Association of Municipal Electrical Utilities (AMEU) Convention

26 to 28 September 2011

Eskom Integrated Demand Management

Andrew Etzinger

Senior General Manager

Integrated Demand Management (IDM)

Eskom

Abstract:

The Eskom Integrated Demand Management (IDM) business unit has been tasked to implement demand-side management (DSM) measures to assist in the alleviation of electricity system constraints which will prevail for the next 5 years. IDM has been managing DSM-related projects for almost nine years and offers funding mechanisms and programmes with which to deliver demand and energy savings initiatives in the municipal, commercial, industrial, and agricultural sectors and environments of the country. The paper provides an overview of the electricity supply-demand situation and the demand-side measures to deal with expected system constraints. A closer working relationship between the DSM function of municipalities and that of Eskom is proposed to ensure that the national resources available for DSM are used to optimal effect.

Table of contents

1 Background

Demand-side management (DSM) involves technical and behavioural measures driven by a utility in order to influence the demand for electricity. In the short term, DSM is an effective measure to reduce the severity and occurrence of load-shedding incidents and reduce the cost of operating expensive peaking plant. DSM is often a favourable alternative to supply-side investments in the long term when considering cost, lead time to implementation, and environmental impact.

Eskom has amalgamated various demand-side initiatives under a single Integrated Demand Management business unit. Eskom has long offered DSM programmes geared towards supporting and funding energy efficiency and load management. In the past year, Eskom positioned energy efficiency as a key core business strategy. Eskom is working towards its DSM objectives through:

- implementing a "step change" in demand management delivery through an integrated and innovative portfolio of demand management initiatives;
- optimally using Eskom and national resources to deliver the national demand management initiative;
- transparent communication of the extent and nature of the electricity crisis to create acute national awareness that will drive the required response; and
- partnering with stakeholders through a proactive and collaborative approach to contribute to national energy efficiency objectives.

NERSA has, in the MYPD2, allocated R5.4 billion to fund these initiatives over three years. Certain initiatives are fully funded, while Eskom (and, in some cases, entities such as the Department of Energy with regard to low-pressure solar geyser installations) contributes towards others.

2 Current system status and outlook

Eskom has kept South Africa's lights on during the winter of 2011, thanks to the (slightly) lower than expected electricity demand and to the initiatives Eskom had put in place to manage a tight system. However, the projection for the system continues to be tight during the upcoming summer season, which is when Eskom does most of the maintenance of its power stations. Available capacity will drop during the summer months, as power station units are taken out of service for essential maintenance.

Demand has been below our forecasts throughout most of the winter. Electricity demand growth over the period was about 1.4% year on year, below Eskom's 2% growth forecast for the full year. The peak demand reached just over

37 000 MW at the end of May, lower than the 37 500 MW at which demand had been expected to peak in July.

Some of the reasons for this are the following:

- Cold snaps this winter had been relatively short. In addition, strikes in the metals and mining industries had reduced demand during the coldest winter months. Large power users had reduced demand in response to high winter peak tariffs, though demand was expected to rise again later in the year.

- Demand patterns also reflect weaker than expected economic activity and the efficiencies achieved by Eskom customers, which had reduced demand by 113 gigawatt-hours during the first quarter of this year.

While there had been no national load-shedding, there had been local distribution supply interruptions in some regions. Severe weather, snowstorms, and heavy winds had affected power supplies in some parts of KwaZulu-Natal and the Eastern Cape. In densely urbanised areas, local outages were caused mainly by overloading resulting from illegal connections.

Since Eskom initiated demand-side management projects in 2004, and actively measured the results, the demand savings realised in the Eskom evening peak (18:00 to 20:00) have risen in line with the growing requirement for demand reduction (see Figure 1). IDM has focused on the realisation of energy and demand savings within the evening peak utilising ESCo-related projects in the industrial, mining, and commercial sectors of the economy in addition to hot water load management and energy-efficient lighting projects (compact fluorescent lamps (CFLs)) within the municipal residential environments.

The total Eskom evening peak demand savings achieved for the 2011 financial year were 345.1 MW against the Eskom target of 301 MW. The annualised energy savings for this financial year were 1 339 GWh against the annualised energy savings target of 995 GWh. This includes the annualised energy savings for all projects.

The accumulated verified demand savings, for the combined financial years 2005 to 2011, are 2 717 MW.

3 IDM funding model initiatives

3.1 Original funding model

3.1.1 ESCo model

Energy service companies (ESCos) who are accredited by Eskom operate by establishing a three-way partnership between themselves,

Eskom, and the customer and use their knowledge of DSM technologies and programmes to determine the best way of obtaining results at customer premises.

