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SOUTH AFRICAN LOCAL GOVERNMENT ASSOCIATION
SALGA
Inspiring service delivery

SALGA comments: IRP base case

Submission – Executive summary

March 2017

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1 Glossary

EE	-	Energy efficiency (often the efficiency of electric end use technologies)
DOS	-	Distributor own supply. Utility scale generation either owned by the electricity distributors, or IPP with PPA contract with municipality.
LG	-	Local Government. Usually in this document referring to LG electricity distributors which have been engaged in a process of analysing the IRP2016 Base Case and making comments on it.
IPP	-	Independent power producer. Privately-owned generator, typically utility scale, any technology.
IRP	-	Integrated resource plan, the result of a specific type of electricity planning that extends assessment of centralised generation technology systems to assessment of the whole electricity system, including energy usage technologies, demand management, and network services into account, to achieve least cost systems.
PPA	-	Power purchase agreement. Often used by utility (central buyer, LG electricity distributor) to source electricity from IPP.
PV	-	Photovoltaic. Typically PV panels used either on residential roofs in small configurations (1-5kW), factories/commercial buildings (up to 100kW or more), utility scale PV 'farms', from 10-200MW or more.
SSEG	-	Small-scale electricity generation. Typically (but not only) PV

2 Context

On the 22nd November, the Minister of Energy announced that a consultation process for the updated Integrated Resource Plan (IRP), and invited the public to make inputs and comments before the 15th of February 2017. The IRP will present a mix of electricity generation technologies options to meet the forecasted demand for the period 2017-2050.

2.1 The consultation process

The Minister gave notice of "roadshows in the major cities between 7 December to 15 December 2016 and further "provincial consultation roadshows" in January, with consultations open until the 15th February 2017. There has been strong interest in the process so far, both at the roadshows and in the local media, with some economically powerful stakeholders making inputs. Many stakeholders submitted that the time allocated to the consultation process was far too short. The date for submissions was subsequently extended until 31 March 2017. SALGA was invited by the Department of Energy to make a comments on the IRP base case in the interdepartmental consultation.

2.2 LG and SALGA submission

The IRP is of significant importance to local government (LG) mainly since the decisions made in the IRP will impact on the electricity price from the grid. The IRP also depicts a vision for the South African electricity sector until 2050. With municipalities accounting for more than 40% of the electricity consumed in South Africa, and with the current global changes in the electricity value chain, particularly at distribution level, municipalities will play an increasing role in the sector and have the opportunity to be a dynamic factor in the electricity value chain, offering load management, flexibility and investment opportunities. Greater energy management at local level may also be important in providing much needed economic growth in cities.

LG and SALGA are hereby making a submission. SALGA believes that the consultation process needs to provide more details of how LG will engage with subsequent scenario formulations, scenario evaluations and assessments and the decision process leading to the next iteration of what is the current IRP2010-2030. Please refer to the "conclusion and way forward" section for LG requests and suggestions.

This larger document provides the background information for the summary document: "SALGA Comments on IRP Base Case March 2017_submission executive summary".

3 Introduction[1]

The Integrated Resource Plan (IRP) is *the* key electricity planning document of the South African Government.

South African municipalities play a vital role in the electricity sector because the constitution assigns the function to reticulate electricity to local government. Given that LG represented more than 40% of electricity energy demand on the national system, and serves the majority of customers, and given the increased integration of local generation and energy services technologies with centralised generation technology systems, and given cooperative governance requirements, the integration of local government in the national system planning is essential.

This integration has taken on additional importance over the past ten years, and this is likely to increase. With the substantial increases in real electricity tariffs as well as the decrease in the cost of energy efficiency and local energy service technologies and solutions, many of these 'behind the meter' and out of effective regulatory 'restrictive reach', consumers are investing in new technologies at their own initiative. This reduces their electricity consumption and/or substantially changes demand patterns, with significant implications for centralised generation technology system with a top-down, one-way supply approach. Municipalities, driven by similar issues involving technology developments and relative costs, and combined with commitments to reduce their carbon footprints, are also investigating opportunities to reduce the GHG emissions content of their electricity services, while at the same time using these opportunities to improve access to sustainable and affordable sources of electricity and energy.

The changing energy landscape in municipalities (greater energy efficiency, increased embedded generation, substitutes for energy services) affect demand on the national grid and the demand forecast. In parallel, major opportunities arise for municipalities in the electricity generation space, through solutions and systems which often have substantial local co-benefits, such as local economic development or air quality management. The IRP should thus consider both the elements that make up these solutions (e.g. SSEG), the systems that will enable the integration of these elements (e.g. appropriately configured distribution networks; appropriate metering and tariff systems) and the planning processes that can effectively incorporate these into a national plan that reflects the rapid and possibly profound transitions that very plausibly will take place in electricity systems in the IRP2016 planning period until 2050.

Besides the technology and economic drivers mentioned above, LG also faces severe challenges related to tariffs, subsidies and finances and as a result has to (and some LG are already) develop and implement new business models to ensure financial viability. This is a global trend but is exacerbated in South Africa owing to challenges involving a combination of rapid structural increases in bulk supply costs from the national grid and

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[1] Several portions of this section, are largely inspired by the Briefing Papers on Cities and Electricity: Briefing paper 1: Understanding Electricity Demand Patterns in South Africa's cities ; Briefing paper 2: Understanding recent changes in the electricity supply industry with particular reference to new energy and South Africa's cities ; Briefing paper 3: Implications of electricity demand and supply dynamics for South Africa's cities; Briefing Paper 4 Critical issues facing South African cities with respect to electricity. Also, it is LG view, that a thorough familiarity with these reports, and the other references mentioned in this submission, would be useful in further understanding the position described in this submission.

specific service delivery challenges including rapid expansion of services and cross-subsidies.

While the beginning of this introduction has focussed on electricity industry issues, it is most important that the IRP recognises and incorporates the perspective that **the prime concerns for LG are poverty eradication, and socio-economic development. Electricity plays a key role in these, for example through affordability for energy services provision,** competitiveness of electricity for economic production, and opportunities for industrial and economic investment and environmentally and financially sustainable development.

The rest of this document compiles specific issues and comments that LG would like considered in the IRP update process, with the view of ensuring that the IRP is a plan of all key actors of the electricity sector including local government.

4 The South African IRP: differentiating between an Integrated Resource Plan and a Conventional Utility Generation Capacity Expansion Plan

Two general definitions of IRP have guided the overall analysis in compiling LG comments.

