Oil Depletion Protocol: A Plan to Avert Oil Wars, Terrorism, and Economic Collapse, New Society Publishers, Gabriola Island, Canada, 2006.

¹⁵ . Grantham, Jeremy Living on a Finite Planet (Where Nobody Likes to Hear the Bad News), University of Cambridge Program For Sustainability Leadership, 2012, pp.2; Available at <http://www.cpsl.cam.ac.uk/Resources/Publications-and-Downloads.aspx>

This set of changes is commonly referred to as global warming or climate change. It should be noted that some analysts have argued that carbon emissions are not the sole causal factor and that rapid urbanization, as well as industrial agriculture, have caused key changes to water cycles which in themselves are contributing to extensive weather system change.¹⁶ Be that as it may, the effect of these cumulative changes to planetary weather systems has been an increase in what is known as extreme weather: more floods, more droughts, more intense hurricanes and typhoons, colder winters, hotter summers, and so on.¹⁷ The science of calculating exactly how much extreme weather costs the world economy is still in its infancy, not least because of the uncertainty surrounding the definition of what constitutes extreme weather. We know that it has increased in frequency in the aggregate, but because meteorology is a probabilistic science it cannot pinpoint any individual event as directly caused by climate change and therefore fails to provide a basis for econometric calculations. For the purposes of the argument this research is making, however, the exact costs are less important than the type of costs incurred. There are of course direct costs of overcoming a particular extreme event, humanitarian aid and so on, and these will be discussed at more length later since many of them fall upon local government. There are also consequences affecting the individual loss of private capital (houses, livestock, soil, human capital) which are likely to have greater impact in the global South where most livelihoods remain land-based. However, the key point being made here is the effect on the macro-economy in relation to macro-economic theory. Extreme weather is costly in the sense that productive capital is tied up replacing investments already made, whether such are infrastructural (roads, bridges, electricity power stations) or directly productive (buildings, equipment, etc). Very preliminary estimates consider this cost to be about 1 % of GDP:

“A value $f_{max} = 5\%$ means that the economy can mobilize about 1% of GDP per year for the reconstruction i.e. about 90 G\$ per year for EU- 15. This order of magnitude can be compared with other efforts diverting investments from productive activities such as the 1.2% of US GDP spent yearly for the Vietnam war and the 0.5% for the 1990-1991 war in Iraq. One per cent of GDP for a specific reconstruction activity thus represents a significant effort.”¹⁸

This capital is thus not available for new investments to grow the economy.

¹⁶ . Kravčík, Michal , Jan Pokorný, Juraj Kohutiar, Martin Kováč, and Eugen Tóth Water for the Recovery of the Climate - A New Water Paradigm Krupa Print, Žilina, Slovakia, 2007. Available at [http://www.waterparadigm.org/download/Water for the Recovery of the Climate A New Water Paradigm.pdf](http://www.waterparadigm.org/download/Water%20for%20the%20Recovery%20of%20the%20Climate%20A%20New%20Water%20Paradigm.pdf)

¹⁷ . Petoukhov, V., S. Rahmstorf, S. Petri, and H. J. Schellnhuber *Quasi-Resonant Amplification Of Planetary Waves And Recent Northern Hemisphere Weather Extremes*. Proceedings of the National Academy of Sciences, 110/14, 2013, pps. 5336-5341; Jisk J Attema, , Jessica M Loriaux and Geert Lenderink *Extreme Precipitation Response To Climate Perturbations In An Atmospheric Mesoscale Model* Environmental Research Letters 9.1, 2014: 014003. Available at: http://iopscience.iop.org/1748-9326/9/1/014003/pdf/1748-9326_9_1_014003.pdf

¹⁸ . Hallegatte, Stéphane, Jean-Charles Hourcade and Patrice Dumas. *Why Economic Dynamics Matter In Assessing Climate Change Damages: Illustration On Extreme Events*. Ecological Economics 62.2 , 2007, 330-340, pp. 337.

In this sense extreme weather can be seen to impose a 'tax' on the economy which drains money from new productive investments. Continued impact over the long term readily accounts for the economic slowdown.

However, the core problem is that macro-economic theory would measure the capital invested as part of GDP. From the point of view of financial theory, it does not matter whether the capital invested is used to replace an old bridge which got washed away or a new bridge. It still looks as if the economy is growing. Still, from the point of view of the real world finite economy, where there is only so much tar, lime, or ecosystems services available at a viable cost, it does matter. It is a matter of critical importance whether we are draining our real economy merely to replace what was there or whether we are using it to provide better for a growing population. In this sense extreme weather poses a challenge to conventional economic theory. The theory cannot measure what is actually happening. Worse, the theory makes it look like the economy is growing whereas in the real world it is barely keeping pace. If this is true than it means that the real growth rate has been somewhat overstated for as many years as extreme weather has grown in frequency. The third explanatory factor in the world economic slowdown can be seen to be marked by cognitive dissonance and a failure to predict what the theory has not been able to adequately perceive. We would consider this mental blind spot to be far more important in blocking our way out of the depression than any other factor, i.e. not just the failure of mainstream economic theory to adequately comprehend reality, but its very failure to understand its incomprehension.¹⁹

Let us return to our previous example of food. An economic science which recognized the finiteness of resources would recommend an agricultural system which does not use them up. The nutrients and plant mass which are used to produce one crop would be replaced before planting another one. Examples of such systems abound. In fact, it has been shown that because solar energy continues to be supplied to the earth, it is in fact possible to increase the level of nutrients from year to year in a regenerative organic agricultural system. As has been noted above, this would cut our fossil fuel use by 30%-50% and therefore our carbon emissions. Moreover, it is possible within this system to store carbon and in that way give us the time we need to overcome the climate crisis:

"On-farm soil carbon sequestration can potentially sequester all of our current annual global greenhouse gas emissions of roughly 52 gigatonnes of carbon dioxide equivalent (~52 GtCO₂e). Indeed, if sequestration rates attained by exemplar cases were achieved on crop and pastureland across the globe,

¹⁹ . Cf. also Wendell Berry "In agriculture, as in nature and culture, the more complex the system or structure (within the obvious biological and human limits), the more sound and durable it is likely to be. The present industrial system of agriculture is failing because it is too simple to provide even rudimentary methods of soil conservation, or to be capable of the restraints necessary for the survival of rural neighbourhoods, and because it fosters a mentality too simple to note these deficiencies." *Foreword* in [The Gift of Good Land: Further Essays Cultural And Agricultural](#), Counterpoint, Berkeley, 1981, pp. xi-xii.

regenerative agriculture could sequester more than our current annual carbon dioxide (CO₂) emissions. Even if modest assumptions about soil's carbon sequestration potential are made, regenerative agriculture can easily keep 6-7 annual emissions within the desirable lower end of the 41-47 GtCO₂e range by 2020, which is identified as necessary if we are to have a good chance of limiting warming to 1.5°C²⁰

In the meantime, it will be easier to survive the extreme weather because organic farming yields about one-third more crops in a drought than fossil fuel farming, because of all the humus in the soil.²¹ In other words, this is what is known as a win-win system. The technologies are there to produce more food while using less energy and stabilizing the world climate system. The problem is not that it cannot be done. The problem is that the economic science we use to plan our economies is not seeing this reality. Its analysis and theoretical tools operate as if the world's resources were unlimited and as if a linear production system does not produce externalities such as global warming. There is a cognitive dissonance (or a failure of the imagination) which is likely to keep us in crisis. The conclusion that politicians and policy-makers are acting in a state of cognitive dissonance is one which is becoming more and more widespread amongst informed observers.

"This very orthodox dependency on economic growth metrics, I'm absolutely persuaded that those are obscuring the reality of people's lives, obscuring the reality of what we're doing to the planet, and therefore leaving decision makers and their electorates in a state of total confusion and ignorance about the misery that we're doing to people on the planet. ... This is a political failure, a collective political failure on an unbelievable scale."²²

How does this intellectual psychosis and political blindness play out at local level? This paper looks at the City of Cape Town as an example where cognitive dissonance and political failure to interact constructively with material reality leads to an inability to solve problems in the food/water/energy nexus.

The critical point here is that the more time we waste living in denial of what is happening the longer it will take to come to solutions. We do not have infinite amounts of time:

"Given the fact that fossil fuels are limited in quantity and that we are already in view of the global oil production peak, we *must* turn to a food system that is less fuel-reliant, even if the process is problematic in many ways. Of course, the process will take time; it is a journey that will take place over decades. Nevertheless, it must begin soon, and it must begin with a comprehensive plan.

²⁰ . Rodale Institute [Regenerative Organic Agriculture and Climate Change: A Down-to-Earth Solution to Global Warming](http://rodaleinstitute.org/assets/WhitePaper.pdf) Rodale Institute, Kutztown Pennsylvania, 2014, pp.5-6. Available at <http://rodaleinstitute.org/assets/WhitePaper.pdf> Last Accessed May 2018.

²¹ . Rodale Institute [Regenerative Organic Agriculture and Climate Change](http://rodaleinstitute.org/assets/WhitePaper.pdf), pp.15.

²² . Jonathan Porritt, extracted from an interview conducted on 9 July 2008 by Dr Wayne Visser, Senior Associate, Cambridge Programme for Sustainability Leadership. Available at: <http://www.cpsl.cam.ac.uk/SearchResults.aspx?searchStr=zero%20growth>

The transition to a fossil-fuel-free food system does not constitute a distant utopian proposal. It is an unavoidable, immediate, and immense challenge that will call for unprecedented levels of creativity at all levels of society. ²³

Thus the theory that policy-makers in society are in what appears more and more to be a mass state of denial, aided and abetted by their economic advisors, is instructive. Cape Town is a prime example of this theory in action. Therefore this research report cannot merely be about finding technical solutions. Such are available, proven and demonstrated. It must be about creating the political will to make such solutions happen. From an energy perspective the problem statement is clear. As Wes Jackson has put it:

“Isn’t it time we began figuring out a way to earn a living and amuse ourselves cheaply, which is to say with the least expense to our life-support system? The binge the developed world has enjoyed is about over. It’s time to find our way home and use what little time is left for partial redemption of this prodigal generation.”²⁴

The first step in unleashing creativity for system change must surely be to take off the rose-coloured glasses. There is no business as usual. The party is over. From the point of view of the ecology, it is time to wash the glasses, clean up the ash trays and mop the spilled wine off the carpet. No good can come of leaving the necessary work until tomorrow. We owe coming generations at least that much.