These organisations operate within targeted vertical markets, capable of identifying opportunities for achieving reductions in electricity consumption, and scoping and executing such projects.

To participate in the funding programme, the ESCo submits a proposal on significant energy from ideally > 200 kW, which IDM reviews on its technical and financial merits, as well as energy savings potential. Once a contract has been signed, the ESCo is given the go-ahead to implement the project.

In order to ensure that ESCo projects deliver the promised savings, there are penalty clauses in place that ensure that when ESCos scope projects, they do so accurately to ensure that projected consumption savings are, in fact, achieved.

Unfortunately, lengthy processes are required to obtain project approval, which have necessitated alternative funding mechanisms as described below.

3.2 New funding model initiatives

In order to expedite projects, it became necessary to expand the traditional ESCo funding mechanism to alternative models, which offer greater speed and convenience for smaller customers and projects.

3.2.1 Standard Offer Programme

The Standard Offer is a mechanism used by Eskom for acquiring demand-side savings, under which Eskom pays for verified *energy* savings using a predetermined and pre-published rate in c/kWh for the implementation of an approved technology.

The Standard Offer Programme will:

- pay for energy savings at a published rate; 70% on installation, and 10% in each of the next 3 years for verified savings
- focus on the 16 daytime hours between 06:00 and 22:00, weekdays only; and
- have a contract duration of three years.

Any energy user (customer), project developer, or energy service company (ESCo) that can deliver verifiable energy savings, from

50 kW to 5 MW, can propose projects and, if successful, shall be paid the fixed amount per kWh over a period of three years. Achieved savings will be verified by an authorised, independent measurement and verification (M&V) organisation.

It should be noted that the Standard Offer does not replace the existing Eskom IDM application process.

3.2.2 Standard Product Programme

The Standard Product programme is designed to cater for customers with energy savings of 1 kW to 100 kW and energy savings of at least 2 MWh per annum.

The Standard Product (SP) programme is a mechanism designed to provide specific rebates for efficiency improvements derived from the implementation of approved technologies. Standard Products are solutions designed to act as replacements for less energy-efficient technologies.

Participation in the SP programme requires no formal contract – only a formal commitment by the customer. The project approval turnaround time frame has been streamlined in order to create the capacity to implement small and medium-sized projects. In order to accelerate energy efficiency projects, the Standard Product project approval time frame should take no more than four weeks.

Only technologies that have been approved by Eskom will be considered to be Standard Products. Customers must ensure that new installations and technologies conform to all applicable laws, specifications, and regulations. It should be noted that any deviation from Standard Product specifications will be for the customer's account. This Standard Product list will continue to grow as "new" technologies are identified and approved for inclusion.

3.2.3 Performance Contracting

Performance Contracting is a programme that targets projects larger than 5 MW. A contract will be placed with a single entity (project developer) and will allow the entity to utilise a basket of projects and technologies to realise demand and energy savings. The contract will be over a period of three years, during which time proven energy savings will be purchased at a rate of 55 c/kWh during the "peak" period (06:00 to 22:00) and 10 c/kWh during the off-peak period and over weekends.

4 Technologies of the future

The DSM landscape for the next five years will be dominated by three technologies – each of which will have a substantial impact on load reduction.

4.1 Renewable energy technologies

Numerous studies during the preceding decade have confirmed and reinforced the view that South Africa has access to an abundance of renewable energy sources and that these energy resources have the potential to make a large and vital contribution to the South African energy sector, society, and the economy.

These studies have shown that, at present, solar PV and wind power dominate the current renewable energy market (~896 MW installed and 1 800 GWh/a produced), both of which offer capacity factors of approximately 20%. Renewable energy options remain comparatively expensive, and storage devices that can effectively increase capacity factors add significantly to the cost. Indications from interviewed market players were that grid-tied systems were most commonly designed to supply 10 to 40% of annual energy needs.

International trends suggest that the growth in small-scale and micro-renewable generation has outpaced larger installations in recent years.

Eskom is considering the potential contribution of small-scale renewable energy to the Standard Offer and Standard Product pilot initiatives. As part of these two performance-based incentive mechanisms, the renewable energy incentive programme would be subject to NERSA approval.

IDM's realistic expectation is for renewable energy sources to contribute between 2.5 and 5 MW to the national grid (R15 million and R25 million) until March 2013. Thereafter, significant growth is expected, as technology matures and costs reduce.

4.2 Waste energy recovery projects

Definitions for waste energy abound, but it has been defined for the purpose of this application as:

The use of heat that is produced in a thermodynamic cycle (secondary energy), such as in a furnace, combustion engine, etc., in another process, such as heating water, air, or generating electricity.