1. "IRP is the basis for supply side and demand side commitments, the principal basis for making those decisions. Minimizing the present value of revenue requirements[2] is the principle decision criterion, and it's a long term horizon, 20 plus years." [3]

2. "Integrated resource planning differs from traditional utility planning practices primarily in its:

    - increased attention to demand-side management (DSM) programs and its
    - integration of supply- and demand-side resources into a combined resource portfolio." [4]

Held against these definitions the South African IRP could be more likened to a traditional generation capacity expansion plan, prioritising a plan for meeting specified demand from conventional centralised generation technology system. While its stated basis is minimising revenue requirements (the tariff level), within the always implicit acknowledgement of adhering to general policies, it does not integrate demand side resources into a combined resource portfolio, which is generally required in integrated planning. An analysis of many of the individual issues in the remainder of this document reveals that application of these two basic requirements would have led to the IRP addressing a significant portion of the issues raised in this document.

[2] In the South African case this would translate to minimising system capex plus opex cost, to meet demand

[3] A competitive electricity market: Implications for integrated resource planning. Harvard Electricity Policy Group, San Diego Conference, 13,14 January 1994.

[4] Schweitzer, M. Hirst, E. Hill, L.J. 1991. Demand-Side Management and Integrated Resource Planning: Findings From a Survey of 24 Electric-Utilities. Oak Ridge National Laboratories, Oak Ridge, Tennessee.

As such, SALGA would like to ensure that the planning realises the well-analysed benefits of integrated planning over those of conventional generation expansion planning and wishes engage with the DOE on how best to include them.

5 IRP2016 Base Case demand forecast

5.1 Total energy services demand vs. demand on the centralised generation technology system

It is necessary to explicitly differentiate between total demand for energy services that could be covered in the IRP through "integration of supply- and demand-side resources into a combined resource portfolio[5]", and what we will refer to as demand on the centralised generation technology system, which is the priority of the generation capacity expansion plan of the November 2016 draft of IRP2016 Base Case.

The following example demonstrates the differentiation, and why it is necessary.

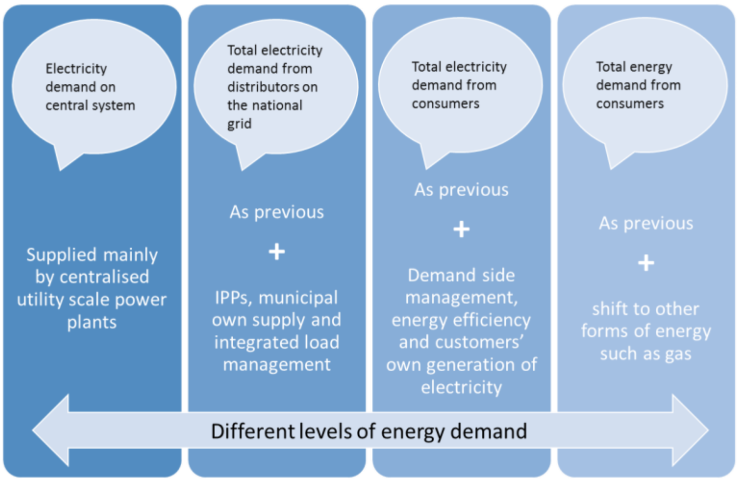
A typical demand side resource would be the load shifting that can be achieved through 'ripple-control' of electricity hot water heaters (geysers). Simple, very-low-cost technology has been applied worldwide and in South Africa from the 1960's (at least) and can provide significant cost savings and also, in time of supply-system constraint, reduce the need for load shedding. A low cost switch is installed on geysers and at peak times a signal is sent to selected geysers, switching them off for periods so short that the thermal inertia in the water prevents service levels being appreciably altered. The hot water is being used as "electricity storage" for usage at peak demand times.

The peak demand can be significantly reduced, while providing the same service. The result is that the whole electricity system (generation, transmission and distribution) can be smaller, lowering costs and tariffs. This benefits the customers and the national economy.

This example demonstrates that demand for energy services (hot water) can remain the same while demand for electricity on the centralised generation technology system can be substantially reduced. It also demonstrates the potential large-sub-optimalities that can result from not considering demand-side resources appropriately.

The example above illustrates demand side solution through ripple control. There are many other ways of providing energy services to customers and centralised generation is only one of them. The graph below represents the different types of solutions to meeting energy and electricity demand at different levels:

[5] See definition of integrated resource plan above



As prices of electricity from the central grid increase and demand-side, distributed and embedded technology costs decrease, there are a number of demand-side resources that are becoming increasingly cost competitive and in many cases already offer least cost, or most-affordable energy service solutions, from a customer point of view.

Using solutions such as demand-side or distributed or embedded technology, when their costs are lower than the equivalent centralised generation solution can benefit the local economy through lower costs of services, higher economic efficiency / competitiveness, lower flow of payments for electricity out of local economy and can participate to the development of local energy services industry, creating employment and socio-economic development. In turn, it also benefits the natural environment, the national economy and customers through lower costs and better affordability.

5.2 LG electricity distributors' demand on centralised system

LG represents 40% of demand and is by far the largest single category. Its demand profile differs from Eskom distribution as well as other sectors and has largely remained flat since 2008 (see Figure I below). As it stands, municipal distributors' past and planned demand curves, combined with local realities, differ quite significantly to the IRP2016 Base Case demand forecast.

Figure I – Historic Eskom electricity sales[6]

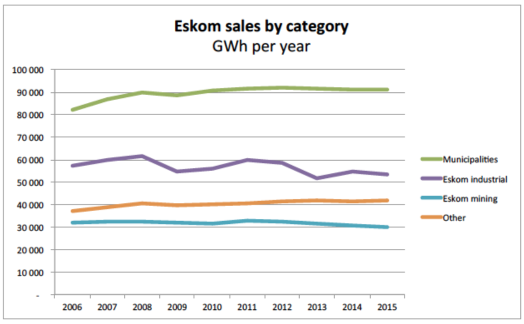


Figure 8: Eskom's sales by main customer category

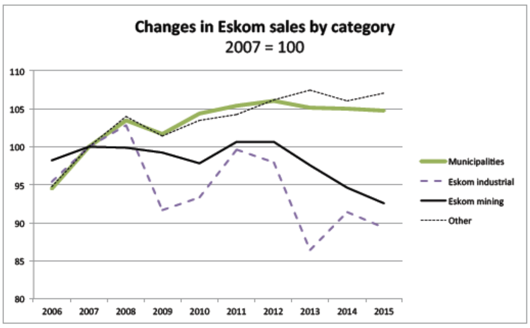


Figure 9: Changes in Eskom sales by customer category

Figures II shows a significant drop in demand for the metros from 2007-2015. In most municipalities, over the last ten years, electric-energy consumption has either decreased or increased marginally and has become more peaky: i.e. the ratio of peak demand to energy supplied has increased.