The South African Context

The South African economy has been singularly ill-placed to withstand the global downturn. The implementation of the Growth, Equity and Redistribution (GEAR) strategy as from 1997 meant not only that the country developed a pattern of jobless growth which created a very narrow productive base for the economy, but that South Africa completed a dependence on global trade at the very time that global trade fell by some 29 %.²⁵ The effects on the South African economy were far-reaching. Unemployment rose sharply in the first few years after 2008, and although total employment is now slowly recovering to 2007 levels, total unemployment has continued to rise because of the growth in population. Of particular concern has been the sharp rise in discouraged job seekers who have exited the formal labour market.²⁶

²³ . Heinberg, Richard *What Will We Eat as the Oil Runs Out? The Lady Eve Balfour Lecture*, November 22, 2007.

Available at <http://richardheinberg.com/188-what-will-we-eat-as-the-oil-runs-out>

²⁴ Jackson, Wesley *Homecoming* in *Nature As Measure: The Selected Essays of Wes Jackson*. Counterpoint, Berkeley, 2011, pp. 38.

²⁵ . Eaton, Jonathan, Samuel Kortum, Brent Neiman, and John Romalis *Trade And The Global Recession*. No. w16666. National Bureau of Economic Research, 2011.

²⁶ . Padayachee, Vishnu *Global Economic Recession: Effects And Implications For South Africa At A Time Of Political Challenges* *Claves de la Economia Mundial*, 2012. Available at <http://www.lse.ac.uk/internationalDevelopment/20thAnniversaryConference/ImpactoftheGlobalFC.pdf>

Many have warned of the ticking time bomb represented by growing numbers of young people who are not only unemployed but unemployable in an economy hopelessly ill-suited to their capacities, and who have given up all hope of ever finding a formal-sector job.²⁷

Of fundamental importance to the discussion in the previous section is the fact that the South African economy has inherited from *apartheid* an economy which is fundamentally extractive. The finite resources which are economically viable have since 1872 been largely extracted. Mining as a share of the economy has contracted by some 7 % since 1994, despite the fact that real GDP during the same period grew by 77 %.²⁸ Another way of putting it is that mining's contribution to GDP growth has been weakly negative during this period, a mere -0.03 %.²⁹ Grantham's energy conundrum, that is, the fact that it takes more energy to mine deeper as more accessible deposits have become mined out, has to at some point reach its logical conclusion. It is not unreasonable to suggest that, with eight of the ten deepest mines in the world being in South Africa, we are there now.³⁰ The fact that mining's contribution to the economy has never really recovered from its 2008 lows can only partially be blamed on continuing low global commodity prices. The other part of the explanation is that many mines truly have reached the end of their useful life, and are being run only to recover what can be recovered of their capital investment.³¹ Yet at the very moment when positive action is required to fundamentally re-structure the country's economy away from a dependence on finite resources, the state has revealed a complete failure of the imagination. Its solutions can best be characterized as more of the same approach which led us to this place.³²

In South Africa this structural crisis has taken the form of a battle over energy. In South Africa, where electricity is defined as a public good and produced by a state-owned monopoly, the question of the state's ability to function becomes particularly important. With public goods, economically rational decisions about production, consumption and pricing are supposed to be made through a process of democratic governance. When an elite has captured the state, however, the risk is great that decisions made will be neither rational nor democratic. In fact, the role of the state in relation to energy can best be characterized as elite capture. The historical decisions made by ESKOM are a case in point.

²⁷ . Lefko-Everett, Kate *Ticking Time Bomb Or Demographic Dividend? Youth and Reconciliation in South Africa: SA Reconciliation Barometer Survey: 2012 Report*. 2012.

²⁸ . Department of Research and Information *South African Economy: An Overview of Key Trends since 1994*, Industrial Development Corporation, Pretoria, 2013, pps. 1 and 13.

²⁹ . *Ibid.*, pp. 7.

³⁰ . *The Top Ten Deepest Mines in The World Mining Technology* 11 September, 2013. Available at <http://www.mining-technology.com/features/feature-top-ten-deepest-mines-world-south-africa/>

³¹ . A fact conceded even by anti-environmentalists. Cg. eg. Turton, Anthony *The Drivers of the South African Mine Conflict* 9 January, 2014 *The Broker: Connecting Worlds of Knowledge*. Available at <http://www.thebrokeronline.eu/Blogs/Power-dynamics-and-natural-resources/The-drivers-of-the-South-African-mine-conflict>

³² . Cf. eg. National Planning Commission *National Development Plan*, The Presidency, Pretoria, 2012. Available at <http://www.gov.za/issues/national-development-plan-2030>

First, there was the scandal that a private company, BHP Billiton, was receiving a subsidy for their energy purchases which left them paying less for electricity than most poor households. Coincidentally, shares are held in this company by Bridgette Radebe, wife of the Minister of Justice and sister to Patrice Motsepe, one of the nations' largest new industrialists with huge interests in coal.³³ BHP Billiton also employs the former Minister of Finance, Derek Keys in a top post. Be that as it may, after being successfully sued by the opposition party to release the precise details of this subsidy, Eskom's then CFO finally released a statement saying that it would amount to about R 5.5 billion for the remainder of the contract. The newspaper Business Day remarked:

"A few days ago Paul O'Flaherty (Eskom's chief financial officer) treated the nation to a lesson in modern arithmetic when he announced that the residual seven to eight years of the BHP Billiton "contract" would result in an accumulated loss to Eskom of R5.5 billion. Based on an ex-generator delivery of 2000 megawatts, that represents a loss of something over 4c per kilowatt hour while Eskom's present unit cost of production is declared at some 50c/kWh. To believe this is akin to O'Flaherty's belief in leprechauns as the arithmetic is based on some wondrous crystal ball-gazing to estimate the future aluminium price, rand/dollar exchange rates, and world price of coal."³⁴

The choice of continued heavy dependence on coal for energy production was made in a context where a R40-billion contract for boilers at the Medupi and Kusile coal power stations were awarded to Hitachi Power Africa, in which Chancellor House (the investment arm of the ruling party) had a 25% shareholding. Moreover, a R2-billion contract from Eskom for materials-handling at the new Kusile coal power station was awarded to engineering company Bateman Africa, in which Chancellor House has a 10% stake.³⁵ These two new plants were to have been funded by a World Bank loan. After much agitation from civil society, the World Bank subsequently decided to not grant the portion of the loan which was intended for the compromised contracts citing, amongst other reasons, non-compliance with WB procurement rules.³⁶ A more expensive loan was subsequently raised from the African Development Bank. Of course, both the ruling party and the state monopoly stated that the procurement process was above reproach.

The deeper issue of whether the (at times) rather rabid insistence on coal production choices during the nation's energy planning process, the Integrated Resource Plan II (IRPII) of 2010-2011, was completely unconnected to the fact that the ANC and many of its members stood to benefit from coal-fired electricity will probably never be clear. Suffice it say that if the 'democratic process' was intended to replace the market in making

³³ . . <http://www.amandlapublishers.co.za/amandla-magazine/current-issue/1592-our-wealth-our-poison--by-amandla-correspondents>

³⁴ . http://www.iol.co.za/business/business-news/eskom-deal-with-bhp-billiton-akin-to-power-theft-1.1421070#.UK4AyYfNZ_U

³⁵ . Although these shares have subsequently been sold, it could be argued that future profit flows were incorporated into the share price. Cf. Institute For Security Studies: *SA Democracy Incorporated: Corporate Fronts and Political Party Funding* , Cape Town, 2006. Available at <http://www.issafrica.org/pgcontent.php?UID=20503>

³⁶ . Cf. <http://mg.co.za/article/2012-07-27-00-ancs-chancellor-house-lands-new-deal>

economically and ecologically rational choices about electricity production, it has been doing a spectacularly bad job.

Currently, the electricity parastatal can best be described as having reached a state of permanent crisis due to the decision to continue to rely on a finite fossil fuel. It has been unable to complete the two coal power stations as planned, and allegations of the extent to which cronyism and nepotism have played a role in this inability to do its job are almost contemporaneous with the project itself.³⁷ The delay in completion has cost Eskom somewhere around R 257 billion in inflationary cost escalations, interest payments on the ADB loan, and coal contracts which bound the utility to purchase a certain amount of coal, whether or not the power stations could use them.³⁸ This has led to the first of what is bound to be many Treasury bailouts. While evidence abounds of the massive lack of governance and the prevalence of corruption in Eskom, this has been cast as the failure of the political system rather than its logical conclusion.³⁹ Replacing the board and letting a few heads roll has so far done little in resolving the *structural* problem that, although we have plenty of coal reserves, they are becoming so expensive to extract that they are ceasing to become an economic resource. The issue is not how much coal is there. The issue is that it cannot be brought to market at a price of electricity the average South African can afford.

A related issue of course is that climate destabilization caused by burning all the coal is causing its own problems. Thus even when Medupi and Kusile are completely commissioned they are unlikely to be able to run at full capacity because the increasing frequency of droughts means they will not have enough water.⁴⁰ This is something Eskom was told during the 'consultation' process for IRP II. Its scientists insisted water was not a problem.⁴¹ Besides being another excellent example of the food/water/energy nexus, this is also a demonstration of the cognitive dissonance which rules economic planning. The water shortage problem was easily foreseeable, but because economic science does not have tools to understand shortages the plants got built anyway.