International trends show that before renewable energy sources are introduced, we need to learn to efficiently utilise the energy sources we currently have. In industry, a great deal of energy has been "dumped" in the form of hot air or hot water as a by-product from processing. Due to the

previously low cost of energy and lack of environmental penalties and controls, companies have dumped thousands of MWh on an annual basis. However, due to the rising cost of energy, the energy constraint on economic growth, and growing environmental regulations, technologists are focusing on new products that allow energy recovery from their waste energy streams in a cost-effective manner.

The areas of impact for waste energy generation are in the mining and manufacturing areas. Prospective projects can be broken down according to the primary fuel, the nature of the process, and the thermal load, as these affect the quality and temperature of the waste stream.

4.3 LED technology

LED technology has undergone substantial increase in quality, variety and cost effectiveness over the past 2 years.

LED downlights are the most energy-efficient option in terms of lumens per watt (amount of light produced compared to the energy required).

Eskom will initially apply LED technology in the commercial and industrial sectors due to the high load factors on lighting systems. The residential sector will be targeted once the cost of LED lamps falls to below R100 per lamp.

Municipal street lighting is a promising application of LED technology. It is anticipated that many LED street light projects will be forthcoming in 2012/2013.

5 Eskom projects impacting municipal customers

5.1 Municipal ripple radio hot water load control projects

Hot water load control represents an effective load management tool for the management of peak demand. Many municipalities have initiated ripple and radio geyser control projects as a way to reducing peak demand. To date, projects with 183.94 MW of contracted demand savings have been, or are in the process of being, implemented through the DSM programme.

5.2 Marketing and media campaigns

Much of the demand for electricity arises from residential households. In order to create awareness with the general public, Eskom started “Power Alert”. This alert is an interactive media communication system aimed at the residential market to influence consumption patterns during weekday evening peak periods (18:00 to 21:00). This campaign has proven its worth by assisting Eskom to reduce load at peak times by between 100 MW and

900 MW, depending on the criticality. The challenge with this method of DSM is to grow a currently unsustainable electricity reduction (short-term) into a more deeply seated long-term cultural change with the consumers, through which customers will naturally try to be as energy aware and efficient as possible.

The support of the AMEU in conveying energy savings information and campaigns to constituents is greatly appreciated.

5.3 Efficient lighting, including compact fluorescent lights (CFLs)

During the Western Cape crisis in 2006, Eskom realised the massive impact that CFLs could have on an accelerated DSM initiative. When one considers that, on average, a CFL saves approximately 31 W per bulb, a mass roll-out of millions saves hundreds of Megawatts in a short space of time. A major success has been Eskom's ability to roll out in excess of 100 000 CFLs per day, where needed. Eskom has saved over 1 800 MW of power utilising this method alone for the period March 2006 to March 2011.

From a sustainability point of view, CFLs have vastly superior lifespans (3 000 to 15 000 hours or longer) to conventional bulbs. Because of this, CFLs have been shown to be highly cost-effective as a load reduction tool. The price per MWh (demand consumed over time) has been shown to be up to five times cheaper than peaking generation plants such as OCGT, seeing that the roll-out or construction time frames are similar.

CFLs, in particular, have an environmental impact, however, and a major challenge has been the implementation of suitable disposal strategies for the waste light bulbs. However, these hurdles have been overcome, and CFL roll-outs have become a major success for the utility.

Six million failed CFL lamps will be replaced as part of a sustainability programme in the current financial year. Joint operations between Eskom and municipal structures are essential to ensure a successful roll-out.

5.4 Solar water heating

In an average residential household, the major contributor to residential load is the energy required to heat water in geysers. To reduce this load, Eskom has embarked on an initiative to offer consumers subsidised solar water heaters. The costs of the subsidy initiative are shown to be in line with, or better than, production of additional generating plant, in addition to giving the end-user a large degree of independence from Eskom from a hot water point of view. Eskom is estimating between 200 MW and 600 MW of savings within the next five years, depending on the level of funding available.

Even at five years, the implementation is quicker than, and as sustainable as, a baseload power station of similar capacity. It is the speed of the roll-out that provides the greatest challenge to the utility. When doing these large-scale initiatives, an economic balancing act needs to be maintained, where the demand for the product is finely balanced with the available supply of units to be installed.

In addition, large-scale marketing and customer service assistance is required in order to achieve a smooth campaign. In this regard, a dedicated help desk was created, and specific marketing initiatives were created consisting of print media and television programmes.

6 Conclusion

Much has been achieved through the national DSM programme to date, but even more is expected in future. A partnership between municipalities and Eskom is clearly required in the areas of street lighting, solar water heating, smart metering systems and municipal pumping. In certain cases, such partnerships are already flourishing, with visible successes, but more must be done in general. Eskom appreciates the opportunity given to provide information on our IDM programme.