ENERGY FUTURES REPORT: Cape Town

Information for decision-makers

CITY OF CAPE TOWN
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Purpose of document:
To present key information from Cape Town energy futures modelling, as well as workshopped feedback on this modelling and the way forward for the City as suggested by various internal and external stakeholders, in order to facilitate the update of the City's Energy and Climate Change Action Plan.

Sustainable Energy Africa
September 2015

SEA SUSTAINABLE ENERGY AFRICA

Background

The City of Cape Town was the first African city to establish an Energy and Climate Change Strategy (completed 2006); a document that sets out a vision for the delivery and consumption of sustainable, environmentally sound energy, and provides quantifiable targets in this regard. It was also a leading city in the implementation and support of such a strategy through the implementation of institutional reforms. The Strategy built on the City's State of Energy report (first completed 2003, updated 2007), which provided a picture of energy supply and demand in Cape Town. Initial energy modelling[1] was undertaken in 2005 in order for the City to assess the implications of different future development paths.

In response to the Strategy and modelling report, the City developed an Energy and Climate Action Plan (ECAP), which was adopted by Council in May 2010. The ECAP is made up of 11 key objectives, further divided into programme areas consisting of individual projects, currently underway or planned, extending over a three-year period. The projects were taken through an initial prioritisation process. However, additional information regarding consumption patterns, costs, trends, risks, etc., was required to underpin the ECAP and thereby verify the initial prioritisation, assist with the setting of targets, and extend the plan into the longer term.

Energy data gathered was used to identify what was termed the Optimum Energy Future (OEF) Scenario, which provides a more in-depth energy sector analysis and projections than previously; based on an extended and up-to-date set of energy consumption data, supply mix options, costing and trends. This exercise was completed in 2011.

This report forms part of a State of Energy and Energy Futures modelling update, to identify any energy use and emissions trends and update the energy futures modelling. It will inform an update of the ECAP targets, and the City's 2040 Energy Vision. This process is in line with the City's international and national emissions reporting and target-setting commitments such as the Mexico City Pact and C40.

Key issues and opportunities

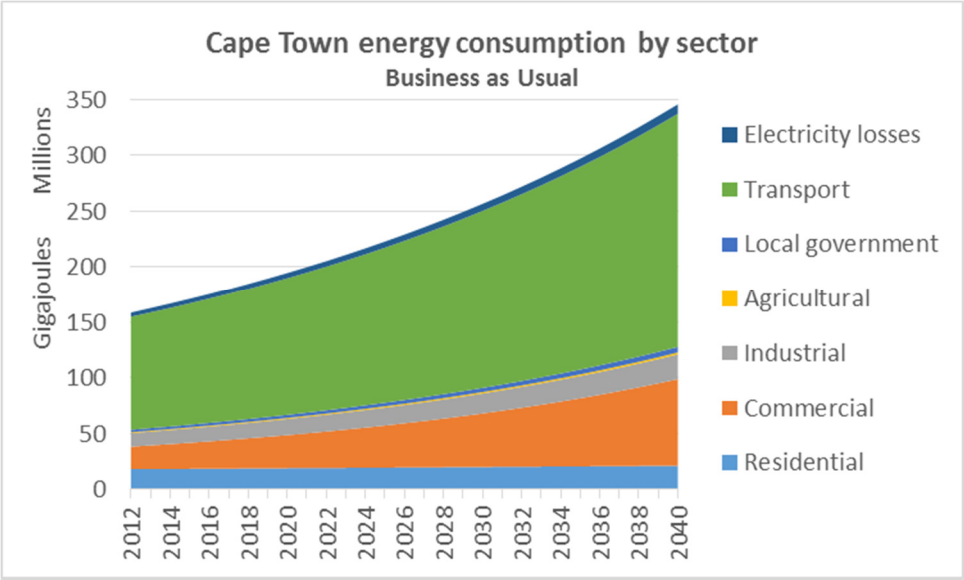
An extrapolation of current city energy consumption trends into the future highlights Cape Town as a city that is vulnerable to rising fossil fuel prices and global emissions constraint charges. City prosperity is hampered by severe inefficiencies in economic inputs and mobility, and 'liveability' is reduced through congestion and the social risk of poverty and inequality. Energy and emissions modelling indicates that an alternative energy future is not only necessary, but also possible given current technologies. Greater efficiencies can be achieved and a new, poverty-alleviating conception of energy services is possible. The city is well-placed to pioneer the new wave of distributed energy generation that is emerging globally. This future holds enormous opportunities, but requires a sizeable commitment to tra nsforming the status quo through, amongst others, urban design, the concept of municipal energy services (vs. energy supply), and the role of local government in directing development directions.