³⁷ . National Union of Metalworkers Memorandum Re : Appalling Working Conditions & Deteriorating Working Conditions Within The Medupi Project 19 October 2012. Available at <http://www.numsa.org.za/article/numsa-memorandum-of-demands-to-eskom-and-department-of-labour-on-the-appalling-and-deteriorating-working-conditions-and-within-medupi-2012-10-19/>

³⁸ . Steyn, Lisa *Eskom's Black Hole* Mail and Guardian 6 February, 2015. Available at <http://mg.co.za/article/2015-02-05-sinking-into-eskoms-black-hole>

³⁹ . Public Protector State Of Capture: Report on an Investigation Into Alleged Improper and Unethical Conduct by the President and Other State Functionaries..., Office of the Public Protector, Pretoria, No. 6 of 2016/2017, 2016. Available at http://www.pprotect.org/sites/default/files/legislation_report/State_Capture_14October2016.pdf Last accessed May 2018.

⁴⁰ Schneider, Keith *Kusile, Medupi Conceived In 20th Century, Struggling In Water-Scarce 21st* Fin 24/City Press May 18, 2016. <https://www.fin24.com/Economy/Eskom/kusile-medupi-conceived-in-20th-century-struggling-in-water-scarce-21st-20160318> Last accessed May 2018.

⁴¹ Naidoo, Brindaveni *No Water Worries for Medupi* Engineering News, 14 May 2010. Available at <http://www.engineeringnews.co.za/article/medupi-power-station-has-enough-water-supply-2010-05-14> Last accessed May 2018.

In short, they have been a colossal waste of money with very little to show for it except political failure to understand that the linear economy is reaching its logical conclusion: the end of the line.

In the meantime, observers continue to ask what all this additional energy is supposed to be for? With the world economy continuing to falter, newer estimates of energy consumption have reduced the amount of electricity we should be planning for.⁴² However, post-2008 estimates, even where they are made by the Department of Energy, have not influenced energy planning in the least. The problem of non-implementation has been accompanied by a complete failure to develop energy policy as required by South African law and the Constitution, leaving us with an outdated energy plan.⁴³ Elite capture, implementation failure and policy drift are strong indications that the South African state is approaching 'failed state' status (or at least 'very, very ineffective state'). Even if the government had the creative imagination to deal with the cognitive leaps required, it is not in a position to meet the structural economic challenges with any degree of cohesive response. It cannot even do what it has said it is going to do in respect of supporting the fossil fuel economy. Thus, the chances that the current system of government would be able to support system change towards a more sustainable economy are remote.

The Local Government Context

From a systems perspective it is clear that the problem to be solved at local government level is about re-planning the entire system. Restructuring electricity supply and consumption on its own would be of little use if total energy flows at local government level are destructive to the economy. As Deelstra and Girardet have argued:

"The linear metabolic system of most contemporary cities is unsustainable. It is profoundly different from the metabolism of nature's own ecosystems, which could be likened to a large circle: every output by an organism is also an input, which renews and sustains the whole living environment... On a predominantly urban planet, cities need to adopt circular metabolic systems to assure their own sustainability and the long-term viability of the environments on which they depend."⁴⁴

If this is true of South Africa's cities then it should not be surprising that the analysis of the national state in the previous section applies with yet more force to local government.

⁴² . Creamer, Terence *IRP Update Cuts Energy Demand, Suggests Nuclear Decision Be Delayed* Engineering News, 3 December, 2013. Available at http://www.engineeringnews.co.za/article/irp-update-cuts-demand-outlook-suggests-nuclear-decision-be-delayed-2013-12-03/rep_id:3182

⁴³ . Khambule, Happy Complaint To Public Protector: 7/2 -007205/15 Energy Governance South Africa, Cape Town, 2014

⁴⁴ . Deelstra, Tjeerd and Herbert Girardet *Urban Agriculture and Sustainable Cities* in Bakker, Nico, Mariëlle Dubbeling, Sabine Gündel, Ulrich Sabel-Koschella and Henk de Zeeuw (eds.) Growing Cities, Growing Food: Urban Agriculture on the Policy Agenda, Deutsche Stiftung für Internationale Entwicklung, Feldafing Germany, 2000, pp. 51.

Local government is a critical sphere of government, being widely viewed as the level of government most accessible to the people. Yet its linear functioning means it has reached the limits of its sustainability,

That the view of local government as the sphere closest to the people is shared by communities themselves is evident from a workshop held in Cape Town which is the inception of the current research.⁴⁵ At the launch of the EGI report Smart Electricity Planning⁴⁶ the feedback from community members present was that they found centralized national planning too far away from their daily reality, and difficult to deal with. Although they approved of the ideas and suggestions made in Smart Electricity Planning, they felt that governance was difficult to exercise when plans were made at such a distant level. They expressed a strong desire for more localized planning which would not require such an extensive knowledge transfer, after all, they were the experts on their own energy needs. This would also allow them to exert more influence over electricity planning since local government was seen as more accessible. The desire of people to bring electricity governance closer to where they are situated has been confirmed from several studies.⁴⁷ In addition, since the electricity price increases have risen over 150 % in the last ten years, while regular power cuts have become a normalized feature of life, electricity has become a heated political issue. The system of subsidizing local government work through electricity sales has meant that in some areas end-user prices have vastly exceeded Eskom tariff increases. The precise effect is difficult to measure due to variations in municipal tariff systems. Nevertheless, the poor are becoming increasingly aware that poor electricity planning results in higher prices for them, and that the only way to remedy this situation is to participate actively in governance processes.

There are some challenges to a local approach to energy planning, not least that some 40% of municipal taxes are raised through electricity levies which gives municipalities a financial motive for increasing electricity consumption in cases where energy efficiency might make more sense, and proposing constructive options through which local governments can finance service delivery. In the 2014-2015 financial year the Minister of Local Government remarked:

“We welcome the fact that 198 (58%) of all 335 municipalities and municipal entities received unqualified audit opinions for their financial statements. This is up from 165 (49%) last year. For municipalities, 148 (53%) now have unqualified audits - up from

⁴⁵ . Launch of the Electricity Governance Initiative South Africa Report SMART Electricity: Fast-Tracking Our Transition To A Healthy, Modern, Affordable Electricity Supply For All on the 8:th May, 2013.

⁴⁶ . Atkins, Peter and Brenda Martin (eds.) Smart Electricity Planning , 2013 *op cit*.

⁴⁷ . Cf. Abrahams, Yvette “*It Is Just Like Apartheid*” : Energy And Governance From The Ground Up Energy Caucus 2013, Project 90 by 2030, Cape Town, 31 July, 2013; Adam, Ferriall Free Basic Electricity: A Better Life For All Earthlife Africa Johannesburg, Braamfontein, 2010,; Hallowes, David Talking Energy: Part One Of The People’s Power Series groundwork, Pietermaritzburg, 2013.

120 (43%) last year. Auditees with financially unqualified opinions now account for 76% of the total local government expenditure budget of R315 billion.”⁴⁸

That this result is a marked improvement on previous years can only be a dismal indictment of local government administrations. If there is a huge capacity-failure at national level, local government can only be said to suffer from the same problem but worse.

A second telling example is perhaps the gradual collapse of sewerage systems in local government. Thus the Department of Water and Sanitation stated that almost 50 % of the country’s 824 sewerage works are either in a critical state or poor, meaning they release more than half the sewerage received back into the ecosystem in an untreated state.⁴⁹ The Department itself acknowledges that this is a systems crisis.⁵⁰ However, more telling for our purposes is probably the fact that the Department has since refused to release the results of its monitoring. An unnamed provincial Water and Sanitation official was quoted as saying that by not releasing the data: “..the government ensured people had little chance of knowing what was polluting their water. ‘You would be crazy as government to hand over something so damning’ said the official.”⁵¹ The Department has refused to comment. Be that as it may, when the state ceases to monitor (for whatever reason) and/or communicate its findings to the electorate, it is a strong sign of system failure.

This response becomes even more problematic when it is seen in the context of the responsibilities given to local government in respect of system change. The National Climate Change Response Policy (NCCRP) acknowledges that local government is the key to any form of adaptation⁵²:

“In addition to a refinement of top-down approaches, developing more detailed bottom-up approaches informed by the responses of local communities and local

⁴⁸ . Gordhan, Pravin COGTA: The Consolidated General Audit Outcomes Of Local Government For 2013/14 Department of Co-operative Governance and Traditional Affairs, Pretoria, 2015. Available at <http://www.polity.org.za/article/cogta-the-consolidated-general-audit-outcomes-of-local-government-for-201314-2015-06-03> Last accessed May 2018.

⁴⁹ . Directorate: Waste Water Services Regulation Executive Summary For the 2013 Green Drop Report Department of Water and Sanitation, Pretoria, 2014, pp. 2. Available at https://www.dwa.gov.za/dir_ws/GDS/Docs/DocsDefault.aspx Last accessed April 2018.

⁵⁰ . Ibid., pp.3.

⁵¹ . Kings, Siphon Politics Results in Filthy Water Mail and Guardian 7-13 August, 2015, pp. 13.

⁵² . Contrary to the NCCRP we hold the view that adaptation is probably not possible except within very narrow limits (i.e. not beyond + 1 °C) because of the fragility of the current human socio-political ecosystem, and therefore consider the best form of adaptation to be mitigation. Cf. *Abrahams, Yvette Stop Complaining About The Price Of Bread! Start A Bakery!": Colonial Patriarchy As the Cause Of Current High Food Prices*, in Koen, Karen (ed.) Proceedings of GETNET Feminist Consultative Conference On Women and Socially Excluded Groups Bearing The Social Costs of The Economic And Social Crisis, Gender And Education Training Network, Athlone, 2009. Available at www.khoelife.com . Last Accessed March 2018.

government will deliver results with a higher degree of confidence than is currently possible.”⁵³

Moreover it is understood that local government is key to not just to electricity planning but to the system change which regulates energy flows:

“Local government plays a crucial role in building climate resilience through planning human settlements and urban development; the provision of municipal infrastructure and services; water and energy demand management; and local disaster response, amongst others. Climate change considerations and constraints will be integrated into municipal development planning tools such as Integrated Development Plans, and municipal service delivery programmes.”⁵⁴

At the same time it is recognized that local government may not have the capacity to implement the measures required of it, and that, moreover, the mandate bestowed upon it by the NCCRP is essentially an unfunded mandate (a point made forcefully by the South African Local Government Association (SALGA) during the NCCRP hearings. Thus the policy provides that:

“At the same time the mandate for local government to take on various specific climate change-related issues is not always clear, and it may be useful to assign specific powers for mitigation and adaptation actions such as coastal management, infrastructure management and natural resource stewardship, some of which fall within the jurisdictions of other spheres of government. A critical review of the policy and legislation relating to local government functions and powers with respect to climate change is required. The Department of Cooperative Governance and Traditional Affairs will lead such a process.”⁵⁵

However, a recent review of the NCCRP could not discover that any such process had been initiated. In fact, the review concluded that:

“The over-all approach of ‘mainstreaming’ as the means of pursuing policy objectives has achieved limited traction across government at the national level, or with local government beyond a few exceptions, such as eThekweni Municipality and the City of Cape Town.

