The Virtual Power Station

A New Age In

Demand Side Management
## Reserve Margin Decrease

<table>
<thead>
<tr>
<th>Year</th>
<th>Reserve Margin</th>
<th>Capacity added (MW)</th>
<th>Load Factor (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>27.1</td>
<td>900</td>
<td>61</td>
</tr>
<tr>
<td>2000</td>
<td>24.6</td>
<td>300</td>
<td>60.5</td>
</tr>
<tr>
<td>2001</td>
<td>23.2</td>
<td>300</td>
<td>60</td>
</tr>
<tr>
<td>2002</td>
<td>19.2</td>
<td>0</td>
<td>62.5</td>
</tr>
<tr>
<td>2003</td>
<td>15.9</td>
<td>0</td>
<td>66.5</td>
</tr>
<tr>
<td>2004</td>
<td>8.2</td>
<td>0</td>
<td>69.0</td>
</tr>
<tr>
<td>2005</td>
<td>10.8</td>
<td>195</td>
<td>70.0</td>
</tr>
<tr>
<td>2006</td>
<td>6.4</td>
<td>377</td>
<td>72.5</td>
</tr>
<tr>
<td>2007</td>
<td>5.1</td>
<td>1684</td>
<td>74.0</td>
</tr>
</tbody>
</table>

Courtesy of Eskom PCP
Forecast for the Reserve Margin

% net capacity reserve margin

-4 -2 0 2 4 6 8 10 12 14 16 18 20

-4
-2
0
2
4
6
8
10
12
14
16
18
20

Eskom Base case
10% demand savings
5% demand savings

2012:
The general public randomly lynches electrical industry people

Courtesy of Eskom PCP
Demand Side Customer Participation
VPS = A Peaking Power Station

DSM Load Control
Smart Metering
Emergency Load Shedding
DGP
DMP
Standby Gen

A Peaking Power Station
Challenges of Demand Response Programmes

- Cumbersome dispatch notification process.
- Manageability is not built into the systems.
A Supplemental VPS Event Report

**EVENT PERFORMANCE**
- Total Energy Shed: 163.303 MWh
- Total Load Reduction: 54.434 MW

**EVENT PERFORMANCE RATING**
- Performance Percentage: 98.97%
- Performance Rating: SUCCESSFUL

**EVENT PERFORMANCE GRAPH**

![Load Profile Graph](image)
An Instantaneous VPS Event Report

**EVENT PERFORMANCE**
Total Load Reduction: 71.807 MW

**EVENT PERFORMANCE RATING**
Performance Percentage: 56.10%
Performance Rating: UNSUCCESSFUL

**EVENT PERFORMANCE GRAPH**

![Load Profile Graph]

- Actual Load
- Frequency
- Frequency during event
VPS – Events Per Month

Number of events

- 2005:
  - January: 10
  - February: 15
  - March: 10
  - April: 20
  - May: 30
  - June: 20
  - July: 10
  - August: 5
  - September: 20
  - October: 30
  - November: 20
  - December: 15

- 2006:
  - January: 20
  - February: 30
  - March: 40
  - April: 50
  - May: 60
  - June: 50
  - July: 40
  - August: 30
  - September: 20
  - October: 30
  - November: 20
  - December: 10

- 2007:
  - January: 50
  - February: 60
  - March: 70
  - April: 80
  - May: 90
  - June: 80
  - July: 70
  - August: 60
  - September: 50
  - October: 40
  - November: 30
  - December: 20

Number of events per month for the years 2005, 2006, and 2007.
Impact of VPS

Average Weekday Load [kW] vs Hour of weekday [h]

- VPS Filtered
- VPS
VPS = A Data/Energy Exchange Mechanism
National SA Load Contribution

Courtesy Eskom DSM

Arc Furnaces – 19%
Processing – 15%
Pumping – 11%
Process heating – 10%
Compressed air – 8%
Lighting – 8%
Mat. handling – 6%
Line losses – 6%
Other – 17%

Uncontrolled water heating – 18%
Space Heating – 14%
Incandescents – 13%
Cool Storage – 8.5%
Stoves & Ovens – 7%
Controlled WH – 6%
Other cooking – 4%
Line losses – 15%
Other – 14.5%

Lighting – 34%
HVAC – 27%
Process heating – 10%
Fans – 9%
Homes & hostels – 6%
Line losses – 10%
Other – 3%

Mat. handling – 21%
Processing – 15.5%
Compressed air – 15%
Pumping – 14.8%
Ind. Cooling – 7%
Fans – 7%
Homes & hostels – 6%
Line losses – 6%
Other – 7.5%
VPS Advantages

- Provision of an efficient mechanism to dispatch ‘negawatts’
- A broad view of the available load
- Centralised bidding, customer contracting and planning
VPS Advantages Cont.

- Centralised administration
- The mechanism provides for competitive forces
- A transparent process
VPS Benefits over Physical PS

- Environmental benefits
- Faster implementation time
- The speed with which the VPS can modify its capacity and energy delivery curves is extremely fast
- Effects of supply from a VPS are distributed, effectively reducing network constraints
VPS and the Smart Grid

- Increasing reliability, efficiency and safety of the power grid (prevent outages, lower CO$_2$, lower electricity bills).

- Enabling decentralised power generation so consumers can be both energy client and supplier (provide consumers with interactive tool to manage energy usage).

- Inclusion of flexibility to power consumption at the clients side and supplier selection (enables distributed generation, solar, wind, biomass).