Figure II – Historic metro electricity consumption[7]

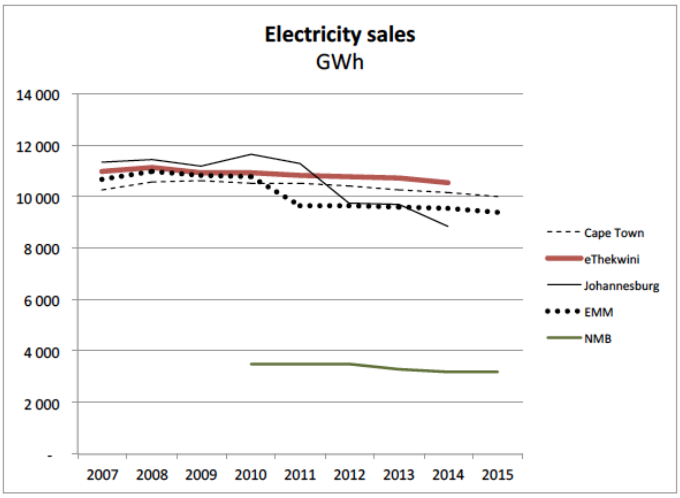


Figure 14: Metropolitan electricity sales

Table I - Example of demand feedback from municipalities (high level impressions):

Type of municipalities	Impressions on demand
Metro 1	Load is getting more peaky. Overall demand decreased by 10% but peak demand went up.

[6] http://cityenergy.org.za/uploads/resource_363.pdf Briefing Paper 1 Understanding Electricity Demand Patterns in South Africa's cities
[7] Same as previous

Metro 2	Demand sensitive to economic growth in commercial sector. Demand increased marginally over the past years
Metro 3	Demand in kVA remain stagnant, but energy demand lower (EE, PV -> price elasticity)
LM 1 (small community + central transport node)	Over the last years, no growth in the town. However, discussion of big mining development could change the future perspectives.
LM 2 (Development node)	Demand of total municipality: some growth to a small extend. Residential and lower income components: expect influx in the next years (not using much energy put will push up the demand component – PEAK).
LM 3 (secondary city)	Although still connecting new Electrical connections similar than in the past, the physical consumption has decreased per connection. This is also the case in Cape Town or eThekwini for example (see Figure III)
LM 4 (small towns)	see a small growth in demand. Expecting massive influx to do possible but uncertain big development
LM 5 (secondary city)	Demand in MVA has significantly decreased (by 9%) over the past 10 years. Consumption going down due to own generation. Seeing a shift in electricity consumptions despite no exodus from the city

Figure III - metros' average consumption per domestic connection, showing a decrease over time[8]

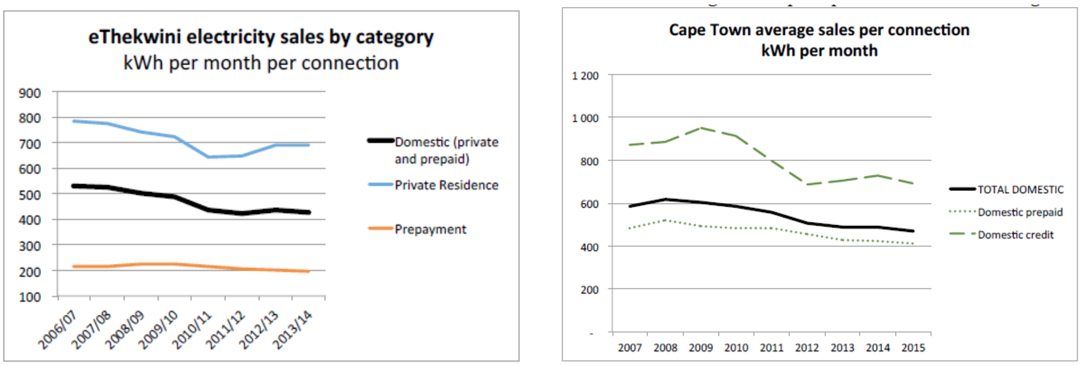


Figure 25: Average consumption per domestic connection (eThekwini, *Figure 23: Average consumption per domestic connection (Cape Town)*

There are marked differences between municipalities in terms of the sectoral demand characteristics. Some important ones, among many, are that in some areas even though connection numbers are increasing, energy per connection is decreasing; demand in some cases is sensitive to commercial sector economic performance, and that while demand from existing customers is decreasing, in special cases new singular industrial developments (if they arrive) will boost electricity generation.

Despite these difference, **LG representatives also (largely) agree that firstly, at least until around 2020, their demand will be decreasing or flat, and; secondly, that after 2020 it will most likely increase at a rate substantially lower than the low scenario of the IRP2016 Base Case forecast rate**, owing to a number of developments, in particular the introduction of new technology such as EE, SSEG and others as previously mentioned.

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[8] Same as previous

Some of the largest metros are planning for a significant decrease in demand from the central grid. One of the largest "suggests a reduction on the National Grid from approximately 92% in the short term (next 5 years = 2020), to approximately 60% over the medium term (next 15 years = 2030)[9]." The city of Cape Town forecasts a further drop in electricity demand until 2020 (figure IV).

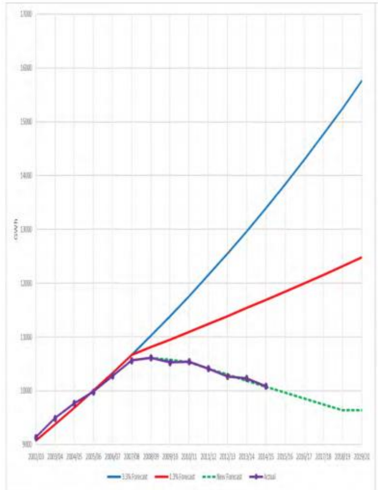

Figure IV - City of Cape Town historic electricity consumption and forecast[10]