⁵³. Hereinafter referred to as NCCRP National Climate Change Response Policy, Department of Environmental Affairs, Pretoria, 2011. Available at http://www.gov.za/sites/www.gov.za/files/national_climatechange_response_whitepaper_0.pdf . Last accessed April 2018.

⁵⁴ . NCCRP, pp. 38.

⁵⁵ . Ibid..

The absence of an explicitly strengthened mandate and institutional arrangements for driving implementation severely undermines the potential for the lead department to deliver, exacerbated by lack of dedicated resources. Heavy dependence on donor funding, including for the most fundamental research, analysis and systems development, is both symptomatic of and a contributory factor to significant implementation short-falls.”⁵⁶

In other words, we are justified in assuming that the severe system failures at national level negatively affect the ability of the system to function at local level. At the same time, particularly in view of our analytical focus on local government as a food/water/energy nexus, system change must be what is required. From the point of view of the nexus, energy flows as they relate to the human ecosystem at local level all need to be re-planned. At worst, one can tinker with the system we have at present where nothing really functions. At best, the slow breakdown of the current system may be viewed as an opportunity. Like biogas, it is an opportunity to turn something really foul-smelling into something fertile and life-giving.

⁵⁶ . Worthington, Richard Report on a Review of Implementation of South Africa’s National Climate Change Response White Paper (NCCRWP), Project 90 By 2030, Cape Town, 2014, pp. 24. Available at: http://www.90by2030.org.za/oid%5Cdownloads%5C5%5C135_4_7_09_03_AM_FINAL%20Report%20on%20Implementation%20of%20the%20NCCRWP%20to%20print.pdf

A Cape Town Case Study

Transitional justice in relation to climate change opens up new possibilities. In working with local government energy planning, one thing became abundantly clear. Every local government is different. It is not possible, as with national planning, to think of a 'one size fits all' approach. We found ourselves during the three years of the project having to make recommendations for eight different sets of circumstance. Therefore this section focuses on one municipality. However, what is important is our approach. We sought to develop a methodology in the context of this case study which can be applicable to other municipalities.

To begin understanding that the planning work is going to be specific to a particular local government is a cognitive change which fits in very well with the potential of renewable energy. Renewable energy is more like organic and permaculture farming than fossil fuel energy, in the sense that because it gets its power from natural forces – sun, wind, water – one has to be aware of the seasons, the microclimate, local conditions and so on as an important factor in the planning. It is not a big step from there to also take the local human ecology into account, and work on creatively managing the human/technology interface in such a way that many functions are stacked at the same time. _Any permaculture manual tells you to start with a good plan. Armed with good intentions, we began by investigating the kind of data that would be needed for energy planning at local government level. The Guide to the Community Strategic Energy Planning⁵⁷ document proposes that the following data be collected for the purpose of developing an energy profile:

"An energy profile maps out a jurisdiction's present energy landscape, including:

- Current and projected future energy use and supply data;
- An inventory of existing energy-related activities, projects, programs, and policies; and
- Information on available human and organizational resources to help implement a CESP".⁵⁸

These steps are useful because:

"...you need to know where you are. The goals, strategies, and actions to be identified in later steps will be most effective if they are informed by and built on current energy use data and the existing organizational and policy framework. This will ensure that the plan is focused on true gaps and/or needs and that the actions identified are attainable. The current situation will also serve as the baseline for measuring future progress."⁵⁹

⁵⁷ . US Department of Energy and Vermont Energy Investment Corporation Guide to the Community Strategic Energy Planning, Washington, 2013; hereinafter Guide. Available at http://energy.gov/sites/prod/files/2014/05/f15/cesp_guide.pdf Last accessed 1/7/ 2016.

⁵⁸ . Guide, pp. 4.2.

⁵⁹ . Guide, pp. 4.2.

As examples of the kind of data that should be required, the Guide offers the following instances:

“High-level Information – Government Buildings..

Metric	Electricity	Natural Gas	Heating Oil	Propane/Other (Wood, etc.)
Cost	\$/Yr	\$/Yr	\$/Yr	\$/Yr
Energy Use	kWh/Yr	Therms/Yr	Gallons/Yr	Gallons/Yr
Conversion	Convert to MMBtu	Convert to MMBtu	Convert to MMBtu	Convert to MMBtu
Building Area	Total sq ft	Total sq ft	Total sq ft	Total sq ft
Standardized Use	MMBtu/sq ft	MMBtu/sq ft	MMBtu/sq ft	MMBtu/sq ft
Standardized Cost	\$/sq ft	\$/sq ft	\$/sq ft	\$/sq ft ⁶⁰

Further to this step the Guide recommends that one do a similar exercise for other aspects of municipal consumption. For instance, it proposes that one calculates:

“High-level Information – Other Government Facilities and Infrastructure (Wastewater, Streetlights, Landfill, etc.)

Ask the D[e]partment of P[ublic] W[orks] Manager what other functions the local government has that consume energy resources, such as wastewater, streetlights, landfills, etc...

Collect the same information as for buildings – calculate energy use per facility or department. ⁶¹

The Guide goes on to suggest that similar data be gathered for the municipal fleet of vehicles, for different types of buildings within the municipality (residential, commercial, state-owned, etc), and for broader community transportation.

⁶⁰ . Guide , pp. 4.3.

⁶¹ Guide, pp. 4.4.

Moreover, planners are advised to do so for as many previous years as possible so that they have an idea of trends over time. Now, while it may be just about possible to collect this level of data for larger municipalities it is not possible to collect them for smaller municipalities. This is probably a common situation in developing countries, and would prove a barrier to energy scenario planning if it were the case that this level of data-collection is the only way to go about it. We failed utterly to collect them for City of Cape Town. This is not because the data is not collectable, but because one first would have had to persuade decision-makers that such an exercise would be useful. This is extremely hard to do without a persuasive data set. It is a chicken and egg situation: you have to have a good case to be able to motivate even larger municipalities to spend resources on the data collection, but it is difficult to construct this case without the data. The human/technology interface fails because of the reality of human ecology. Cape Town municipality turned out to be a good example of the vagaries of power in a failing system: officials said we needed political will to make it work, it would have required resources far beyond what we were able to muster to generate such political will. It is not that the knowledge required is not there. It is that the power to collate the necessary data resided in many different places in the municipality and could not cohere sufficiently to achieve the cognitive transformation required.

We then tried an alternative approach. We started to look at what kind of data is available for municipalities and exploring what kind of scenario planning is possible using what data is available. This could be termed the permaculture approach to energy planning: use what is there and do the best you can with what you have.

An alternative approach is laid out in the Sustainable Urban Energy Planning: A Handbook for Cities and Towns in Developing Countries⁶², which suggests that rather than look at the supply side of energy planning, one looks at the demand side. In other words, one consults with people to find out how much energy they need, and then goes about planning how to produce this energy:

“This is because energy service needs do not necessarily need to be met with a supply of energy. Take for instance the need for a warm house in winter or a cool house in summer – this can be met by installing a ceiling and insulation or by overall energy-efficient design for new build; the need for hot water can be met by installing solar water heaters.

⁶² . Ward, Sarah and Mahomed, Leila Sustainable Urban Energy Planning: A Handbook for Cities and Towns in Developing Countries, UN-Habitat and ICLEI, Nairobi, 2009.
http://www.unep.org/urban_environment/PDFs/Sustainable_Energy_Handbook.pdf Last accessed 12/9/ 2016.

A supply-led regime would just assume that the household could use electricity for heating or make some other plan from the energy sources available. A demand-led approach would also plan at a much more local scale and try to create closed/no waste systems.”⁶³

This is an innovative approach, however, it comes up once more against the problem that local governments are structured by relations of power. Finding out how much the poor (for instance) would need is not the same as ensuring those needs are met. There exists a suppressed demand for energy in poor communities which future energy planning must take into account – at least is if is to be serious about social justice and job creation. Otherwise the energy needs of those who can afford to pay will become more important than those who cannot.

It is significant that the energy scenario document drawn up for Cape Town looks at energy demand in highly unequal terms.⁶⁴ The scenario is a very well-researched effort, many years in the making. Still, it is worth noting, in the light of our earlier observations around resource constraints and municipal capacity, that even in one of the richest cities in Africa, it required donor funding from two countries to enable this document to be drawn up. It is also interesting to see that the poor and marginalized are mentioned in the document as passive recipients rather than as actors. Thus among necessary steps to implement these scenarios are: “Further analysis of the implications of a growing poor population on the city’s ability to provide basic services and the longer-term impact of this trend on city coffers.”⁶⁵ There is no discussion of how these poor or going to cease being poor through socially just energy policy. Energy production becomes something which is done ‘for’ them, rather than something which they do. What this approach struggles to deal with are issues around implementation, monitoring and evaluation. Ignoring relations of power begs the question *‘who’* is going to ensure that implementation occurs according to plan? Obviously if the poor – being the majority of any municipality – are objects rather than subjects of the scenario, then there is no powerful interest group driving implementation. Instead, success of the scenario becomes dependent on sympathetic ‘drivers’ within the City. While these are a treasure to any work, they cannot be a substitute for a strong organized push for change from the side of voters. But if we were to tell the poor that our scenario assumes that they will stay poor and permanently in need of help, it is unlikely to receive wide public support. Therefore the relationship between social justice and implementation is an intimate and necessary one.