A Business as Usual path is not feasible

[1] Cape Town: State of Energy and Energy Futures Report 2011

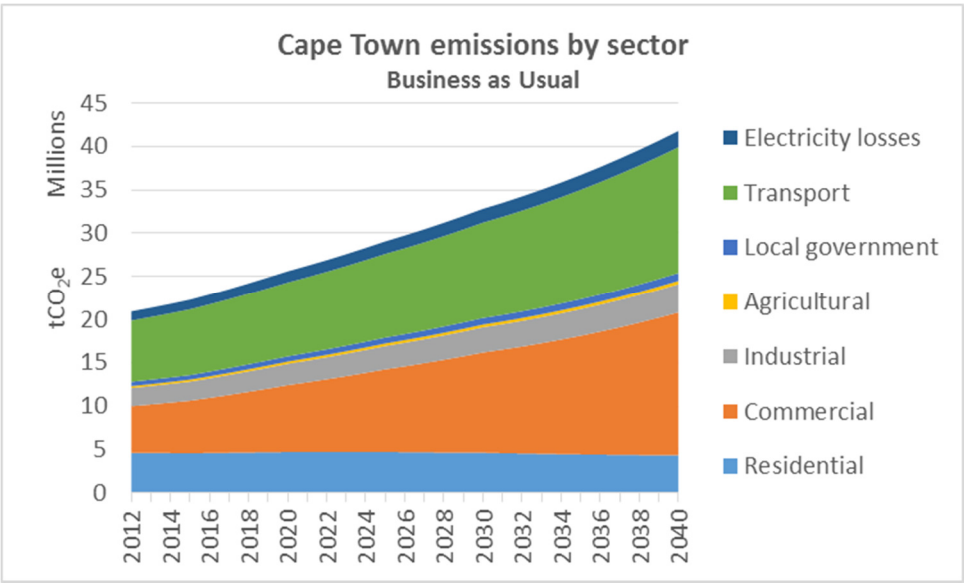
1. Energy consumption more than doubles by 2040

On a Business as Usual energy demand path, energy consumption increases by 118% by 2040, at an average annual increase of 2.8%. The international trend is that resource-efficient cities (using water, energy, etc., efficiently) are more competitive. Following an energy inefficient path will lead to an uncompetitive future.



2. Emissions double by 2040

On a Business as Usual energy emissions path, emissions levels increases by 100% by 2040, at an average annual increase of 2.5%. Energy-related carbon equivalent emissions will increase from 5.5 to 9.8 tonnes per capita. This is well above the 2011 world average of 4.9[2] and the global "fair share" of 2 tonnes/capita required by science to limit catastrophic climate change impacts.

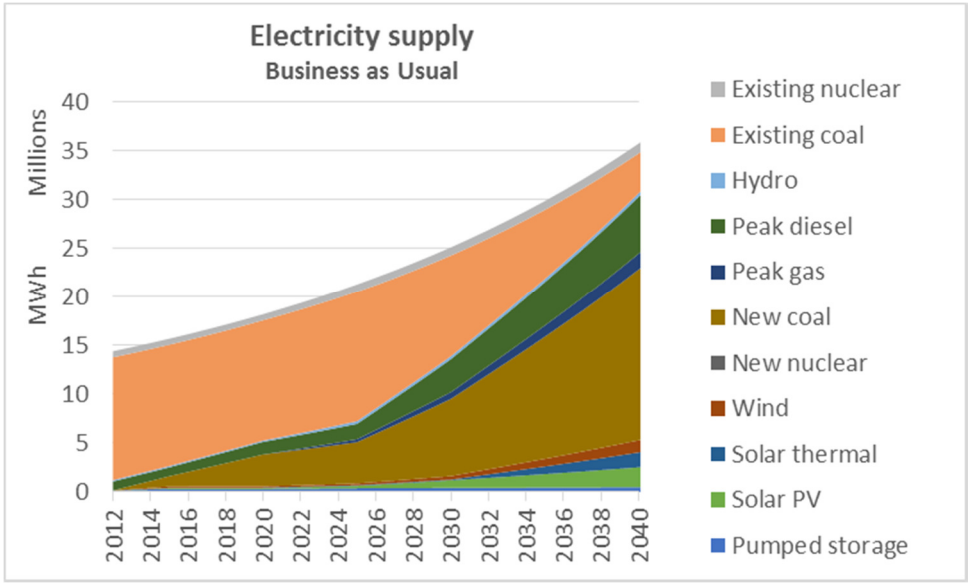


The national electricity build path follows the Weathering the Storm scenario set out in the Integrated Resource Plan 2010 (2013 update), which was felt to be the most likely scenario by