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

In the future, it is highly plausible that electricity demand from LG that is currently met by the centralised generation technology system will increasingly be most economically substituted by a variety of local energy services solutions (see Rapidly Changing Industry section below). **LG does not seek to under-emphasise the need for an increase in total energy services for socio-economic development and, to this end, LG recognises the importance of the total supply of energy services increasing to meet socio-economic development objectives. This however does not necessarily translate into electricity demand on the centralised generation technology system increasing at the same rate, or increasing at all. This is because elements of the most economical supply of energy services will in future be increasingly provided by a mix of technologies within distribution grids or behind customer meters**, inter alia:

- Energy efficiency.
    - As electricity prices rise and prices of efficient technologies decrease, much greater energy service levels can be provided with far less electrical energy. This is somewhat catered for by the "electricity intensity" "correction factor" in the CSIR demand forecast, but this is a very 'blunt tool' and does not take into account details of trajectories in energy efficiency technology costs, non-linearities in substitutions (tipping-points are an example of this), and price elasticities and differentials between sub-sectors.
- SSEG for own-supply and supply onto the grid, with potential developments in prices and storage over the timeframe of the IRP2016 being disruptive.
- Distributor own-supply (DOS)
- Large customer own-supply and supply onto the grid

These developments are already being observed, despite the existing arrangements which often dis-incentivise them. They are largely arranged with private investment and initiative. For economically optimal uptake they are best integrated pro-actively in conjunction with 'smart' load management by electricity distributors. In addition to being

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[9] Written communications, not yet confirmed for attribution. These kind of data and inputs could be viewed as crucial for an integrated planning process which actively engages the biggest customers and customer classes, especially very large distributors with critical expertise and information regarding evolution of demand.

[10] http://www.energy.gov.za/IRP/irp-presentaions/cape-town/City-of-Cape-Town-Submission-on-IRP-2016.pdf slide 5

lower cost and hence providing lower cost services and stimulating the economy, these local solutions also make a substantial contribution to local industrial development. There is thus the option of facilitating voluntary private investment in energy services, which lower electricity prices while removing load from the state-funded electricity supply, in a context of increasingly limited and high-cost financing for centralised generation options.

Some metros have prepared analyses and plans incorporating such solutions. These are not mentioned in the IRP2016 Base Case. Municipal representatives involved in the engagements to prepare this SALGA submission report have not been actively approached by the department and planning officials for this key data. It is not appropriate for such data to be provided in a very time-pressured one way “invitation for submissions” process as the kind of planning for the IRP requires active collaboration. They are thus mentioned here, with some key data, but the recommendation for inclusion of this information in the plan involves active collaboration in the IRP process with LG electricity distributors.

For example, the City of Johannesburg, has made an input informing the IRP submission that it is planning for a future where 66% of its supply would come from the centralised grid by 2050, while the rest will be supplied by a range of distributed local solutions. The City of Cape Town has signalled its interest to source a substantial part of its supply independently from the centralised generation technology system and has developed electricity analyses that show substantial savings from sourcing a significant portion of its supply from low-carbon IPPs. On first analysis[11] this is not done at any additional cost to the centralised generation technology systems (integration costs[12]: see reference below for definition).

These LG plans indicate that some LG electricity distributors are being put in the position where ongoing reliance on the system envisaged by the IRP2106 Base Case would result in significant unnecessary additional electricity system costs, and hence tariffs for its customers. Also, electricity supply would account for significant unnecessary greenhouse gases emissions. The IRP has to take such options into account in its demand forecast, or at least in some of the scenarios.

5.3 Comment on the demand forecast methodology: the need to include price elasticities

Since 2007, after a century of invariable increasing demand (albeit with some volatility and a few years here and there of reductions), electricity consumption in South Africa has demonstrated an apparent deviation from previous patterns. Demand peaked in 2007, stayed flat and by 2016 was lower than in 2007. This could partly be explained by a chronic supply shortage. However, recent alleviation of this shortage since mid-2015 and the re-establishment of a supply surplus on the national system has not led to resumption of the increasing demand. Also, as outlined later, submissions by stakeholders who have

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[11] The analysis uses the Eskom Megaflex tariff with the assumption that these tariffs cover peak system costs: i.e. that the metro sourcing substantial supplies from variable sources not from the current centralised generation technology system currently supplying the national grid would not impose significant integration costs.

[12] Hurth, Lion, Falko Ueckerdt & Ottmar Edenhofer (2015): “Integration Costs Revisited – An economic framework of wind and solar variability”, Renewable Energy 74, 925–939. doi:10.1016/j.renene.2014.08.065.

substantial experience and knowledge, and the results of research indicate that there could be a structural break in the patterns of demand for electricity from the centralised generation technology system.

Demand is complex and subject to many variables. Possibly the biggest change from the pre-2007 era to the current era is a structural change in electricity costs, and hence in the regulated electricity tariff. In spite of a fourfold increase in tariffs from 2007, Eskom continues to submit to NERSA that tariffs do not cover the centralised generation technology systems. A recent study conducted for government forecasts ongoing increases in real prices[13]. The previous IRP2010-2030 also forecast price increases until 2020, with a levelling off. The latter did not take the large Medupi and Kusile overruns into account, which would have exacerbated the increase.

In the medium to long term, demand for electricity from energy intensive industry is impacted by relative costs between SA and alternative locations. Where energy input costs are an important factor for locating an industrial facility, the differential between costs in South Africa and alternative markets will effect investments decisions. Relatively very low South African electricity costs (and hence prices) have historically been an important factor in investments in domestic energy intensive industry. The IRP2016 Base Case demand forecast does not take the recent structural changes in South African electricity costs compared with electricity costs in alternative investments destinations into account.

The CSIR demand forecast report[14] does not include price-elasticity of demand as an input variable but the peer-reviewed paper[15] (Koen and Holloway, 2014) indicate a “need to study the effect of the price increases on demand.” This is a serious omission. The effects of price is stated much more forthrightly in a 2015 peer-reviewed academic study[16] (Blignaut et al, 2015) of the impacts of price on demand which states that:

> “Our results show that the majority of industrial sectors have become much more sensitive to changes in the price of electricity following 2007/2008, indicating to policymakers that tariff restructuring might influence consumer behaviour significantly.”

Another peer-reviewed paper[17] (Cameron & Roussouw, 2012) comes to the conclusions with regard to price impacts on industry financial viability that “13 sectors (5-digit SIC) contain tipping points accounting for approximately 25% of Eskom revenue”, and that ”6 customers were flagged that clearly appear to potentially be in jeopardy based on the various tipping point analysis - accounting for 4.1% of the utility’s revenue and 3,623 GWh energy (4.0% in 2011 terms).”