⁶³ . Ward and Mahomed *Sustainable Urban Energy Planning*, pp. 13.

⁶⁴ . Energy Research Unit, University of Cape Town and Sustainable Energy Africa *Energy Scenarios For Cape Town: Exploring The Implications Of Different Energy Futures For The City Up To 2050*, City of Cape Town , Cape Town, 2011. Available at https://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Documents/Energy_Scenarios_for_CT_to_2050_2011-08.pdf . Last accessed 20 August, 2016.

⁶⁵ . *Energy Scenarios For Cape Town*, pp. 3.

Scenario-planning cannot be done by a group of experts 'for' people.

Incidentally, it is interesting that the Sustainable Urban Energy Planning emphasizes public participation, but no signs of it are evident in the Energy Scenarios For Cape Town.⁶⁶ It is in this regard that Project 90's approach, which begins by working with communities and through participatory narratives gaining some idea of what constitutes suppressed demand works to construct scenarios with, rather than for, poor voters.

As such it should not be surprising that, though the energy efficiency measures are interesting, both savings and supply options in the 2011 Scenario are relatively conservative. For instance, it is suggested that transport efficiencies be achieved by improving public transport vehicle efficiency.⁶⁷ Were one to ask the poor, however, it is likely that an improvement in the passenger rail system would be the measure in greatest demand.⁶⁸ While strictly speaking, Metrorail may fall under the national, rather than the local government level, an energy planning scenario could include plans for the City to advocate and lobby of better rail services would do more both for energy efficiency and empowerment of working class people.

⁶⁶ . Ward and Mahomed Sustainable Urban Energy Planning, pp. 27.

⁶⁷ . Energy Scenarios For Cape Town, pp. 16.

⁶⁸ . Cf. eg. Rail Commuters Action Group v Transnet Ltd t/a Metrorail (CCT 56/03) [2004] ZACC 20; 2005 (2) SA 359 (CC); 2005 (4) BCLR 301 (CC) (26 November 2004). Available at: <http://www.saflii.org/za/cases/ZACC/2004/20.html>
Last accessed 21 July, 2016.
<http://www.fin24.com/Economy/Labour/News/thousands-of-cosatu-workers-to-protest-in-cape-town-20160621>
<http://www.iol.co.za/news/south-africa/western-cape/thousands-to-take-part-in-protest-against-metrorail-2036855>
<http://www.bdlive.co.za/national/labour/2016/04/07/metrorail-protesters-ignore-interdict-and-gather-at-train-station-in-cape-town>

Similarly, energy supply options are surprisingly conservative, as may be seen below.

“Table 3: The Electricity Supply Mix for Optimum Energy Future

Electricity Supply	2020 (%)	2050 (%)
Municipal Waste	1%	3%
Solar Thermal Electricity	0%	8%
Wind	9%	26%
New Nuclear	2%	9%
New Fossil Base (coal)	4%	48%
New Gas Turbines (Peak)	2%	4%
Existing Hydro	2%	2%
Existing Gas Turbines (Peak)	3%	0%
Existing Fossil Base (coal)	75%	0%
Existing Nuclear	2%	0% ⁶⁹

No doubt this conservatism is related to simply extrapolating percentages from the national Integrated Resource Plan II, however, it is strange that extremely little importance is attached to the possibilities of the local power generation. Because if the national level was to determine the local, then there would be little point in constructing local energy scenarios.

The devil, however, is as always in the detail. One of the biggest problems with the Energy Scenarios For Cape Town is that it does not appear to have been taken up in the City’s main planning document, the Integrated Development Plan⁷⁰. This though the IDP was developed shortly after the completion of the Scenarios.

⁶⁹ . Energy Scenarios For Cape Town, pp. 17.

⁷⁰ . City Of Cape Town 5-Year Plan For Cape Town 2012-2017: Integrated Development Plan (IDP) Review, CCT, 2012; hereinafter IDP12. Available at http://www.capetown.gov.za/en/IDP/Documents/IDP12_final_May12.pdf Last Accessed 24 September, 2016.

Some elements have been taken up, for instance a commitment to expanding public transport through the development of the My Citi bus system.⁷¹ Somewhat confusingly, oil and gas were identified in the IDP12 as priority sectors for development,⁷² along with a commitment to investigating renewable energy options in solar, wind and biogas.⁷³ Some attention is also paid to energy efficiency programmes such as solar water heaters and ceiling retrofits.⁷⁴ Unfortunately, however, investment in renewable energy (Strategic Focus Area 1.1.c) does not receive a performance management indicator on the City scorecard, making it difficult to monitor.⁷⁵ Improvements in public transport do (SFA 1.4, KPI 1.k.)⁷⁶. Retrofitting gets somewhat lost, being rephrased as “Provide for the needs of informal settlements and backyard residences through improved services” (SFA 3.4. KPI 3.d)⁷⁷ , which is not quite the same as retrofitting existing housing stock. In local government, as elsewhere, only that which gets measured gets done. Not surprisingly, therefore, key elements of the Energy Scenarios do not appear in the budget. For instance, while some solar water heater high pressure systems are budgeted for (it is unlikely from the context that these were installed in low-income areas), and some work was done to reduce the City’s own energy use, retrofitting of existing RDP stocks has disappeared from the radar.⁷⁸ It should be noted that demand side management programmes were funded through a transfer from national government.⁷⁹

Even more confusingly, SFA and KPI numbers as set out in the IDP are not reflected in the City’s annual budget.⁸⁰ In fact the City does not practice a line number system in its budget at all. This lack of alignment means that there are essentially two reporting systems, and it is impossible (unless you are within the system) to relate performance as set out in the one to the other. This monitoring and evaluation by the public is not enabled.

However, it is interesting to note that a sum of R 1.14 million is allocated for: “The Supply of Technical Support Services for the Curtiss Wright MOD/POD Gas Turbine Generating Plant to the City of Cape Town.”⁸¹

⁷¹ . IDP 12, pp. 28.

⁷² . IDP12, pp. 44.

⁷³ . IDP12, pp. 63.

⁷⁴ . IDP12, pp. 102.

⁷⁵ . IDP12, pp. 149.

⁷⁶ . IDP12, pp. 150.

⁷⁷ . IDP12, pp. 151.

⁷⁸ City Of Cape Town Integrated Annual Report 2012/13, Cape Town, 2013; hereinafter AR2013, pp. 50 . Available at http://www.capetown.gov.za/en/IDP/Documents/2012-2013_int_annual.pdf Last accessed 24 September 2016.

⁷⁹ . AR2013, pp. 185.

⁸⁰ . City of Cape Town 2012/13 Annual Budget and Medium Term Receipt and Expenditure Framework, Cape Town, 2013, hereinafter Budget 2012. Available at http://www.capetown.gov.za/en/Budget/Budget%20201213/1213Budget_May2012CouncilMeeting.pdf Last accessed 24 September, 2016.

⁸¹ . Budget 2012, pp. 150.

In other words, the slippage from planning to implementation means that we cannot track to what extent the Energy Scenarios For Cape Town actually got implemented, although it is possible for a specialist to map some elements of it. This means that any kind of nexus thinking, that is, where different elements of an urban ecosystem are supposed to work together, would be require a revision of existing reporting systems. It also means that projects which were not in the Scenarios, or in the IDP, and which clearly bear no relation to any form of public consultation process or citizen's monitoring can be planned and funded by City money. We should not be surprised to note that, some three years later the City announced that it planned to buy electricity from a privately owned gas turbine power plant ⁸², or that, coincidentally, a large oil natural gas pipeline and generator is being built in Saldanha.⁸³

In this review of the fate of the Energy Scenarios, it should be noted that this is a best-case study for South Africa. The City of Cape Town is unusual in its consistency in receiving clean audits and delivering services of a relatively good quality. Other municipalities are likely to be worse. All the more reason to properly consider what can be learnt from this analysis:

- Scenario planning should be based on easily available data. Any exercise which involves extensive use of expensive expertise is possible, but not always the best use of city money.
- Monitoring and evaluation is everything in scenario planning. Easily accessible data means easy monitoring which can and should be done by citizens rather than experts.
- The scenario plan should be constructed in such a way that there is a seamless fit between planning, consultation, budgeting, performance management and reporting. This process should be accessible to all and simple to follow.
- The scenario plan should be based in community needs and responsive to community demands. The work cannot be considered done until a sufficient critical mass of citizens are committed to monitoring and evaluation of the system.
- Lastly, it should contain negative prohibitions. In other words, it should be made clear in the process itself that a commitment on the part of the City to the plan involves a commitment to not spend ratepayer's money on things which are not in the plan. Anything less makes a mockery of the notion of public consultation.

⁸² . <http://businesstech.co.za/news/general/82281/cape-town-wants-to-make-its-own-electricity/>

⁸³ . <http://www.engineeringnews.co.za/article/driver-trett-appointment-for-the-saldanha-gas-power-project-advisory-management-services-2016-02-24>

Alternative Cape Town Scenario Plan

Bearing the previous considerations in mind, we conceived of an alternative plan. It would deal with the full food/water/energy nexus, which has become all the more imperative as extreme weather affects Cape Town in ever more noticeable ways. We looked at a situation in which 90 % of the data is known, where the system change required to produce renewable energy is very small, and where it is very easy for citizens to monitor and evaluate progress. Using these parameters it appeared that an integrated biogas system in our sewerage works would be the easiest to implement. The data regarding water and sanitation are relatively well known, with only people still living in informal settlements where the 'bucket' system operates being left out of official figures regarding the availability and location of sewerage. No major system change is required besides converting sewerage plants to electricity production plants with non-food permacultures and water recycling elements added. There is enough sufficient data to draw up a rough outline, that is, sufficient to advocate for a full-scale feasibility study. As for questions about the human ecology, that is to say,

- Would this form of energy production be corruption proof?
- And if it were, would there remain sufficient motivation for local governments to implement it?

These can only be answered in political practice. It is not possible to reach an answer at a theoretical level.