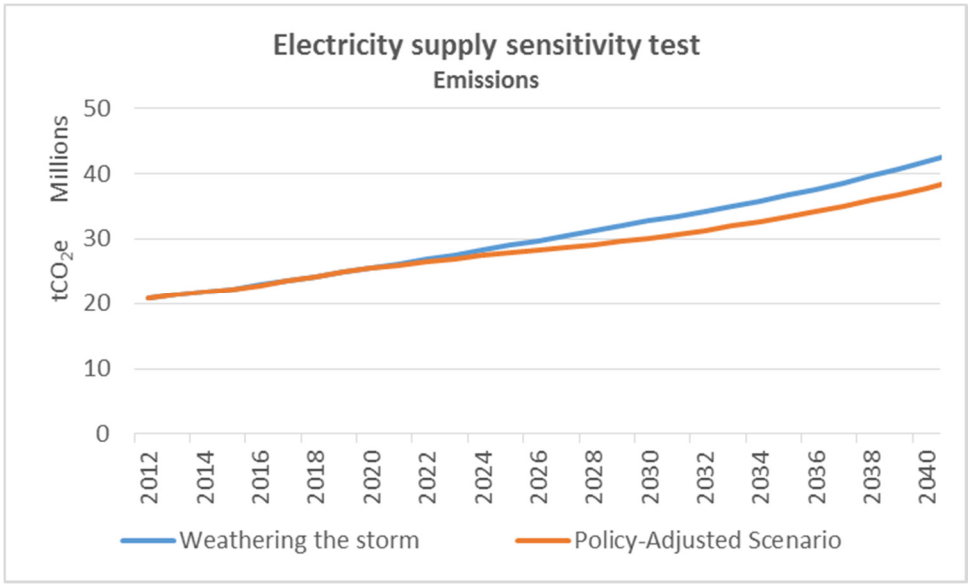
[2] Source: US Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC)

energy experts.[3] This electricity supply scenario excludes nuclear and includes a greater amount of renewables (14.5% of total electricity supply by 2040).

By 2040, electricity still produces a high amount of emissions per unit energy, as coal-fired power continues to contribute to a large proportion of electricity produced (59%). This results in disproportionately high emissions produced by sectors using mainly electricity (e.g. residential and commercial sectors), when compared to those sectors' energy use. Emissions in the commercial sector, in particular, grows fast due to (1) its high reliance on electricity and (2) the high economic and therefore high energy use growth forecast for this sector.



A sensitivity test was done that included the national electricity build path as outlined in the Integrated Resource Plan (IRP) 2010 Policy-Adjusted Scenario. Emissions are lower than the Weathering the Storm Scenario used in business as usual, but still not low enough.

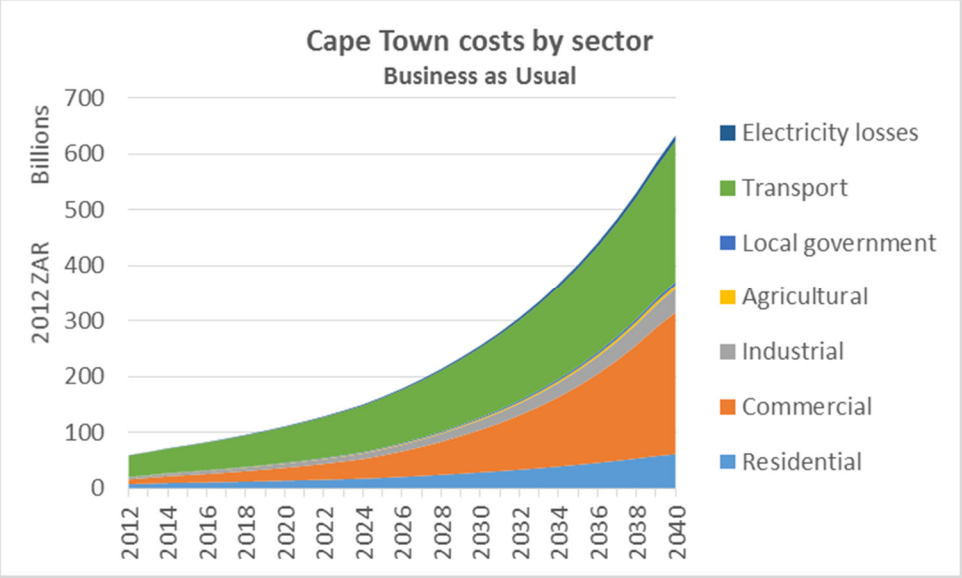


[3] Discussion with Eskom's Power Systems Economics Chief Advisor. It is noted, though, that ultimately the decision will be political and the current outcome is unknown.

The national electricity supply mix will not meet national or local emissions reduction ambitions. The City would need to pursue its own renewable/cleaner energy options and embark on aggressive energy efficiency to be in accord with national and local ambitions.

3. Costs increase dramatically

Costs grow dramatically due to an increase in energy costs. Liquid fuel cost have increased on average 4-6% per annum above inflation over the past decade and this trend is expected to continue. Electricity price increases will also be well above inflation (8% on average).