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[13] Genesis Analytics, 2016. Eskom Asset Restructuring –A Study into the Impact on the Long-Run Tariff Path May 2016. Business leadership South Africa. Trade and Industry Policy Strategies. Genesis Analytics (Pty) Ltd Office 3, 50 Sixth Road Hyde Park, 2196, Johannesburg, South Africa.

[14] CSIR,2016. Forecasts for electricity demand in South Africa (2014 – 2050) using the CSIR sectoral regression model January 2016 Project report Prepared for: Eskom (as inputs into the IRP 2015 (sic))

[15] Koen, R. Holloway, J. 2014 Application of multiple regression analysis to forecasting South Africa’s electricity demand. Journal of Energy in Southern Africa , Vol 25 No 4, November 2014

[16] Blignaut, J. Inglesi-Lotz, R. Weideman, J.P. 2015. Sectoral electricity elasticities in South Africa: Before and after the supply crisis of 2008. Afr J Sci. 2015;111(9/10), Art. #2014-0093, 7 pages.http://dx.doi.org/10.17159/ sajs.2015/20140093

[17] Cameron, M. and Roussouw, R. 2012. Modelling the Economic Impact of Electricity Tariff Increases on Eskom’s Top Customer Segment. International Journal of Energy Engineering 2012, 2(6): 315-331DOI: 10.5923/j.ijee.20120206.06.

The EIUG made the following statements in its presentation to the IRP2016 hearings.

> "South Africa's electricity demand has not grown since 2007, due largely to structural (not cyclical) changes in commodity markets, weak economic growth and energy efficiency. The lack of generation capacity was not the main reason for the drop in demand, meaning the availability of new capacity will not automatically cause renewed demand growth."

While price elasticity of demand in the post 2007 era has not been well-studied, and are thus not yet well-understood, the available studies that have been identified above, and the corroborating EIUG statement, indicate that prices could impact demand to the extent that the validity of the IRP2016 demand forecast is seriously brought into question, especially if, given the level of uncertainty and absence of thorough evidence based analysis, only this one demand forecast is allowed to serve as justification for the amount of capital expenditure which the IRP could lead to.

Further examination of the 2014 paper describing the model used for the CSIR demand forecasts reveals additional concerning detail. The paper states that (page 54): "Each sectoral model should to some extent accommodate factors that are believed to be influencers of electricity consumption in that sector, i.e. be logically defensible", but then states in the concluding remarks (page 56) that: **"Our chosen data-driven methodology has the disadvantage of not being able to model the effect of variables that did not play a statistically significant role in the historical data, or of causal factors which could not be quantified."**

It appears that a combined assessment of the studies mentioned above and submissions by the EIUG (see above and below) and LG metro electricity department energy and electricity analysis and planning documents (see above) are compelling in the evidence they present that **price should be included as an important factor in the demand forecast.**

The coverage of the potential limitations in the IRP demand forecast, should include what the impacts on the IRP could be and what the various risks might be for various stakeholders, and how these are mitigated, or not.

Combined with the previously mentioned analyses of LG demand, these additional concerns about the demand forecast methodology raise further **substantial questions regarding the relevance and validity of the demand forecast used in the November draft of the IRP2016 Base Case.**

5.4 The risks of over-building

The EIUG also made the following statement in its presentation to IRP2016 hearings which talks about the risks of over-building:

> **"Over-building, leading to over-capacity will result in severe price increases, stifling further growth and triggering a negative spiral, where above inflation price increases and falling demand feed on each other".**

This is a legitimate concern for LG because the cost of over-building will in the end be paid mainly by residents and local government consumers[18]:

1. Electricity costs will increase unnecessarily if investments are made to meet perceived demand which does not materialise
2. If demand does not materialise fixed costs will still need to be paid, increasing electricity prices even further.
3. The negative spiral will exacerbate this as mentioned by EIUG
4. This will lead to second order effects (see analysis below): unnecessary acceleration of moves to own-generation and grid defection which pose challenges to LG finances.
5. It will become more costly to provide basic services to low income households, resulting in the need for higher subsidies.
6. In general, higher than necessary electricity prices are problematic.

The IRP assumes that demand will in fact be taken up in that it does not present relevant information to allow comparison of scenarios having differential risks for over-build. It currently includes a large component of long lead-time, large unit size, long economic life generation assets to meet demand, without information on risks associated with the history of over-build.

Given the very large potential economic impacts that over-building will have, specifically on LG, this requires detailed attention. The IRP should also cater for options to differ investment should the demand not materialise as initially foreseen. This needs to be thoroughly analysed in the IRP.

5.5 Requests from SALGA

In summary, SALGA suggests that the IRP use multiple forecasts and that some of these are substantially lower than the November draft. These forecasts would integrate EE as the first fuel, as well as SSEG and take relevant LG electricity distributor energy service and electricity supply options into account. SALGA also requests that a tariff impact study of the different scenario is published for public scrutiny.

6 A rapidly changing electricity industry

6.1 Planning for a future of change

From the early 2000s, internationally, and, more recently increasingly locally in South Africa, developments in electricity supply, distribution and usage technologies and the systems that integrate these technologies, including information technologies, and natural environmental protection issues have been profoundly transforming the electricity industry. Indications are that the transition is accelerating and that tipping points could cause substantial disruption.

These developments are in marked contrast to the dominant picture painted by the IRP2016 Base Case which is silent on the main features of rapid (r)evolutions in the

[18] As submitted by one of the large LG electricity distributors in the IRP hearings.

electricity industry and their relevance (or otherwise) to the long-term South African electricity plan.

The IRP paints a picture of a South African electricity sector in 2050 similar in many respects to the one of 2016 or of decades before. This picture limits itself to centralised generation supplying a national transmission grid that delivers electricity to passive LG electricity distributors who largely limit themselves to re-selling electricity to passive customers. The analysis of the relationship of LG electricity distributors with the centralised generation technology systems system views LG electricity distributors as having no other options but supply from the national grid and to limiting themselves to being the aggregators of electricity demand from passive electricity consumers, who also have no other options. Demand from the national grid is accordingly analysed using a model based on this legacy configuration and is thus deemed to continue to increase at similar rates to the past. This then requires massive investment in centralised generation technology systems and continuing increases in electricity tariffs.

The investments in these centralised generation technology systems will typically be in plant with an economic life extending significantly past 2050, thus the IRP, if implemented, will lock-in the current vision. Should the electricity industry continues changing at a very high pace, this may lead to large stranding of assets with associated large economic losses.

