SUSTAINABLE ENERGY PROVISION OPTIONS FOR SOUTH AFRICAN CITIES

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1. Introduction

The recent imperatives of the power crisis, climate change and electricity price rises present a very different set of challenges for the electricity industry compared with even a few years ago. There is widespread recognition that renewable energy has to play a big part in the future supply mix, and that energy efficiency needs to be implemented to a far greater degree than anything we have engaged with so far. Municipalities have a clear role to play in many of these areas – in fact they are critical to national success in meeting these challenges. Yet many remain in the domain of "just a business trying to keep the lights on" instead of engaging with these challenges in a proactive way. Such a strategic focus, as opposed to purely operational, is especially necessary for the larger city distributors. Not to engage with them is likely to lead to severe disadvantages in the medium and long-term. Yet many cities lack the capacity and information to engage in this area. In addition, whatever strategic focus they had has often atrophied with the expectation of the REDs, which dealt a blow to even basic forward-planning.

This paper describes some of the challenges and points to key areas of action for municipalities. It draws extensively on analysis done for the City of Cape Town, where a more detailed level of information has become available, but attempts to be applicable to all cities in South Africa.

2. The situation

The major cities, forming the economic backbone of South Africa, are responsible for around half of South African energy use, yet only occupy 4% of the land area. They are thus energy intensive hubs, and transforming the national energy profile inevitably requires that cities change. South Africa as a whole is energy inefficiency because of our historically cheap energy prices, particularly electricity. This also means that we are carbon intensive, and are in the top 12 emitters of CO2e per capita globally, and amongst the top few per unit of GDP. Some implications are:

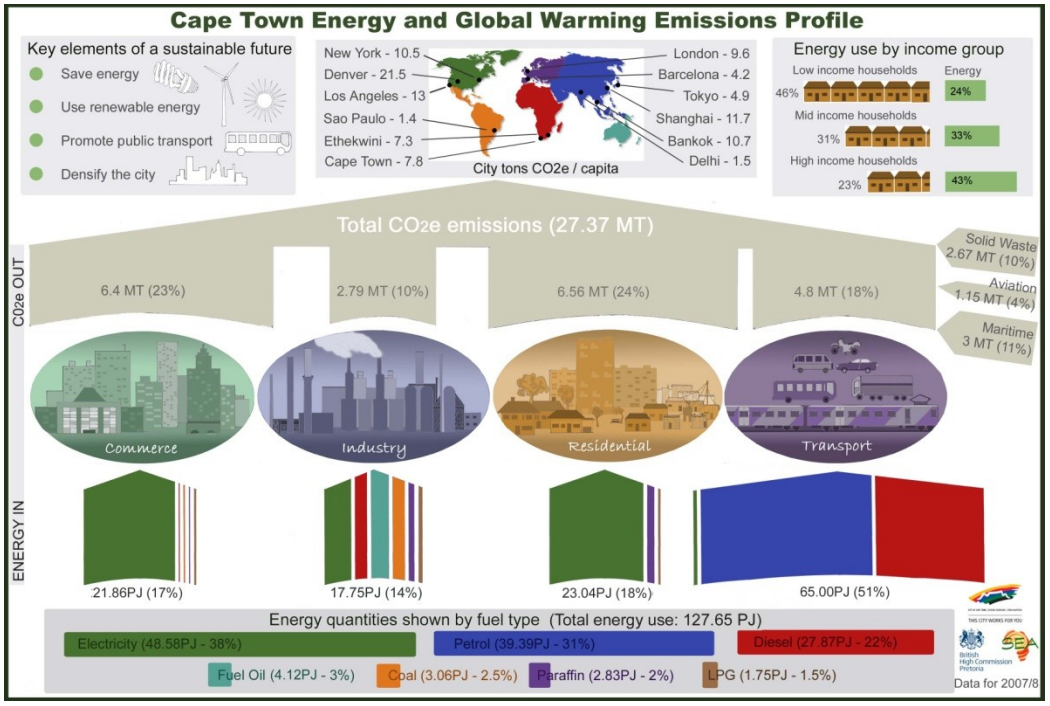

Figure 1 Cape Town energy profile

- Our economy is using significantly more energy resources than it needs to per unit production
- As power prices rise steeply, our economy will be severely impacted
- Sooner or later there will be firm obligations for us to reduce our carbon footprint