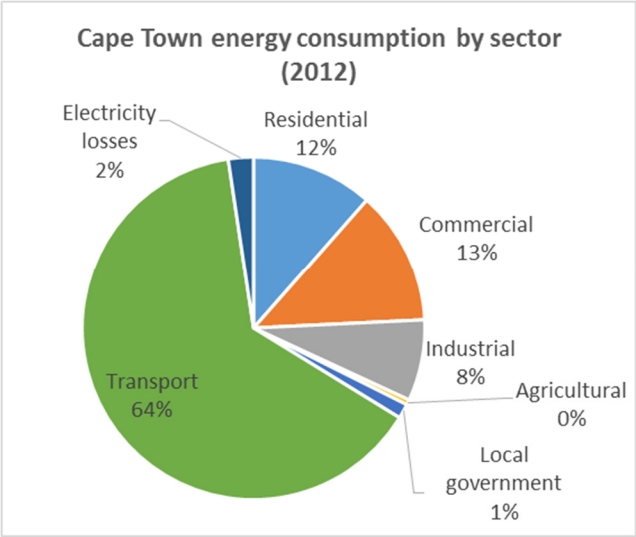


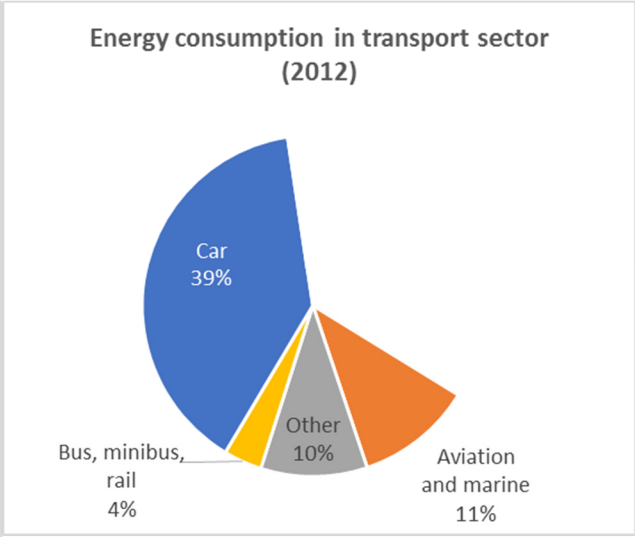
Energy costs place a huge financial burden on Cape Town's residents and economy. There is a particularly high burden on the commercial sector, which is the largest contributor to Cape Town's economy, as a result of (1) the high forecasted economic growth and therefore high energy use growth forecast for this sector, and (2) the high reliance of the commercial sector on electricity, and (3) the escalating electricity prices.

The city cannot afford energy inefficiency in the face of growing energy costs.

4. Transport sector

Almost two-thirds (64%) of all energy consumed in Cape Town is consumed by the transport sector. Again, almost two-thirds of *transport* energy (61%) is consumed by people in cars, amounting to 39% of *total* energy consumed in Cape Town.





The highest amount of energy is consumed in the transport sector and this will only increase over time if left unaddressed. Transport consumes such a vast amount of energy due to the sprawling nature of South African cities, largely a result of car-oriented planning, and inadequate public transport.

The largest amount of transport energy is consumed by people driving in cars; largely on their own. This represents an inefficient use of energy and road space. There is a need to invest in public transport, non-motorised transport and behaviour campaigns (to increase car occupancy and shift people to public transport), but it is critical that spatial form is addressed concurrently, as public and non-motorised transport are not viable in a sprawling city. Densification must also be appropriate, i.e. it is no use to have dense settlements far away from major travel demand routes and economic opportunities.

5. Vulnerable city

Energy consumption in Cape Town currently consists almost exclusively of fossil fuels, which are limited, mainly large-scale (e.g. huge coal-fired power plants), imported (e.g. petrol and diesel) and unstable (load-shedding). This leaves Cape Town vulnerable to price shocks.

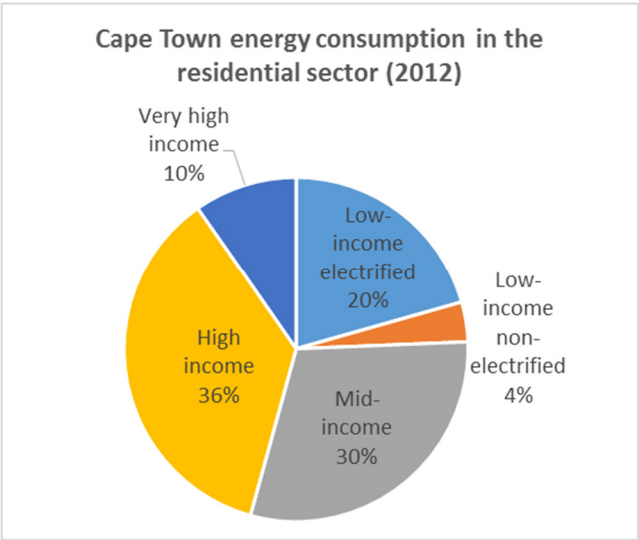
When peak oil occurs (above-normal liquid fuel price increases as a result of oil demand outstripping supply) or a carbon tax is implemented, these costs will be stacked on top of already-high energy costs.