Municipalities have experienced that many other options are coming into play. They view themselves as having other options and they know that their customers have other options. These options could be crucial to national and LG economic competiveness and the healthy evolution of the South African electricity system.

Attempting to force the development trajectory of the South African system so that in 2050 it resembles the current system might expose the industry to significant risk and accordingly could either damage the South African economy or cause SA to miss out on substantial opportunities. South Africa has significant and important components of its economy that are energy, electricity and/or emissions intensive. To remain competitive South Africa will have to pro-actively engage major industry transitions. This raises question about the relevance of alternative 2050 South African electricity system scenarios and how these other alternatives should be catered for in the IRP2016.

6.2 Considerations of LG, local level plans and opportunities[19]

Many LG representatives agree, that while this momentum in the transition of the electricity supply and associated industries is gathering in South Africa, **for the social and economic benefits of the evolution to be properly realized, a pro-active approach is required**.

These are local and bottom-up realities, which are already becoming important to LG electricity distributors and are currently not covered in the IRP. If they were properly considered they would significantly affect the IRP. Accordingly greater coordination of plans in the national government spheres of competence and LG spheres of competence is necessary. Of most significance to LG, are alternatives involving:

- Flexibility with respect to innovations in technology, costs and business models.
- SSEG ; SSEG and storage

[19] Future energy plans for 2 metros were presented above, in section 5.2

- LG supply from IPPs – wheeling
- LG electricity demand from the national grid, and hence, from centralised generation technology systems
- Possibilities for LG supply to the national grid
- Competitive electricity prices for local industry
- (EEDSM as mentioned above)
- LG electricity generation above 1MW
- The limitations/risks of centralised planning for LG

Given the linkages between energy, environment, economic development, basic service provision and electricity generation and usage, local planning cannot avoid, and should not avoid, an integrated approach and hence some LG metros have developed plans accordingly. These are among the guiding principles of integrated resource planning and integrated energy planning. Other similar principles would include the requirement to engage regional, national, provincial and local planning and plans.

6.2.1 Energy plans and climate change mitigation commitments

LG has made emissions mitigation commitments, sometimes at the international levels through institutions and networks such as ICLEI and C40: 4 South African cities are members of the C40 Group, 15 of the biggest South African municipalities report to the carbon*n* Climate Registry and compact of mayors and many municipalities in South Africa have or are developing climate plans. To achieve these carbon mitigation objectives, specific electricity options need to be pursued and are integrated in these municipal policies and plans.

These often incorporate the principle that mitigation should be least cost. **Because the electricity sector provides lower costs for emissions mitigation than other sectors, municipal policies and plans includes electricity emission related options beyond the IRP-electricity sector emissions allocation.** This is then integrated in innovative municipal energy plans as mentioned in the demand section.

Knowledge and expertise, as well as the local options integrated in these municipal plans present a significant set of resources both for the IRP2016 planning process. LG can be engaged on this topic and can be seen as a set of investment sources, creative initiatives offering options for generation and energy service resources as solutions.

6.2.2 Economic benefits of local electricity generation and energy-service options.

As well as becoming increasingly cost effective, local energy solutions provide important additional benefits which an "integrated" plan should consider, including:

a. Small local business/economic development
b. Local pollution / environmental protection
c. Employment

A typical local solution is rooftop PV, either on residences, commercial building or factories. Another is PV-plus-storage. While storage is still not cost competitive in most applications there are plausible scenarios where it might reach grid-defection levels for significant numbers of customers well within the IRP2016 planning timeframe, for example in the 2030-2040 period, with potentially negative impacts for the distribution sector. Depending on the relative level of costs this could plausibly cause radical changes. This could significantly impact the sector and should be covered in the IRP2016 Base Case.

Another typical set of energy service options that are similarly not covered are energy efficiency investments and load-shifting measures.

LG is often best placed to carry out load management. If LG also sources electricity services from resources other than the centralised generation technology systems feeding the national grid, the combination of these sources and load management could provide overall solutions significantly below tariff levels on the national grid. Combined with supply from centralised generation technology system, this could provide an optimal mix.

Given the national policy priorities of socio-economic development and poverty reduction, priorities should be given to electricity supply and demand option which provide the same level of energy service provision at the lowest cost. For larger contributions to poverty reduction, these options deserve adequate consideration in the IRP.

6.2.3 Distribution systems to enable the fundamental transition

It is most plausible that an array of "behind the meter" devices will continue to be invested in, whether these are accommodated or incentivised by the regulatory system and electricity distributors or not. These include:

- Roof-top PV for own-supply
- (New own-supply solutions not yet known)
- Storage
- Back-up systems
- Demand management
- Energy efficiency
- Energy management systems
- Electric vehicles: while these may be purchased for their transport utility, their electricity storage resources could be a valuable system asset

Instead of viewing these "behind the meter" energy solutions as competition to the centralised generation technology systems it is economically and strategically rational to view them as complimentary resources. The economic and financial value of these resources, to the supply system as a whole, could be considerably leveraged firstly by providing grid services to integrate, access and manage them and secondly by designing overall systems whereby these resources work in conjunction with other system assets. This integrated view is not present in the IRP2016, neither are considerations of distribution grid configurations and associated investments. Possibly this would only be viable if such assessments and planning were conducted in collaboration with LG distributors. Local opportunities and requirements are specific to local conditions, specialised local knowledge is embedded in LG distributors. Each distributor would have varying options, conditions and constraints. The integrated industry view, including distribution needs to be included in the IRP planning and the one-size fits all centralised planning needs to be challenges to integrate local solutions.

6.2.4 There are a wide variety of distributor conditions, resources and statuses

While some larger metro distributors have energy and electricity futures analyses and plans, others, for example the smaller ones, do not. The sector in the aggregate is not breaking even financially and there is a maintenance backlog of crisis proportions.

This does not mean that all distributors are not subject to the same factors driving the fundamental changes. For example, own-supply and/or grid defection in a small LG distributor could conceivably be even more of a challenge if the distributor has financial and maintenance backlog constraints and views new resources being invested in by local customers from a defensive revenue loss position instead of as resources to be integrated. To avoid this double-challenge, an IRP that was embracing these changes would include a realistic assessment of radical changes to the industry, also from the perspective of LG distributors who do not have the capacity to do this themselves (not just some metros).

Many small LG distributors do not have the institutional and human resources to address the demands of the transition. Nevertheless, the transition is driven by exogenous factors outside the control of a centralised generation technology systems plan and it is very plausible that in the period to 2050 these will substantially impact the evolution of the system, down to the smallest least-capacitated LG distributor. A pro-active integrative approach in the IRP would be appropriate.