Government has been discussing the introduction of a carbon tax which will further escalate the already steeply increasing electricity price. Experts indicate that it is not a question of whether this tax is introduced, but only of when and how much. One way or another, this is likely to have a major impact on consumers and the economy.

3. What needs to be done

In overview, there are three main areas of intervention which are necessary for a sustainable city – (1) energy efficiency, (2) transport efficiency (based on a modal shift to public transport) and (3) renewable energy provision. From an electricity department's point of view, both renewable energy options and energy efficiency have to be scaled up significantly. Efficiency implementation generally sits squarely in City's domain, but large scale renewable implementation, as with most large supply options, tend to be handled by the national generation system which is guided by the 2010 Integrated Resource Plan.

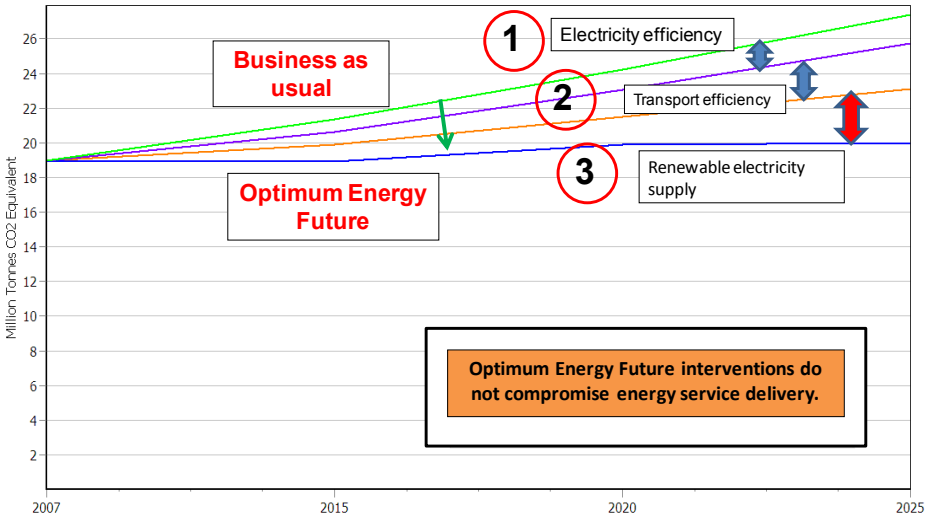

Figure 2 The three areas of intervention and their impact on carbon emissions

4. What will a sustainable energy system cost?

Although all new national-scale generation options are much more expensive than from the current generator system, costs for greater proportions of renewable electricity generation are still expected to increase average electricity costs. Analysis undertaken for Cape Town on a city scale indicates that a strong renewable component may increase costs by around 7c/kWh. However, the analysis also shows that net costs to consumers reduce because of the savings from electricity efficiency programmes. If a carbon tax is taken into consideration, savings to users from a combination of renewable and energy efficiency become very significant.