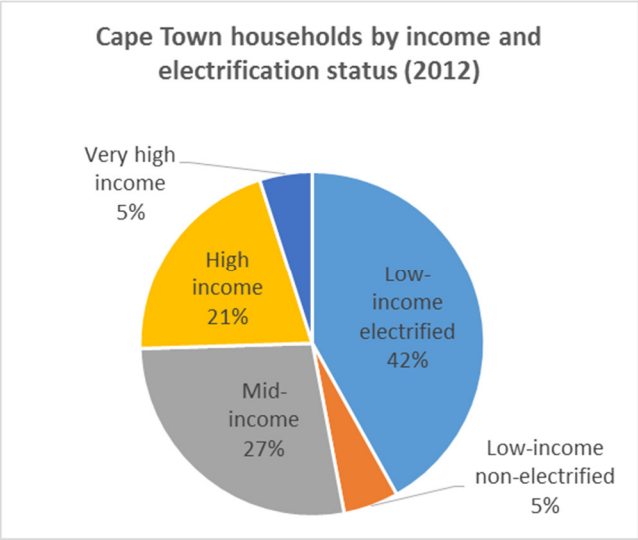
Cape Town is also particularly vulnerable to climate change impacts such as sea level rise, flooding and wild fires.

Reducing energy use, moving towards cleaner and renewable energy, and reducing emissions will to some extent mitigate against these potentially severe impacts.

6. Vulnerable households and inequitable use of energy

Cape Town's residential sector provides a duel problem: while high-income households consume too much energy, low-income households consume too little. Currently, in the residential sector, roughly a quarter of the households use half of the energy (high-income) while half of the households use a quarter of the energy (low-income).





Almost half (47%) of the city's households earn less than R 3,200 per month.[4] Energy poverty, the inability to afford safe, reliable and adequate energy, manifests in the use of unsafe fuels such as paraffin, wood, coal and candles for cooking, water heating and lighting. The use of these fuels places a financial burden on the City as the result of shack fires and health issues (e.g. respiratory problems).

While national government and the City have made remarkable strides in electrifying households (Cape Town is the metro with the highest proportion of electrified households[5]), the future issue would be whether these households can afford the electricity. Some may voluntarily disconnect or opt for cheaper, unsafe fuels in the face of rising electricity costs.

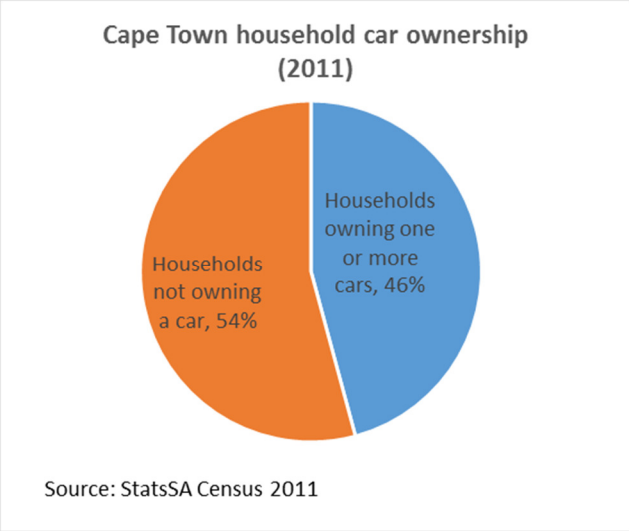
Poor households contribute very little towards the city's carbon emissions, yet they will bear the brunt of climate change impacts such as flooding and wild fires.

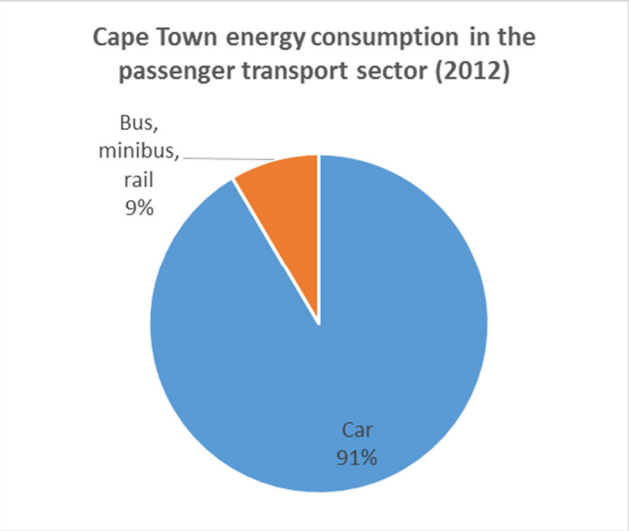
The City should identify and promote access to clean, affordable, safe and reliable energy forms.

Poor households are largely situated in dense "dormitory towns" on the margins of the city, far away from economic opportunities. Transport costs are therefore high and travel times are long. Poor households may not even be able to afford the transport to go looking for jobs. The National Department of Transport indicates that the proportion of overall spending by households on transport more than doubled between 1995/6 and 2005/6; from 4% to 10.6%.[6]

More than half (54%) of all households do not own a car[7], yet indications are that 91% of all passenger transport energy (including energy used by buses, cars, trains, minibus taxis, metered taxis, etc.) is consumed by people travelling in cars. This represents an unfair use of energy. Road space is also allocated unfairly, as most road space is occupied by cars, largely containing only one person.