6.3 "Second-order" impacts of non-least cost solutions

Own-supply for commercial and domestic customers is becoming economically rational for many customers who are beginning to install systems. The economic grid defection tipping point may be realised within a decade for many customers and then accelerate. LG is not in control of these processes as they are technology-cost driven. This already represents loss of sales in the crucial customer classes that provide the subsidies for other electricity customers and city rates.

While there is no inherent economic reason to delay these processes (on the contrary), the financial arrangements and business models for South African electricity distributors, owing to their history, need to be taken into account. The faster that bulk electricity costs from the grid rise, the faster these processes will proceed, presenting challenges.

It should also be noted that accelerating the own-supply and grid defection rates will reduce demand on the centralised transmission grid, requiring consideration of feedback to the IRP demand projections.

6.4 Request: scenario / road map process

To bridge the gap between Base Case that the IRP2016 methodology has resulted in, and the realities of possible and plausible futures that LG thinks need consideration, **the process would need to sketch out alternative electricity futures, with credibility and buy-in from LG electricity distributors, which would then be modelled. The various modelling approaches should follow from the realities needing to be modelled,** not the other way round. This process should take into account the considerable expertise, knowledge and experience of LG electricity distributors and other relevant stakeholders.

This would require appropriate identification and coverage in the IRP2016 of the technologies and cost and system dynamics of a range of electricity systems that could realistically evolve by 2050. The IRP could then propose various pathways towards such new configurations. This would include analysis of the functionality and investment requirements of distribution grids, associated information technology systems and electricity distributor business models to facilitate the evolution. Reference needs to be made in the IRP to crucial reports of mainstream analysts describing possible futures for the electricity industry[20] and South African LG electricity distributor analysis and planning documents. This would allow incorporation of these into the IRP2016 where appropriate.

7 The basis for the plan: a least-cost base case

7.1 Centralised generation technology system least cost, taking risks into account

SALGA has taken note of the many stakeholder submissions on the requirement for accurate, credible and acceptable comparative costing, and bases for considering costs and benefits of the various centralised generation technology systems utility scale generation technologies to provide bulk electricity to the national grid.

EE, EEDSM, SSEG, DOS, and other technologies offer lower cost options to centralised generation technology systems in many cases. But even if these are not considered, the current IRP2016 Base Case centralised generation technology system does not credibly present a least-cost Base Case as the foundation for planning.

In general, it appears as though many mainstream stakeholders, some LG as well, question the credibility of assumptions around these technologies. Thus we leave those issues to be dealt with by the other stakeholders but note the centrality of accurate and credible assumptions.

In addition to credible assumptions on centralised generation technology systems utility scale technologies for optimisation of system costs based on (for example) LCOE which assume that all goes according to plan and that all demand is taken up, costs of actual risks such as budget over-runs, delays, demand not being taken up –i.e. over-build– associated with the different options[21] need to be integrated..

LG bears substantial risks, over which under the current dispensation, it has little control. For example if there are substantial budget over-runs LG customers will need to pay for these. The same would go for over-built. These risks are exacerbated unless:

a. All substantial and relevant costs and risks are explicitly identified, and then based on their potential impact on system capital and operational costs (and hence the resultant national grid tariff), quantified appropriately and precisely in the modelling to achieve optimal solutions, and;

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[20] E.g. https://www.pwc.com/gx/en/utilities/publications/assets/pwc-the-road-ahead.pdf; https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-power-future-global-power-sector-report.pdf; http://energy.mit.edu/research/utility-future-study/; http://www.economist.com/news/briefing/21587782-europes-electricity-providers-face-existential-threat-how-lose-half-trillion-euros; https://www.greentechmedia.com/articles/read/this-is-what-the-utility-death-spiral-looks-like

[21] For example, there is far less risk of overbuild for a short lead-time, small incremental technology than for a long-lead-time large unit-sized technology. Therefore EVEN IF the latter were less costly in terms of LCOE, the costs associated with the over-build risk needs to be incorporated in the analysis for accurate selection of which option in fact would yield a least-cost system.

b. Solutions that deviate from least cost are only implemented with proper motivation for departure from least cost, and appropriately precise quantifications of deviations, including the impact on factors that will affect municipalities.

7.2 EE and DSM are integral, and substantial components of achieving least cost solutions

Investments in EE and DSM, on an equitable footing with investments in generation, have not been considered in the IRP2016 Base Case. A brief examination of the history and development of IRP indicates that this is the essence of the difference between traditional utility planning and integrated resource planning. Such investments could provide the same energy services at a lower cost than supplying them through supply-side options.

Also, EEDSM needs to consider both EE and DSM and not conflate them as it appears to in the DSM profile presented on page 14 of the IRP2016 Base Case Rev1, which equates Energy with Maximum capacity. DSM and load shifting can achieve significant peak reduction without energy consumption decrease, possibly even the opposite, achieving greater utilisation of capital plant.

Potential impacts: If the full potential of EE and DSM measures are not considered, in addition to large national economic benefits being foregone, LG and all electricity consumers would have to bear additional unnecessary electricity costs. It is accepted that EE and DSM are complex to implement but these complexities are well understood and have been addressed in countless EE and DSM programmes worldwide. The potential for these in South Africa and the scant attention given in the IRP2016 Base Case are not matched. The earlier detailed example of ripple control refers.

Also, as much of the investment in EE occurs on the customer side of the meter, this investment would occur inside LG areas, with significant concomitant local economic benefits.

It is suggested that the approach to EE and DSM needs to be explicit, including the potential for EEDSM, estimated as best possible using available data and in line with the (revised) draft National Energy Efficiency Strategy post 2015, which envision EE as the first fuel.

7.3 SSEG should also form part of a least cost analysis and is not properly considered

A similar logic to EEDSM applies to SSEG as in previous section. We therefore don't repeat that, except to summarise that over the time period to 2050, it is most plausible, for example that developments in PV, storage, electric vehicles and distribution and transmission grids could provide energy service and electricity generation solutions that are far less costly than current centralised generation technology systems solutions. Maintaining the current IRP planning rule, in such a context, could either lock South Africa into a highly uncompetitive electricity/energy system and/or lead to costly asset stranding.

It is plausible that SSEG is likely to play a far greater role than is envisaged in the IRP. This was outlined in the 'Rapidly Changing Industry' section above.