It is proposed that the City's sewerage works be converted to biogas plants, using existing wastewater flows and recycling green waste out of landfills. Such plants should become renewable energy hubs, fitted with Solar PV and wind where appropriate so that the biogas can be stored for peak consumption. The primary aim of this approach would be to ensure that the City's wastewater treatment works themselves cease to buy in fossil fuel energy for their own consumption. Where a surplus is produced this can be distributed on the grid.

A secondary aim would be to promote biological water purification and recycling, thus cleaning up the City's waterways and beaches and solving its water problem. Savings brought about by this program should be ringfenced for energy efficiency measures such as retrofitting of old housing stock. Non-food products such as biodiesel are recommending for the water purification process, given that sewerage is contaminated by endocrine disruptors.

Once the initial capital investment is made, any financial gains from such projects would be pure profit, given that the inputs (land, landfill waste, fertilizer and water) come absolutely free to the City and at present in fact costs the City money to dispose of. As such we have not bothered to calculate them.⁸⁴

Finally this approach would solve the problem of the City's falling income from electricity sales. Many jobs would be created by this approach, on existing land surrounding sewerage works, and using most of the same facilities. By creating more work, the City would shrink its indigent population and increase its rates base. It would make more money by more people being employed and paying rates. In other words, the small change (converting to biogas production) would lead to bigger system changes as the economic inequality inherited from *apartheid* would begin to shift in favour of programs to expand the rates base to bring the City's finances on an even keel.

Biogas, though often the stepchild of renewable energy forms, is a tried and tested technology. It has scaled up nicely in countries which have focused and coherent biogas programs. The following table shows how scaling has worked internationally.

Country	Year	Production Twh/Y	Of which wastewater	Percentage	Population In millions
Brazil	2014	0.613	0.042	7%	200
South Korea	2013	2.578	0.969	38%	50
Germany	2014	41.550	3.050	7%	80.6
Sweden	2013	1.686	0.672	40%	9.5
United Kingdom	2013	6.637	0.761	11%	64.1

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⁸⁴ . The author has practiced this system on a small scale (6 m³ digester) for years with great success. It is being practiced in other parts of the world as well: <https://www.youtube.com/watch?v=Ne5HNYGit40&t=407s> Last accessed May 2018.

⁸⁵ . Source: N. Bachmann Sustainable Biogas Production In Municipal Wastewater Treatment Plants , International Energy Agency BioEnergy, 2015, pp. 4.

Looking at biogas in comparison to other forms of energy, it can be seen that biogas can be cost-competitive depending on local circumstances. Even when we disregard externalities for which there is scant information (like global warming) and look only at direct economic costs, biogas is a feasible technology. For comparison purposes, here are the latest Levelised Cost Of Electricity (LCOE) figures for other forms of energy:

- Bid window 1: R 3.66/kWh SPV
 R 1.52/kWh Wind

- Bid Window 4: R 0.87-0.95 SPV
 R 0.69-0.80 Wind
 R 0.85-1.4 Coal
 R 1.9-2.4 Gas
 R 3.1 Diesel⁸⁶

It should be noted that trying to calculate LCOE for biogas is a little like trying to calculate productivity figures for permaculture: biogas production will always be specific to the local microclimate. Producing biogas essentially means farming microbes, it is as much an art as a science. Like any form of organic farming, the only honest answer is "it depends". One of the most important things it depends on is the ability of the farmer. Other factors determining biogas productivity are, amongst others, the availability and cost of feedstock, the temperature, the Ph. value of feedstock, retention time in digester, and the technology used. Due to innovation, newer technologies tend to be more productive than older ones. However, one might for job creation purposes prefer a slightly older and more appropriate technology. Bearing all these factors in mind, figures given here are only indicative and only intended to make the case for biogas production.

Fortunately, the extent of biogas plants built means that one can calculate a range of averages based on the productivity of actual plants. Thus a survey of European plants produces a range of LCOE's from R 2.13- R 3.39/kWh.⁸⁷

⁸⁶ . Bischof-Niemz, Tobias and Crescent Mushwana High-renewables Scenarios:Thought Experiments For The South African Power System CSIR Energy Centre Pretoria, 22 August 2016. Available at http://us-cdn.creamermedia.co.za/assets/articles/attachments/63272_high_re_scenario_-_csir_-_22aug2016.pdf Last accessed September, 2016

⁸⁷ . Kost, Christoph *et al* Levelized Cost Of Electricity Renewable Energy Technologies Fraunhofer Institut for Solar Energy Systems , 2013, pp.2. Available at <https://www.ise.fraunhofer.de/en/publications/veroeffentlichungen-pdf->

These assumed a cost of R 0.40-R0.63/kWh for feedstock and excluded Combined Heat and Power plants for purposes of comparability with other energy forms. In other words, these estimates are in the high range and CHP plants are likely to be even more productive. A study which included US digesters (which tend to be newer) gave an range of LCOE's from R 0.86 – R 3.37/kWh (all technologies except CHP). Including all forms of digesters the range went lower: from R 0.86 – R 2.15/kWh.⁸⁸ These estimates included feedstock.

Calculating the productivity of biogas in relation to the City of Cape Town can then be done for a range. The combined capacity of Cape Town's wastewater treatment plants is 746.13 million litres per day.⁸⁹ This excludes an additional 50 million litres of untreated sewage which apparently is being pumped directly into the sea.⁹⁰ It also excludes an unmeasured amount of sewage escaping into the City's rivers and beaches from underserved informal settlements.⁹¹ The amount converts to approximately 516 329.73 tons of sewerage per day.⁹² This should produce about 2 912 099.6 m³ biogas per day.⁹³ Assuming 60 % methane content, this can yield 5 824 199 kwh/day of electricity.⁹⁴ This amount could be tripled by co-digestion with green waste.⁹⁵

[dateien-en/studien-und-konzeptpapiere/study-levelized-cost-of-electricity-renewable-energies.pdf](#) Last accessed 6 September, 2016.

⁸⁸ . International Renewable Energy Agency Working Paper Volume 1: Power Sector Issue 1/5 Biomass For Power Generation, 2012. Available at https://www.irena.org/DocumentDownloads/Publications/RE_Technologies_Cost_Analysis-BIOMASS.pdf Last accessed 6 September, 2016.

⁸⁹ . <https://www.capetown.gov.za/en/Water/Pages/Wastewater-treatment-works.aspx> Last accessed 24 September, 2016.

⁹⁰ . <http://www.thesouthafrican.com/planning-to-go-to-the-beach-this-summer-welcome-to-cliftons-sea-of-poo/> Last accessed 24 September, 2016.

⁹¹ . <http://www.news24.com/Archives/City-Press/Half-of-WCs-river-systems-contaminated-by-sewage-20150429> Last accessed 24 September, 2016. The source cited, namely City of Cape Town Inland and Coastal Water Quality Report 2015 has not been made publicly available. Cf.

<https://www.capetown.gov.za/en/CSRM/Pages/Reportsandscientificpapers.aspx> Last accessed September, 2016.

⁹² . <http://www.aqua-calc.com/calculate/volume-to-weight> Last accessed September, 2016.

⁹³ . Assuming an average 12 % of digestible material. Cf. Sustainable Energy Authority of Ireland Gas Yields Table. Available at http://www.seai.ie/Renewables/Bioenergy/Bioenergy_Technologies/Anaerobic_Digestion/The_Process_and_Techniques_of_Anaerobic_Digestion/Gas_Yields_Table.pdf For a detailed discussion of factors affecting production cf. Wightman, Jenifer and Peter Woodbury Current and Potential Methane Production for Electricity and Heat from New York State Wastewater Treatment Plants New York State Water Resources Institute, 2014. Available at https://wri.cals.cornell.edu/sites/wri.cals.cornell.edu/files/shared/documents/2013_Woodbury_Final.pdf Source: Nathalie Bachmann Sustainable Biogas Production In Municipal Wastewater Treatment Plants , International Energy Agency BioEnergy, 2015. Available at http://www.iea-biogas.net/files/daten-redaktion/download/Technical%20Brochures/Wastewater_biogas_grey_web-1.pdf Last accessed September 2016.

⁹⁴ . <http://www.biogas-info.co.uk/about/biogas/> Last accessed September 2016.

⁹⁵ . Personal communication, Agama Energy, 29 August, 2016.

At range, this would cost between R 5 008 811 – R 19 447 000/day⁹⁶. Currently the City of Cape Town's operating budget for sewerage treatment is 3.306m/day. It has a capital budget of R 481.6m.⁹⁷ Assuming an average depreciation of 20 years for capital investment, this yields an available sum for investment of R 3.371 m/day. The cost of electricity from biogas calculated this way would therefore be from R 1 636 842/day - R 16 075 031/day, or R.028 - R 2.76/kWh. This compares favourably with the LCOE's of gas and diesel as set out above, and in the low range is competitive with solar PV and wind.

Another way to calculate the feasibility is: each person produces about 0.250 kg of solid waste per day, and a roughly equivalent amount of green waste.¹ The population of Cape Town was 3 740 025 in 2011¹, thus 935 tons of solid waste per day is produced. Working on 32 m³ gas per ton,¹ this would equate to more or less 193 732 kWh/day, or approximately three times that amount if green waste is included. Using global figures as a range this means that the cost of producing electricity from sewerage range from R 166 609/day – R 416 523/day (calculating for brown waste only). If we use current sewerage treatment costs as a hidden 'energy budget', it means there is R 3.371 m/day available for biogas production. In other words, these calculations reveal that we could actually save between R 2 954 476 – R 3 204 391 a day while producing at a minimum almost 200 000 kwh/day. The energy cost is actually negative. Even the highest cost estimates show that the City could produce energy which is, to say the least, free. The money saved could go towards biological water treatment systems which allow us to recycle the water in the sewerage system while producing things like bio-diesel without any external inputs.

It is to be hoped that these rough calculations make the case for biogas as a viable local energy option. There is unfortunately no way around the wide discrepancy of figures than to actually do it and calculate more precisely afterwards, using a weighted average of many different biogas plants around the city. At this point it is sufficient to show that it is advantageous. In planning for system change one often has to build the alternative before the outcome can be measured more exactly. What is possible is to measure process: that we do what we say we are going to do. Because sewerage plants are finite both in space and in the budget, yet located in every area of the city, it is easy for the populace to monitor that they are being used for the stated purpose. Process can be measured using a simple monitoring tool. When that is achieved, system change is easy. And without proper process nothing will continue to happen.