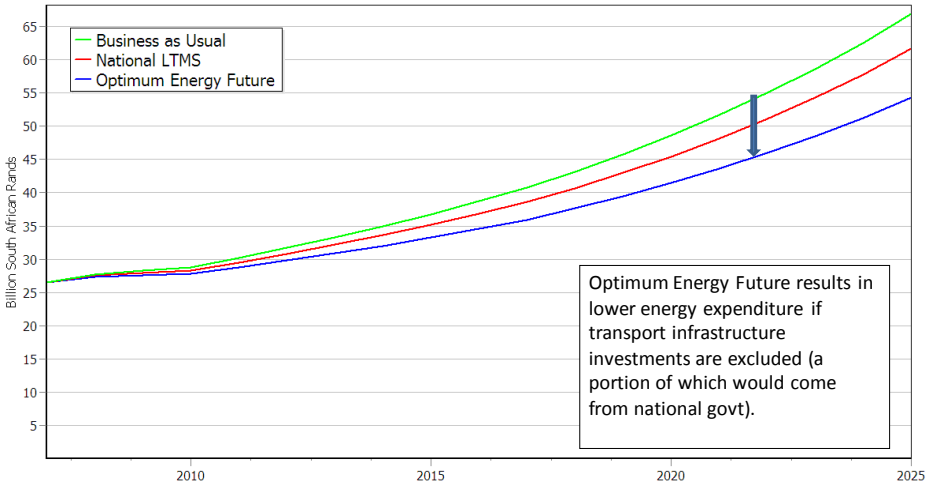

Figure 3 Optimum Energy Future includes efficiency and renewable energy interventions, and is lower cost than business as usual

5. Energy efficiency opportunities

Significant electricity energy efficiency (EE) opportunities common to all cities are located in the **mid-to-high-income residential sector** (efficient water heating and lighting), and the **commercial sector** (lighting and HVAC). Savings opportunities in **low-income residential** sector are much less significant, and EE implementation here contributes to the equity aspect of sustainable systems. While **government** electricity use is not a major component of total city consumption, the efficiency opportunities are significant (streetlights, traffic lights, pumps, buildings) and can be readily implemented. Industry EE opportunities – although more difficult to

generalise - are significant, particularly in the more industrial cities. Analyses indicate that there are vast energy efficiency opportunities which are cost effective from an end-user perspective. This supports the common wisdom that you get more out of a Rand spent saving energy than a Rand spent generating energy.

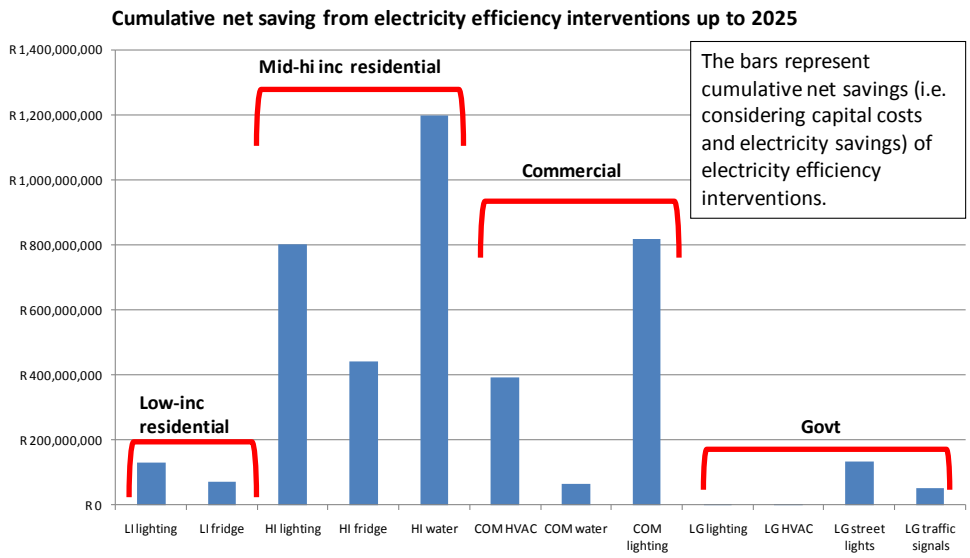

Figure 4 Cumulative net savings from different efficiency interventions in Cape Town (industry is excluded)

6. Electricity efficiency and threats to city revenue

For many cities electricity revenue surpluses are critical to cross-subsidise other city accounts. There are concerns that mass EE programmes will threaten city financial soundness. However, it needs to be remembered that efficiency is likely to impact on sales gradually, and analyses undertaken in one city indicate that annual tariff increases to compensate for revenue losses are small – around 0.2c/kWh. Annual tariff increases can very easily compensate for potential revenue losses without falling foul of NERSA scrutiny. In fact most tariff adjustment calculations undertaken by cities would account for this automatically.