7.4 Least cost options to meet national GHG budget

An economic rationale has not been provided for the GHG emissions allocated[22] to the electricity sector in the IRP. The allocation moving forward is based on the percentage of total emissions that the electricity sector was using in around 2010. There is no economic rationale for why this should be the case over the IRP2016 period. On the contrary, it appears as though it is far more costly to achieve the same reductions of emissions in other sectors in the South African economy than in the electricity sector[23].

The consequence is that if an emissions constraint is placed on the economy as a whole, and the electricity sector retains its allocation, to meet national emissions reduction goals, other emitters, many of these industries in economies in LG areas, other economic actors or residents would be forced to make significantly sub-optimal investments to meet national emissions mitigation goals. Cities' plans[24] have shown for some time that it is possible to achieve much lower-cost GHG mitigation in the electricity sector than other sectors.

These data and analysis are absent from the IRP. The potential negative economic impacts, or alternatively, foregone positive impacts of more comprehensive planning considerations are significant.

a. Owing to the economically irrational allocation of the current emissions budget to the electricity sector the costs of mitigation are irrationally allocated to other economic sectors and actors, when they could be achieved at lower cost in the electricity sector. This has a direct impact on LG options for electricity and energy service supply and LG economies.
b. The potential benefits of local mitigation investments (those that LG can support, incentivise, etc.) in low-carbon electricity generation and energy services are foregone. This could involve large investments and local economic development and significant avoidance of local domestic environmental degradation.

7.5 Competitive electricity prices

Over half of the South African manufacturing workforce is situated in three metros and from 2005-2014 jobs in SA manufacturing decreased by 250,000 to 1.1m, in an economy that desperately needs growth and jobs. If unnecessarily high electricity prices and low reliability lead to challenges with the performance of the manufacturing sector LG electricity distributors need to attend to providing competitively priced reliable electricity. Indications are that the IRP2016 Base Case will involve unnecessarily high costs and that integrated local energy services including local electricity generation could result in an overall system with lower costs and hence more competitive electricity tariffs.

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[22] Note, it is the economic rationale of an integrated plan that is at issue: even if this is "handed over" by another central government entity, such as DEA. It is not an issue between LG and the DOE, it is an issue between LG and the national government IRP. The question remains, why, in terms of economic rationality, is the specific amount of emissions allocated to the electricity sector, when there is evidence that it is more cost effective to invest in low carbon electricity than other measures which would be required under the current allocation. Economic rationality is key in using least cost planning which subsequently is "policy adjusted".

[23] http://deepdecarbonization.org/countries/#south-africa

[24] (e.g. COCT energy futures, COCT IRP, …)

7.6 Transmission system costs, including transmission losses

Transmissions costs are not considered in the IRP, rightly so for a generation plan. However this impacts on optimal-least cost, and the transmission costs would be reflected in the overall system cost. This skews the apparent cost advantage away from LG electricity generation and energy services options towards centralised generation technology systems. Both of these result in not identifying significant economic sub-optimalities with negative impacts on LG, which are not transparent in the IRP analysis. This should be included in a tariff impact analysis.

8 Conclusion and way forward

While laws and regulations can control the changes in the electricity industry up to a point, and retard the evolution to new configurations, beyond that point fundamental techno-economics might destabilise a system that attempts to avoid evolution. Change might thus be forced in a costly and suboptimal manner, instead of pro-actively managed. It appears that if it not allowed to, significant benefits of new technologies will be lost to local distribution utilities. The current IRP update appears to lock South Africa into a legacy system that could become increasingly costly and obsolete.

Three companion documents are appended as Appendix A to C, and the reader is encouraged to consult those documents.

1. *Comments from the City of Johannesburg on the SALGA submission to IRP2016*
2. *SALGA comments: IRP base case - Submission – Executive summary March 2017*
3. *SALGA comments: IRP base case - Summary of key messages and priority requests March 2017*

The essence of the analysis in this paper and the appendices is that the electricity industry is undergoing fundamental changes, especially at the electricity distributor level, whereas the current IRP2016 Base Case maintains a planning approach and methodology that is based in the legacy system that will largely not exist in 2050. Some LG electricity distributors have initiated planning processes and some have substantial analysis and plans that could greatly assist in incorporating into the IRP the changes at electricity distributor level which accounts for more than 40% of demand. LG accordingly offers its knowledge, data and expertise as a resource for the IRP planning process.

Electricity distributors and resources in municipal areas should move from being viewed as a passive receivers of electricity to being involved as a strategic planning, economic and investment partner and resource. SALGA and municipalities look forward to being able to offer the considerable resources that energy services at the local government level can contribute to the development of national energy services. **This will lead to lower electricity prices, more affordable energy services and greater economic development, especially in the context of affordable service delivery and socio-economic development and poverty reduction, in a sustainable economy.**

An IRP with such an outcome would include a scenario with a comprehensive range of local energy service solutions including EE, SSEG, storage, electric-vehicles, distributor own supply and a distribution grid with supply and load management capabilities to integrate these. LG will be most grateful to work collaboratively with the IRP team to formulate such a scenario.

In the spirit of cooperative governance, the LG sphere looks forward to taking this discussion forward and being seen as a key resource in building a vision for the future of the electricity industry in South Africa.

8.1 Priority requests

SALGA, on behalf of local government, suggests the following for inclusion in the IRP update:

1. Active collaboration in IRP planning between national-level team and those LG electricity distributors that currently have the capacity
2. A range of future demand forecast scenarios, in this IRP cycle incorporating:
    a. The modelling of different uptake rates of distributed technologies such as EE, DSM, load shifting, gas, SSEG and other disruptive technologies (e.g. storage or electric vehicles) and their impact on the demand curves.
    b. Price elasticity of demand for both electricity supply and substitutes.
    c. "Bottom-up" demand forecasts from those LG electricity distributors – and other actors – including municipal own supply where economically feasible.

    ⇨ All IRP-scenarios should demonstrate robustness within the range of demand futures.
3. Tariff impact studies and wholesale price path development for the different IRP scenarios and further spiral effects on demand. This is crucial to assess the most suitable options.
4. In medium term, bottom up load forecasting process for LG demand, with necessary technical assistance from national level.
5. In medium term, a methodology that integrates modelling of energy efficiency and demand side management, distributed and embedded electricity generation, storage and other energy services as supply options, on an equivalent footing to utility-scale scale electricity generation options.

9 Appendix A – Comments from the City of Johannesburg on the SALGA submission to IRP2016

10 Appendix B - SALGA comments: IRP base case - Submission – Executive summary March 2017

11 Appendix C - SALGA comments: IRP base case - Summary of key messages and priority requests March 2017