[4] StatsSA Census 2011
[5] 94% using "electricity as main fuel used for lighting" as a proxy for electrification (StatsSA Census 2011.)
[6] DoT 2014. Speech by Minister Peters on the launch of the 2013 National Household Travel Survey. 17 July 2014.
[7] StatsSA Census 2011





The City needs to focus on the provision of reliable and affordable public transport and non-motorised transport options, whilst also pursuing the need to bring the bulk of the populace closer to work opportunities (or visa versa), through spatial planning.

Opportunities for a more sustainable and equitable future

Aggressive yet attainable/reasonable energy efficiency measures can reduce average annual energy demand growth from 2.8% to 1.7%.

7. Transport efficiency

The transport sector has the highest energy reduction potential due to its current high and inefficient use of energy. Likewise, due to the massive amount of energy consumed by people driving in cars, any increase in car efficiency, either through efficient technology (efficient conventional vehicles, hybrid vehicles and electric vehicles) or through behaviour change (driving slower/less aggressively and carrying more people per car), has the largest energy reduction impact when considered in isolation.

Though the modelling showed that behaviour change and efficient vehicles are the biggest energy efficiency wins, it is based off a premise that passenger transport growth can continue unabated (due to model limitations, no congestion tipping points were included). There are, in actual fact, real road space limits. Therefore the long-term focus needs to be on a modal shift from private (car) to public (bus, train, minibus) and non-motorised (bicycles, walking) transport, as well as a reduction in the distances travelled, through people working from home and the densification of the city along areas of economic activity and public transport corridors. This will require a strong focus on the urban form, as public and non-motorised transport is not viable in a sprawling city.

8. Electricity efficiency

Electricity savings are not as high as transport savings, because (1) less electrical energy is consumed when compared to transport fuels and (2) some measure of electricity efficiency interventions have already been implemented, especially in the residential sector, as evidenced by the decrease in electricity sales to that sector over time since 2007.[8]

[8] Cape Town State of Energy 2015

The greatest electricity savings can be realised in the commercial sector (largely in HVAC and lighting), followed by the residential sector (largely in water heating, with notable savings also possible in lighting and refrigeration). Costs savings potential are the highest in the commercial sector, due to the sector's high forecasted growth and the high electricity price increases.

The commercial and residential sectors should be engaged as a priority. Efficient lighting retrofits represent a quick win in both sectors, usually with very quick pay-back. Inefficient HVAC is more difficult to retrofit. The modelling assumed replacement of these systems as they failed. A similar argument is made for refrigeration (replacing old technology with new as the old technology expires).

The industrial sector is not an area of major focus as (1) this sector is rather small in Cape Town and (2) the efficiency interventions are very particular to each type of business (in the commercial and residential sectors, you are in essence dealing with buildings, not particular industrial processes). Industrial sector energy efficiency is being dealt with at the national level.

The agricultural sector, and therefore energy savings within this sector, is also very small in the metro area.

Local government can lead by example. The highest electricity savings potential here is in street lighting and pumps (in wastewater treatment works, bulk water supply and pump stations).

9. Easing the burden on the poor

The poor need to be brought in to the economy from their current situation on the city outskirts far away from economic opportunities. The focus should be on reducing travel time and costs through mixed-use densification (i.e. bringing together places of work, residence, education, shopping, leisure, etc.) and the provision of affordable public transport.

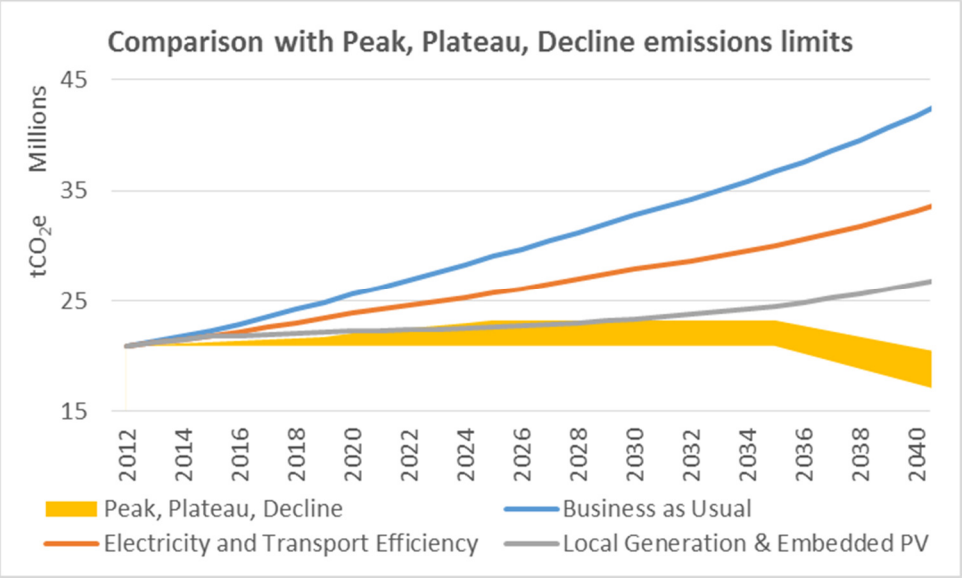
The poor need to be buffered from high and increasing energy costs. There needs to be a shift in thinking; from "providing energy" to "providing energy services," e.g. the installation of a ceiling or solar water heater does not represent the provision of actual energy, but it does the same service as you would get from energy, such as keeping a room warmer (ceiling) and heating water (solar water heater). Electricity tariffs and the provision of free basic electricity/alternative energy need to allow for adequate energy purchases.