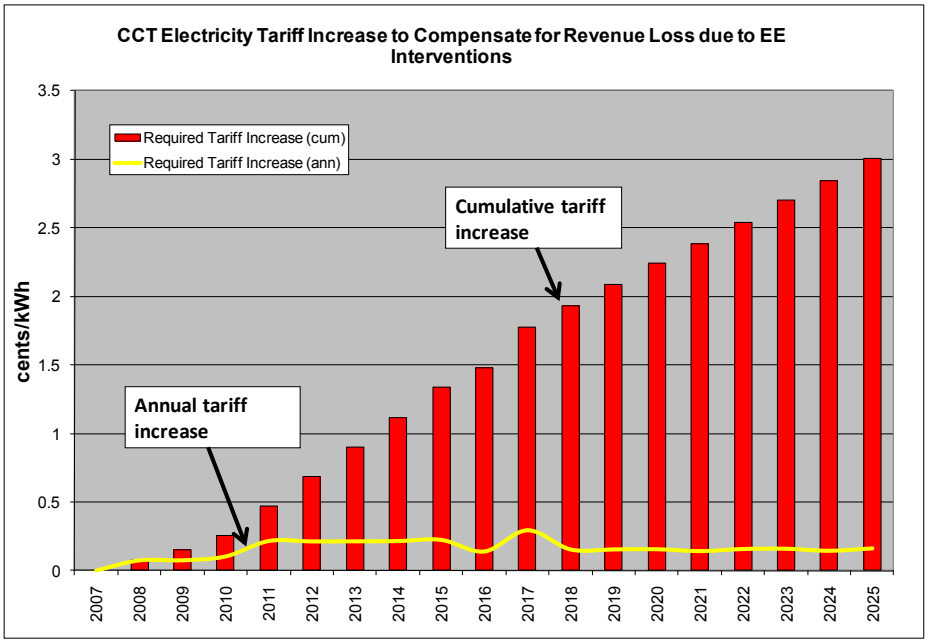

Figure 5 Tariff increases needed to compensate for revenue loss due to efficiency programmes

7. Renewable electricity – what's needed?

The 2010 Integrated Resource Plan (IRP) is far more progressive in terms of renewable electricity generation than previous IRPs. This is largely driven by the fact that a high-carbon future (i.e. coal-based electricity generation) will lead to serious economic disadvantages and social risks. But if the country is to meet its commitments around a lower carbon profile and be economically resilient in the face of global carbon pressures and local carbon taxes, more clean generation will be required. Nuclear seems likely to turn out to be a more expensive option that several large renewable generation sources. Yet renewables such as wind and concentrated solar power (CSP) introduce variability into the generation mix, unlike the base load capability of coal and nuclear. A smart future therefore will need to maximise the use of demand management approaches (interruptible loads, ToU tariffs etc) in conjunction with a stronger renewable generation drive.

For a city to be sustainable into a carbon-constrained future it will therefore need to have a renewable energy focus beyond the 2010 IRP and combine this with demand management measures, in addition to a strong EE focus.