⁹⁶ . The cost of feedstock here remains as an imputed cost of pumping sewerage to the plant.

⁹⁷. City of Cape Town 2016-2017to 2018-2019 Budget, pp.65. Available at

http://www.capetown.gov.za/en/Budget/Budget%20201617/Annexure%20A_1617Budget_May16.pdf Last accessed September, 2016.

Cape Town's electricity sales were 10 255 GWh/year in 2013 and has remained reasonably steady if not declining.⁹⁸ Thus fully utilizing city wastewater could produce 20 % of electricity consumption, or up to 60 % if green waste streams were included. It could do this at a price cheaper than natural gas. This analysis has not looked at utilization of other waste streams, such as abattoir and feedlot manures, or agricultural waste. It has focused on sewerage because at present this is a direct cost to the city.

The job creation potential of electricity from biogas production is considerable. While these would need to be offset against existing jobs in wastewater treatment, the potential of biogas to create jobs should not be overlooked. Thus the Nepalese GC20, an award winning model which can be built by hand, has created some 111 000 short term⁹⁹ and 11 000 long term jobs¹⁰⁰, while producing about 302 MW annually from some 55 million m³ biogas.¹⁰¹ By contrast the state of Oregon municipal plant is estimated to be able to produce some 100 MW/year from biogas, creating 300 long term jobs.¹⁰² A plant in County Durham, Great Britain has created 40 jobs in construction and will create 8 long term jobs while producing 1.56 MW/year.¹⁰³ In Germany, 35 100 jobs existed in 2010¹⁰⁴, for an estimated 2130 MW.¹⁰⁵

In other words, Nepalese technology produces between 3 and 10 times as many jobs per MW as technologies in the global north. This demonstrates the difference made by technology choices in job creation, and should focus our attention on the way these choices are made.¹⁰⁶

⁹⁸ . City of Cape Town State of Energy Report 2015, Cape Town, 2015, pp. 47. Available at https://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Documents/State_of_Energy_Report_2015_2015-09.pdf Last accessed September, 2016.

⁹⁹ Gautam R, Baral S, Herat S; *Biogas As A Sustainable Energy Source In Nepal: Present Status And Future Challenges* ; Renewable and Sustainable Energy Reviews 13 , 2009, 248–252

¹⁰⁰ . Ashden Awards Case Study: Biogas Sector Partnership, Nepal 2010? Available at <http://www.ashden.org/files/BSP%20case%20study%20full.pdf>

¹⁰¹ . The calculation is based on 1m³=5.5 Kwh. Cf. Stenkjaer, Nicholas Introduction To Biogas Nordic Biogas Centre, 2008. Available at www.folkecentre.ref/default.asp?id=41047

¹⁰² Roth, Thad and Peter Weisberg Growing Oregon's Biogas Industry: A Review of Oregon's Biogas Potentials and Benefits, The Climate Trust and The Energy Trust Of Oregon, 2011, pp. 2.

¹⁰³ . County Durham Biogas Power Plant Generates New Jobs The Journal 3 May 2013. Available at: <http://www.thejournal.co.uk/business/business-news/county-durham-biogas-power-plant-4392250>

¹⁰⁴ . Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) Renewably Employed: Short and Long Term Impacts Of The Expansion Of Renewable Energy On The German Labour Market Berlin, 2012, pp. 16.

https://secure.bmu.de/fileadmin/Daten_BMU/Pool/Broschueren/EE_Beschaefigt_eng_bf.pdf

¹⁰⁵ . de Graaf, Daniel and Roland Fendler Biogas Production In Germany Federal Environment Agency, Dessau-Rosslau, 2010. Available at http://spin-project.eu/downloads/0_Background_paper_biogas_Germany_en.pdf

¹⁰⁶ . These figures should also cause us to treat with caution the statement made in one of the most authoritative South African studies to date, that "...judging from interviews conducted with players in this field, the number of employment opportunities tends to be fairly consistent, regardless of size. "Maia, J.; Giordano, T.; Kelder, N.; Bardiën, G.; Bodibe, M.; Du Plooy, P.; Jafta, X.; Jarvis, D.; Kruger-Cloete, E.; Kuhn, G.; Lepelle, R.; Makaulule, L.; Mosoma, K.; Neoh, S.; Netshitomboni, N.; Ngozo, T.; Swanepoel, J. Green Jobs: An Estimate Of The Direct Employment Potential Of A Greening South African Economy. Industrial Development Corporation, Development Bank Of Southern Africa, Trade And Industrial Policy Strategies, 2011, pp. 61.

We could, conceivably, decide which level of job creation is useful in enlarging the rate-paying population, and then choose a technology which creates the requisite number of jobs.

This potential would be enlarged if we started stacking functions beyond the production of energy. For instance, use of the digested effluent in producing things like biofuels would not only be economically efficient but also do much to clean up our rivers and shoreline. Moreover, artificial wetlands could be built to allow for recycling of wastewater, thus easing the City's water crisis. It is to be hoped that these rough calculations make the case for biogas as a viable local energy option. There is unfortunately no way around the wide discrepancy of figures than to actually do it and calculate more precisely afterwards, using a weighted average of many different biogas plants around the city. At this point it is sufficient to show that it is advantageous. In planning for system change one often has to build the alternative before the outcome can be measured more exactly. What is possible is to measure process: that we do what we say we are going to do. Because sewerage plants are finite both in space and in the budget, yet located in every area of the city, it is easy for the populace to monitor that they are being used for the stated purpose. Process can be measured using a simple monitoring tool. When that is achieved, system change is easy. And without proper process nothing will continue to happen.

Conclusion: On Methods of Organizing In Relation To Local Government

What this paper has demonstrated is that energy production at local government level is not a problem from a technical point of view. While not trying to do feasibility studies, we have done enough to show that there are reasons for such studies to be done. We have shown that there are the obstacles are neither technological nor financial in nature. They are essentially, political, that is, problems of power. As such the problem resolves itself into one of generating sufficient political will. The remaining discussion will then focus on techniques for the mobilization of people to generate such political will.

People, as both constructing and being constructed by the food/water/energy nexus in municipalities, are central to the process of system change. If political will is necessary to the reconstruction of unsustainable systems, then the best way to generate political will is through the electorate. Yet in today's South Africa, there are many reservations expressed as to the extent to which people have been empowered to act as fully participatory citizens of a democratic system. The level of disempowerment in fact should rather be regarded as yet another symptom of system failure. The root cause of this problem has perhaps best been described by Biko:

“It becomes more necessary to see the truth as it is if you realise that the only vehicle for change are these people who have lost their personality. The first step therefore is to make the black man come to himself; to pump back life into his empty shell;

to infuse him with pride and dignity, to remind him of his complicity in the crime of allowing himself to be misused and therefore letting evil reign supreme in the country of his birth. This is what we mean by an inward-looking process."¹⁰⁷

Africans, having been for centuries treated as if they were non-citizens of their country, have to some extent internalized this perception. This is not an excuse for inaction, but an explanation. Wangari Maathai has rooted this internalization deep in our history, and made the point that it applies as much to our political leaders as it does to ordinary people:

"While I could understand to some extent the government's paranoia about holding on to power, what I couldn't fathom was why the environment was not as important to my fellow Africans, or Kenyans, or even Kikuyu's, who were in the government or in positions of authority in society, as it was to me. *Why were political leaders behaving as if they had colonized their own country* – and, in so doing, had facilitated the exploitation of natural resources like the indigenous forests and land by handing them over to their political supporters or making them available to corporate interests? Why were they disinheriting their own people and future generations? Then I realized that it was not just the poor who had been culturally uprooted."¹⁰⁸

Maathai defines this death of imagination as an absence of *kwimenya*, a Kikuyu word meaning 'self-knowledge'.¹⁰⁹ Because people lack a sense of self, they continue to endlessly seek it, to fill the emptiness inside with material things, using violence to acquire what we cannot get by honest means. In this sense, unsustainable systems which undermine the very environment which supports them are in Africa rooted in a deep sense of psychological dislocation. As such the endeavor to generate political will has to begin in the psychology of the individual. Trainers and researchers cannot go in make assumptions about citizenship which locate the actions expected to emerge from a raced, gendered and classed perspective. People may not be able to read, to write, to have the financial means to access communication, or travel to a workshop, or even have food to eat that day. If such things are a pre-condition for citizenship than many potential agents for change are not in a position to exercise citizenship. People may not even have the expectation of being able to participate fully in local democracies. All these things may be alien to them because they have been told for so long that they are worthless that some part of them may have become to believe it.

¹⁰⁷ . Biko, Steven *I Write What I Like*, edited by Aelred Stubbs, Bowerdean Press, 1978, London, pp. 29. It should be borne in mind that Biko, writing within the context of his times, would include the gendered 'man' to include women in the sense of 'humankind'.

¹⁰⁸ . Maathai, Wangari *The Challenge For Africa* Arrow Books, London, 2010, pp. 166. Italics ours.

¹⁰⁹ . Maathai *The Challenge For Africa*, pp. 170.