10. Emissions reduction

Even when extensive energy efficiency is implemented, emissions still grow over time, though at a lower rate (1.7% vs. 2.5%). Aggressive implementation of renewable and cleaner energy brings emissions growth down further (0.9%). This emissions path brings Cape Town in line with the national commitment towards a Peak, Plateau, Decline (PPD) emissions trajectory[9] only until 2030, after which it departs. National and provincial-level modelling shows similar results, i.e. an inability

[9] South Africa's commitment is not in line with the large majority of interpretations of a "fair" approach to reach a 2°C pathway. This means it is not consistent with limiting warming to below 2°C. Source: http://climateactiontracker.org/countries/southafrica.html

to remain within PPD limits indefinitely.[10] This is not completely unexpected, in the context of a developing country with high economic growth aspirations. Since economic growth (along with population growth) is a key driver of energy consumption into the future, high economic growth results in high energy consumption. Efficiency mitigates this to some extent, i.e. decoupling economic and energy use growth somewhat.



Further intensification of efficiency and cleaner energy actions will be required if Cape Town is to remain within the PPD limits. The field of electricity provision, in particular, is changing fast. There is a global trend towards decentralisation. New technologies such as battery storage may also provide new solutions. If new "game-changer" efficient technologies do not arise, a paradigm shift may be required in how the city uses energy and/or how it values services (i.e. can the economy be expected to grow indefinitely?).

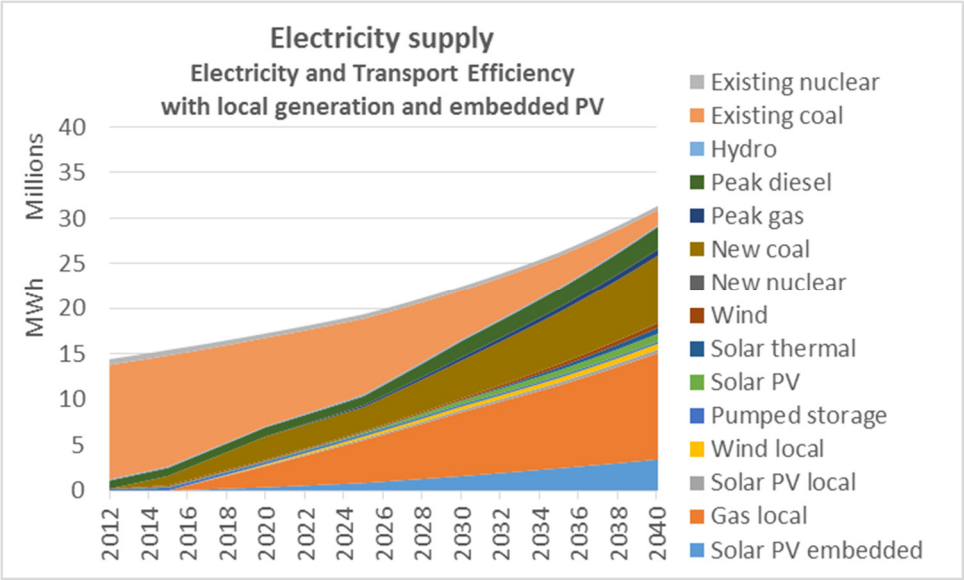
11. Cleaner electricity

Cleaner or renewable energy represents the single-largest emissions reduction potential. Yet this should not be pursued in the absence of energy efficiency. It is still far cheaper to save electricity than to build new power stations (no matter how cheap) to provide the same amount of energy.

The electricity supply required, on top of all the energy efficiency interventions, to bring down emissions growth substantially is quite aggressive, but not prescriptive. It represents a "thought experiment" as to how the City may move forward in light of the fact that the national electricity mix (even if it does include new nuclear) will not be sufficient in reducing carbon emissions to meet national commitments. It remains to be seen whether municipalities will be allowed to generate electricity or buy from a provider other than Eskom, but this issue needs to be taken to national government.

Currently the model includes large-scale rooftop solar PV rollout in the commercial and residential sectors and substantial local generation from gas, with some local wind and large-scale solar PV generation.