8. Renewable electricity – what's feasible for cities?

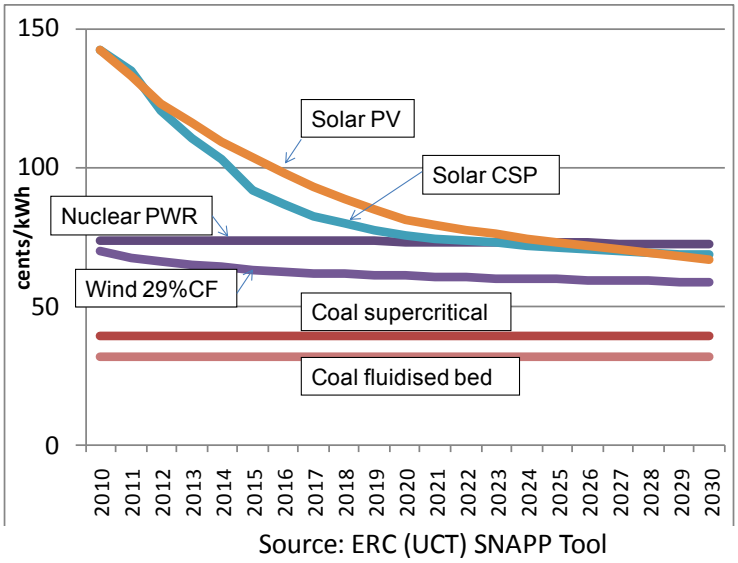

Figure 6 Costs of large-scale electricity generation options

Cities can consider entering into **Power Purchase Agreements** (PPAs) with large scale renewable generation companies. The current regulations do not preclude this. This can be demanding, however, and some officials may see this as falling foul of the MFMA as the price is likely to be higher than the average Eskom price. Also, when large scale generation options are brought onto the grid, they become significant influences on the national grid operation, and so integration with national planning is necessary. So this route is not straightforward. Nevertheless it can be done and is likely to be one of the few routes that will ensure a reasonably resilient city in the face of carbon constraints.

Other smaller-scale options which can be considered by most municipalities include landfill gas generation, and decentralised small-scale solar PV and wind generation.

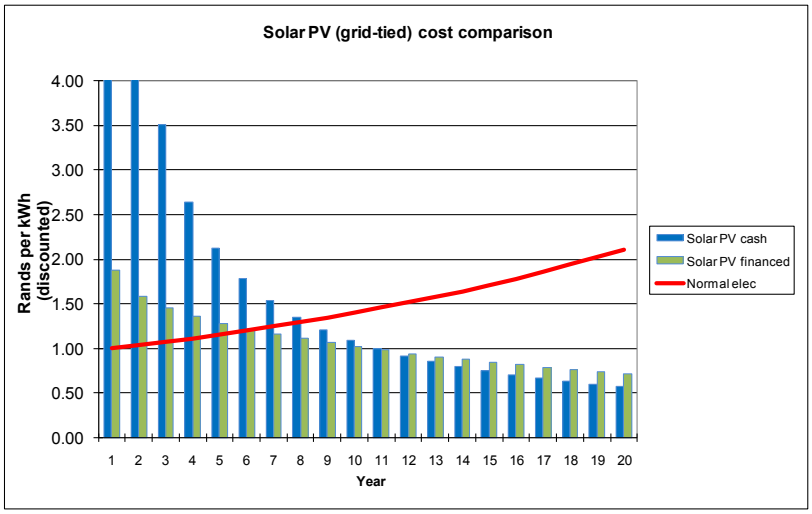

Figure 7 Cost of small-scale net metered solar PV compared with national grid prices

Landfill gas generation was pioneered by eThekwini, and although apparently financially and technically successful today, it demanded a very dedicated focus for several years to work through the technical, social and bureaucratic challenges that such projects encounter. While pioneer projects inevitably face more such constraints than later projects, landfill gas generation is still likely to be reasonably demanding on city resources. Forming PPPs to develop such projects is worth considering. A further uncertainty revolves around carbon revenue – which is currently necessary to make such projects financially feasible. Although experts consider that carbon trading will continue in one form or another, it is unclear what international financial mechanisms will be in place in future to enable revenue from carbon trading. COP17 will hopefully clarify this to some extent.