Post-1994 developments may have served to worsen this alienation by fuelling a sense of entitlement. Mamphela Ramphele has characterized this root problem as follows:

“The question that stares us in the face is: Why has there been such systemic failures in aligning our systems of governance and its performance with the values set out in our constitution? Are we simply another example of the inability of Africa’s post-colonial governments to transcend the legacy of the past? My view is that we have fallen prey to two fatal flaws:

- We have fallen into the trap of heroic politics with the ANC governing as a liberation movement which has not transformed itself into a modern political party,
- We have failed to tackle the challenges of systemic restructuring of the economy to lay the foundation for progressive realization of socio-economic rights and inclusive prosperity.”¹¹⁰

As increasing service delivery protests attest, local communities certainly expect the state to provide essentials basics like Free Basic Water and Electricity. However, it is not clear that people are as conscious of their responsibilities as citizens to co-create a functioning polity in which such services can be provided, while notions such as sustainable system change may be the furthest things from their minds. In other words, community engagement is not so simple as going in with a certain goal in mind (‘generating political will’) and expecting to mobilize people behind such a goal. As Oswald has stated, expecting such a process to occur hides certain assumptions which may not be true: “This understanding harbours two problematic assumptions: 1) that there is someone or some organisation (often the State) that is able to hear, listen to and respond to those preferences and opinions; and 2) that people or groups are willing and able to articulate their preferences and opinions in a way that can be heard.”¹¹¹

Yet in fact these are the very assumptions most unlikely to be true in a situation where an unsustainable system is slowly collapsing and a new one has not yet been put in place. Instead researchers may well find themselves having to support individuals to reconstruct themselves from the inside out through the use of narrative. This conclusion applies as much to political office bearers and local government officials as it does to ordinary people. In other words, if ordinary people may be struggling to articulate themselves due to internalized negative self-perceptions, the State (or rather the individuals who mediate state institutions) may be equally unable to hear, or if hearing, unable to act. When the system was strong it is probable that power adhered in sharply defined centres, where one word from a key decision-maker could effect decisive change. A system in slow collapse however, may well be characterized by power diffusing, where all individuals feel a level of powerlessness and where accountability chases its own tail.

¹¹⁰ . Ramphele, Mamphela Conversations With My Sons and Daughters Penguin Books, Johannesburg, 2012, pp. 82.

¹¹¹ . Oswald, Katy On Speaking, Mediation, Representation And Listening: A Think Piece For The Making All Voices Count Programme, 2014, pp. 5. Available at <http://www.makingallvoicescount.org/publications/voices/> Last accessed March 2018.

Even when people shout very loudly, as in service delivery protests, the system is unable to hear and/or to respond. We contend that this is what is occurring in South Africa today. As Ramphele points out, the problem of cognitive dissonance is widespread at all levels of society:

“..at the heart of the failure of leadership is the lack of a frame of reference for governance which makes a fundamental break with the colonial past. Leaders of most liberation movements derived their education and training from the very systems they later set out to oppose or even wage war against. But opposition to a system does not necessarily signal a commitment to a radically different system of governance.”¹¹²

In essence what Ramphele is pinpointing here is a failure of the imagination. It is worth remembering in these days, witnessing the gradual collapse of the old, that simply being in opposition to it is not necessarily sufficient to reconstruct the new. While a sense of history may help, a radical transformation of the way the world is seen is necessary, and the way people perceive themselves, in order to see beyond the way things have been done in the past in the construction of a sustainable future. It is not enough to be against what is seen in the present. Change has to be different in ways at present unimaginable. In this sense community engagement involves also a transformation of the self which applies as much to those who are engaged upon it as to those influenced by it. It may be that what has to be done with power is not to seize it from a place where it may or may not cohere, but to see it as already in the hands of those who seek change and to teach them use it wisely.

Governance by the community is thus a dual process, constructing but also being constructed by communities. Realigning cognitive dissonance with material reality requires that the narratives told, and through which participants are constructed, must free our creative imagination beyond the visible and invisible systems of meaning which up to now have conditioned our thinking.

There are no quick fixes, only complex multi-layered solutions which may take decades to bear fruit. What can be done is to listen. If the State cannot hear people, civil organizations can. In this sense it is possible to re-imagine the way the system can work. A definition of ‘working’ can be arrived at precisely by looking at which approaches has given communities more voice and more power to construct social knowledge about themselves. As people begin to be able to speak for themselves *as well as define the terms of that which is spoken*, they will themselves continue to improve their situation in ways they think best. In other words, good policy is policy which provides humans with voice, or in a more technical definition, empowers them to be the constructors of knowledge on their own terms.

Energy scenarios which work are therefore policies which are going to generate amongst communities the power to change their own realities.

¹¹² . Ibid., pp.83.

The key challenge is going to be building the capacity of knowledge-generators to monitor and evaluate levels of empowerment generated by a particular policy. As one begins to construct new narratives, new knowledge will be generated about the capacity of individuals and communities to create change. Two theorists have created methodologies which speak to the need for individual and collective transformation, namely Maathai and Ramphele. Though their work has been separated in time and space, they came to similar conclusions.

Maathai states that she began by planting trees, but realized that in order to make her tree planting sustainable, she had to assist people to change. Otherwise they remained dependent on the GBM and when the movement moved to a different region the tree-planting programs fell apart. If people were wounded lacking self-knowledge, they had to go through a process which gave them the sense of identity they had lost. From this premise she constructed the Green Belt Movement's training program based on four principles: gratitude and respect, self-empowerment, self-knowledge and commitment to service. Gratitude and respect were important because in the mindless search for more, people often tended to forget to appreciate what they had. This led them to cut trees and in other ways despoil the environment in the constant search for more. Maathai's training program began by supporting people to discover a sense of appreciation. The concept of not wasting, but of making the most what one has, was in Maathai's thinking central to the notion of gratitude. Self-knowledge stemmed from Maathai's notion of gratitude. She reasoned that if people could re-discover their sense of identity, they would have less desire for material things as a way to fill their lost sense of self. As such, she independently came to the same conclusion as Biko in the opening quote: 'to pump back life into his empty shell; to infuse him with pride and dignity..'. Self-empowerment would then come from a sense of self-knowledge. People who had through the Green Belt Movement training course come to a sense of self-knowledge, had healed their inner wounds and made their peace with themselves, would then be able to understand that it is no use waiting on other people to come and create a life for them. The only people who would be able to improve their lives would be the people themselves.

The commitment to service, finally, stemmed from Maathai's spiritual environmentalism. Having come to ourselves, she reasoned, the first thing we would do would be to see ourselves as part of Creation. Caring for the ecosystem, in Maathai's conception, would be an extension of self-care. In healing earth's wounds we would heal our own. Nurturing the habitat which sustains human beings would become normal and natural to people with a sense of identity and a belief in their own capacity:

“What is it that calls someone to serve, to make that commitment beyond oneself that can transform the lives of those served around one and bring about change that seemed impossible... Here, we are in the realm of the mysterious, and in trying to suggest what causes us to act, it would be prudent to exercise a little humility,

especially since so many of the challenges which confront us as a species are due to our arrogant belief that we know enough not to worry about the consequences of our actions.”¹¹³

That is why, though a format for self-development is important, it is equally important to go into a PCE process knowing that the trainers themselves will be changed. Two wrongs do not make a right. If selective intellectual blindness is one cause of the world’s environmental problems, then Maathai is correct in saying that this trap needs to be avoided in the process of making change possible. Communities each have their own history and their own dynamics. It is only by respecting this history, and coming to it with a sense of ignorance, that a process supportive of change can happen. In this way Maathai’s method requires of its practitioners a sense of profound humility.

It is striking how, in a different methodology half a continent away, Ramphela highlights similar themes as Maathai’s work. Instead of a spiritual approach to the environment, Ramphela’s concerns are about the proper exercise of citizenship in a post-colonial nation. She argues, as set out in the beginning of this section, that simply voting at regular intervals for who shall govern us falls far short of the duties and responsibilities of citizenship. Instead democracy calls for a social contract that involves committed citizens working out of a sense of conscience. Ramphela thus places the responsibility for South Africa’s failures in leadership squarely on the shoulders of the citizenry. Voters have failed to hold leaders accountable, she states, and thus have allowed leaders to fall short of the high standards required for a democratic polity. Ramphela’s organization practices these principles especially in relation to health system reform, but has also used them in relation to slum clearance and the building of new homes. They are equally applicable to any work which requires the mobilization of communities and the generation of political will.

Ramphela’s approach is called Letsema after the traditional circle held for meetings. It can best be described as taking communities through two phases. The first is a recognition of one’s own woundedness. People are encouraged to explore their feelings of supplication, dependency, helplessness, apathy and the various modes of self-sabotage they exercise within the Letsema circle. The very act of being heard and being affirmed then begins the process of healing. Through the work of practical planning exercises to accomplish the proposed changes, people are then encouraged to discover the power of transformation within themselves. From this they develop dignity, accountability, they learn to become positive citizens who experience a sense of wellbeing through their work for self-sufficiency and the taking of initiative. Ramphela states that:

“The capacity of poor people to plan is often underestimated, but with the right environment and space, they show remarkable understanding of the complexity of development challenges and the skill to identify and manage risks.

¹¹³ . Maathai, Wangari Replenishing the Earth: Spiritual Values For Healing Ourselves and the World Doubleday Religion, New York, 2010, pp. 184.

It is this untapped capacity that could be harnessed to drive participatory involvement that is essential for sustainable development.

The process of participation and the affirmation of the dignity of those often marginalized enhances human and social capital and creates a positive environment for further human and social capital development."¹¹⁴

The Green Belt approach and the Letsema method share some important similarities:

1. They both recognize the importance of recognizing the woundedness in communities which stems from a conflictual history. In other words, both methods assume that until this pain is dealt with and healing occurs the community shall not be able to move forward.
2. They are cheap in terms of material goods, that is to say, they do not require powerpoint presentations or other expensive equipment to implement, and can in principle be conducted under a tree (as many often are).
3. They are simple. They do not require an extensive education to understand and practice, and in fact have been tried and developed for decades with English-second language people who may or may not be able to read and write.
4. Neither method is prescriptive in terms of content. They both prescribe a process, but leave open-ended the question of what will come out of the process. As such the methods are extremely adaptable to the uniqueness of each community and each person involved.
5. Peer-to-peer learning is central to the both processes. While assumed in the Green Belt Movement's four-step program, the Letsema method especially underlines the importance of participants learning to hear each other. Much of its healing power is ascribed to the strengthening of communication skills.
6. They are time-consuming, that is to say they are expensive in terms of human power.

Both authors warn of the temptation to rush the process and advise that giving in to such a temptation will lead to failure in the end. They also emphasize that communities must be the ones to determine the pace at which they move. Therefore facilitators and participants must be able to devote the time it takes to work through the process.

¹¹⁴ . Ramphele Conversations, pp. 188.