[10] "Western Cape Climate Change Mitigation Scenarios exercise for the energy sector" by PDG March 2015 and [national reference – Peta knows]



Rooftop PV may be inevitable in the commercial and high-income residential sectors, as electricity prices rise. The gas generation, on the other hand, may be replaced by alternative dispatchable electricity (e.g. batteries) as technologies change in the future. The Integrated Resource Plan 2010 (2013 update) highlighted the importance of being flexible and taking a least-regrets approach, rather than building large-scale projects with a long time horizon, which may represent stranded assets if the energy demand projected does not materialise. International and national experience also points to the fact that large-scale projects are more prone to run late and over budget than smaller projects.

Rooftop solar PV costs are still relatively high, but in light of rising electricity costs and good solar resources within South Africa, it is becoming more attractive. Rooftop PV costs raise the costs overall electricity supply, but these costs are borne voluntarily by the sectors that can afford them (commercial and high-income residential sectors). Accelerating up-take of rooftop PV in Cape Town does point towards an issue with the current national electricity supply price and reliability.

Going the route of local gas and renewable generation is far cheaper in the long run and produces less emissions than relying on the current envisioned national mix (even if the national mix includes new nuclear).

Given City revenue losses under the current tariff structure in the face of energy efficiency and rooftop PV, the City will need to reconsider its electricity tariffs. The tariffs would need to encourage rooftop PV without threatening municipal revenue.

Rooftop PV will also have load-balancing implications in the long term. Battery storage may be a solution if technology costs become viable.

12. Institutional capacity

Given the rapidly-changing energy environment, in particular the electricity supply sector, new City capacity, both in staff numbers and technical skill-sets, will need to be built. New technologies and a departure from business as usual requires innovation and “out the box” thinking. This, in turn, requires capacity and new skills in order for implementation to become a reality.

2040 energy vision

The 2040 energy vision, as presented in the stakeholder workshops, included the following goals for 2040:

- 16% reduction in energy per economic unit
- Less dependency on coal, through large-scale embedded generation (rooftop solar PV) in the commercial and residential sectors
- 500,000 solar water heaters across city rooftops
- A passenger modal shift from private to public transport
- Increased densification levels in areas of economic activity
- 40% reduction in carbon emissions; 21% from energy efficiency alone
- A diversified energy supply, e.g. additional local gas, wind, storage
- Motorised passengers travel in efficient vehicles with higher occupancy levels
- Large-scale energy efficiency is implemented and cleaner energy is used
- Access to public transport, with reduced travel time and distance

Way forward

Seven consultation workshops were held with key stakeholders, including provincial government, business, civil society, academia and City staff from various departments, including finance, trade and investment, utilities, environment, economic development, transport and planning departments amongst others. The vision provided the "what should be done," while the stakeholders workshopped "how it should be done," with a particular focus on the next five years. City departments will be sent a list of collated actions for discussion, alignment and acceptance, after which they will be incorporated into the City's Energy and Climate Action Plan. Particular points for high-level consideration include:

a. There has been broad acceptance from all sectors around the vision. If anything, there has been a call to deepen the levels of ambition relating to efficiency and renewable energy targets.

b. There is a need to consider the institutional development required to manage the energy transition proposed. This would include:

    i. Supporting longer-term, big picture considerations, while balancing these with short term *actions* and identify tensions here that need to be addressed, e.g. financial "cost to company" approaches vs. longer-term socio-economic investments, sustainability and city prosperity.

    ii. Shifting the city from an institution designed to manage the status quo to one that drives innovation, e.g. ensuring that at least half of all city planners are not just "statutory planners" but are "development activists," considering the possibility of an overarching Planning Unit to direct and align the vision and related actions.

    iii. A key activity in the short-term will be to align the City's financial vision/plan with the energy vision/plan.

c. This is a city-wide vision. While the City as an institution needs to lead and to catalyse the action, there are multiple stakeholders. How to hold, maintain and leverage these partnerships necessary to drive transition needs attention.

d. Linked to the above, the need to invest in communication in the broadest sense and to use existing platforms (e.g. the Chamber of Business, Cape Town Partnership, etc.).

e. Within this broad transition agenda, the City needs to identify the key catalytic City actions. These must include:

    i. Development planning approaches that promote the transport/mobility direction required – greater public transport, greater non-motorised transport, and higher levels of occupancy – and align human settlements with urban development.

    ii. Regulation and or interventions (infrastructure or programmes) that support and promote the transport/mobility direction.

    iii. Development of the emerging City concept of energy services delivery that engages with distributed and small-scale energy generation, efficiency and integrated household energy services.

    iv. Fiscal planning and management that supports the transitions. The energy vision must influence City capital and operating spending and must be visible in performance monitoring systems.

f. Transition is iterative and the attitude of learning-by-doing should be embraced. MyCiTi, for example, clearly indicates that densification is critical. Simultaneously MyCiTi may be resulting in attracting developers along transit routes, which is a positive example of how City investment and leadership can leverage the private sector.