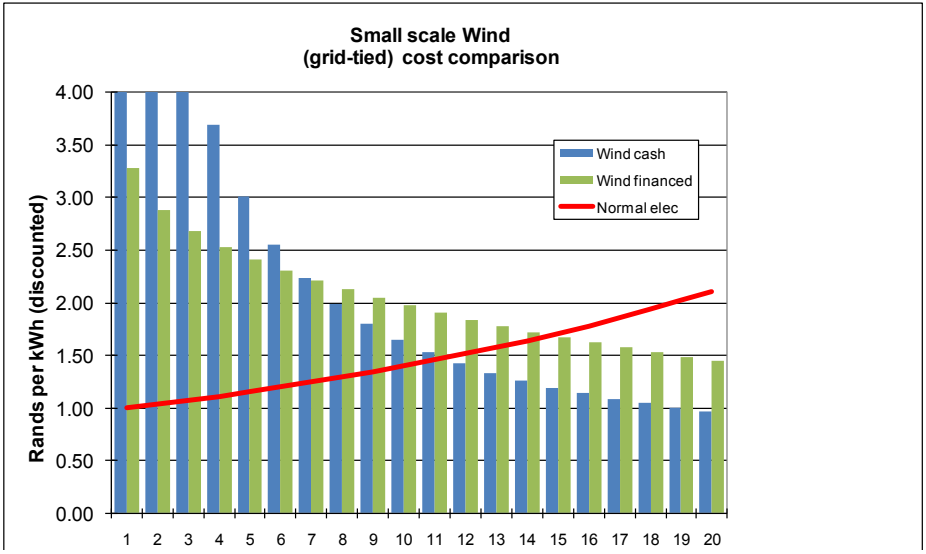

Figure 8 Cost of small-scale net metered wind generation compared with national grid prices

Decentralised, **net-metered solar PV generation** systems are an inevitable part of the future. Prices of solar PV have reduced to the extent that it may soon be the most financially sensible option for a business or household. While these take time to be major contributors to the supply mix, distributors need to plan for and facilitate their adoption, as they will become an important part a low-cost, low carbon, economically resilient city. Such planning will include demand-smoothing measures because of the midday-peaking generation profile introduced by PV. However we should not wait until this detailed planning has been done before we facilitate solar PV net-metering. It will impact on the overall system slowly – a rollout of 10 000 systems of 5kW each will produce 50MW maximum and contribute between 0.5% and 1% to total electricity output of a city.

Contribution of small-scale solar PV and wind, and landfill gas generation to Cape Town's electricity supply picture (illustrative)

	kW/ system	CF	No. systems	Av MW	Peak MW	% of CT MW	Annual GWh	% of CT GWh
Wind	5	20%	10000	10	50	0.5%	87.6	0.6%
PV	5	25%	10000	12.5	50	0.6%	109.5	0.8%
Landfill gas				10	10	0.5%	78.84	0.6%

Small-scale **net-metered wind generation** prices are still relatively high, and thus will be adopted more slowly. Wind costs are also site-specific, and will generally be focused on the windier, coastal areas.

Some municipalities may have nearby perennial **hydro resources** which could provide cheap and reliable power. This is very site specific, and generally only to be considered in the higher rainfall and hilly/mountainous areas of the country. **Sewage methane** power generation is generally more expensive than landfill gas generation, and has much lower potential contribution to city needs.

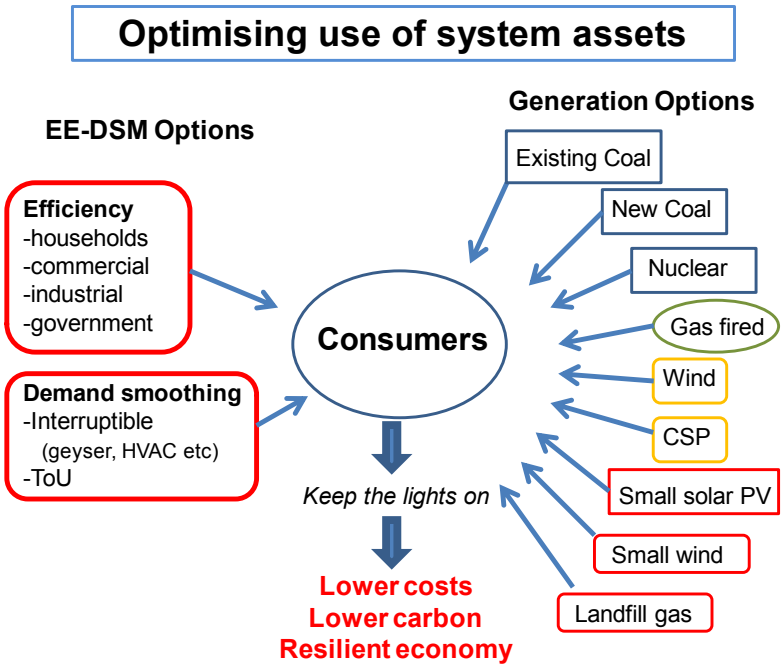

Figure 9 Range of system assets that can be strategically included in a sustainable electricity strategy

9. The need for strategic planning

The city clearly has a strong role and mandate in several areas relevant to an economically and socially workable future. The most obvious is energy efficiency, but also significant is landfill gas and small-scale net-metered renewable generation. In addition, large scale renewable generation PPAs can

be considered, although cities will need to be realistic in terms of the amount of effort required and the capacity to drive this, and complexities around national planning coordination, amongst others.
For distributors to direct their supply systems in a way that supports broader city goals in the longer-term will require something beyond "just keeping the lights on" approaches. Strategic planning is necessary. For many cities that used to have this strategic capacity, the imminent promise of being subsumed into a RED put a stop to forward thinking, and the capacity atrophied. Now with the REDs finally ditched, we need to take up this responsibility again. It is necessary for a reasonably secure, prosperous future. There is usually no department in the city other than the distributor that has the necessary background to take this on.

10. Conclusion – the way forward

The following seem valid:

- Business as usual is likely to result in expensive power systems, higher expenditure by users, and constrained economic growth. To guide the city to a more sustainable, prosperous future, strategic planning is necessary. This will need to involve:
  - Energy efficiency scale-up to massive proportions (it remains much cheaper to save energy than to generate it, and savings are particularly valuable when distribution grids are reaching capacity)
  - Facilitation of net-metered solar PV implementation, and wind generation over time
  - Landfill gas generation project development (though we await clarity on the contribution international carbon finance mechanisms can play in supporting this)
  - Optimising the use of DSM measures to accommodate increased renewable generation in the mix such as interruptible loads and TOU tariffs.
- None of these by themselves are enough to produce the shifts necessary for a more workable future. The challenges are such that we need all of them, even though they might have a small impact at first.
- Engagement with large scale renewable generation PPAs may be feasible, although capacity to pursue this route and coordination with national planning remain issues to be resolved.
- Electricity departments will need to develop the ability for strategic planning to guide this sector such that it supports a prosperous city in the future. Given that half of the current IRP's demand forecast was estimated municipal demand, it is also vital that the capacity to contribute accurate data and analysis to this process is enhanced.

Electricity departments may be concerned that efficiency programmes will reduce their sales and revenue, and scale-down the important role of their department within the city. This seems mistaken. Departments that do not engage in strong energy efficiency promotion and strategic renewable energy facilitation are likely to become less relevant to the future than those that do. Energy is the life-blood of a city system, and tomorrow's energy picture cannot look like today's. While we will always need the solid technical and financial capacity to "keep the lights on" in municipal distributors, we also need a longer-term strategic approach to support city economic and social goals.