



The Electric Power System

- South Africa -



South African Power System



Basic Facts

- Area: 1,221,037 km²
- Population: 51,8 Million (2011)
- Vertically integrated Utility Gx, Tx, Dx
- Peak load: approx. 34,768 GW
- System average interruption duration index (SAIDI) = 36.2^{RA}hours
(RA Reasonable assurance provided by the independent assurance provider)





South Africa in the Southern African Power Pool meshed grid

- Interconnectors to:
 - Botswana
 - Lesotho
 - Mozambique
 - Namibia;
 - Swaziland
 - Zimbabwe



Grid facts and characteristics

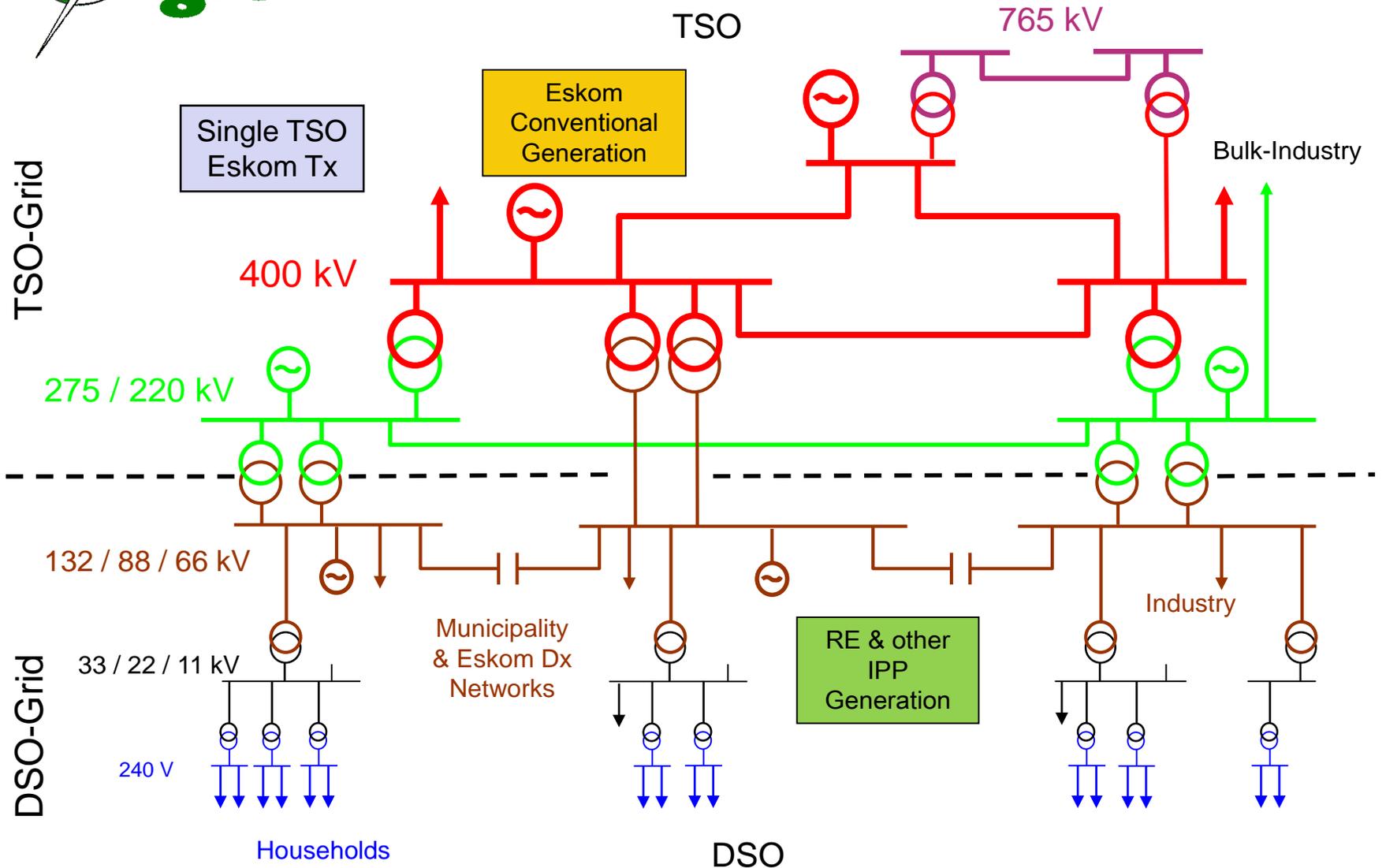
The electricity grid in South African is sub-divided into transmission grids (220/275/400/765kV) and distribution grids (132/88/66/44/33/22/11kV)

Power lines and substations in service at 31 March 2015

| | 2014/15 | 2013/14 | 2012/13 | 2011/12 | 2010/11 |
|---|----------------|---------|---------|---------|---------|
| Power lines | | | | | |
| Transmission power lines, km¹ | 31 107 | 29 924 | 29 297 | 28 995 | 28 790 |
| 765kV | 2 235 | 2 235 | 1 667 | 1 153 | 1 153 |
| 533kV DC (monopolar) | 1 035 | 1 035 | 1 035 | 1 035 | 1 035 |
| 400kV ² | 18 377 | 17 011 | 16 899 | 17 118 | 16 913 |
| 275kV | 7 361 | 7 361 | 7 360 | 7 361 | 7 476 |
| 220kV | 1 217 | 1 217 | 1 217 | 1 217 | 1 217 |
| 132kV | 882 | 1 065 | 1 119 | 1 111 | 996 |
| Distribution power lines, km | 48 278 | 46 093 | 44 396 | 43 856 | 66 247 |
| 132 kV and higher | 24 929 | 22 719 | 21 508 | 21 068 | 43 765 |
| 88 – 33kV | 23 349 | 23 374 | 22 888 | 22 788 | 22 482 |
| Reticulation power lines, km | | | | | |
| 22kV and lower | 281 510 | 276 027 | 269 570 | 265 707 | 263 263 |
| Underground cables, km | 7 436 | 7 293 | 7 026 | 6 770 | 6 326 |
| 132kV and higher | 65 | 65 | 65 | 50 | 49 |
| 33 – 88kV | 361 | 364 | 212 | 217 | 179 |
| 22kV and lower | 7 010 | 6 864 | 6 749 | 6 503 | 6 098 |
| Total all power lines, km | 368 331 | 359 337 | 350 289 | 345 328 | 364 626 |
| Total transformer capacity, MVA | 239 490 | 232 179 | 225 799 | 205 865 | 232 058 |
| Transmission, MVA ³ | 139 610 | 138 350 | 135 840 | 132 955 | 130 005 |
| Distribution and reticulation, MVA | 99 880 | 93 829 | 89 959 | 72 910 | 102 053 |
| Total transformers, number | 335 242 | 329 314 | 320 501 | 315 397 | 351 297 |
| Transmission, number | 423 | 420 | 412 | 408 | 405 |
| Distribution and reticulation, number | 334 819 | 328 894 | 320 089 | 314 989 | 350 892 |

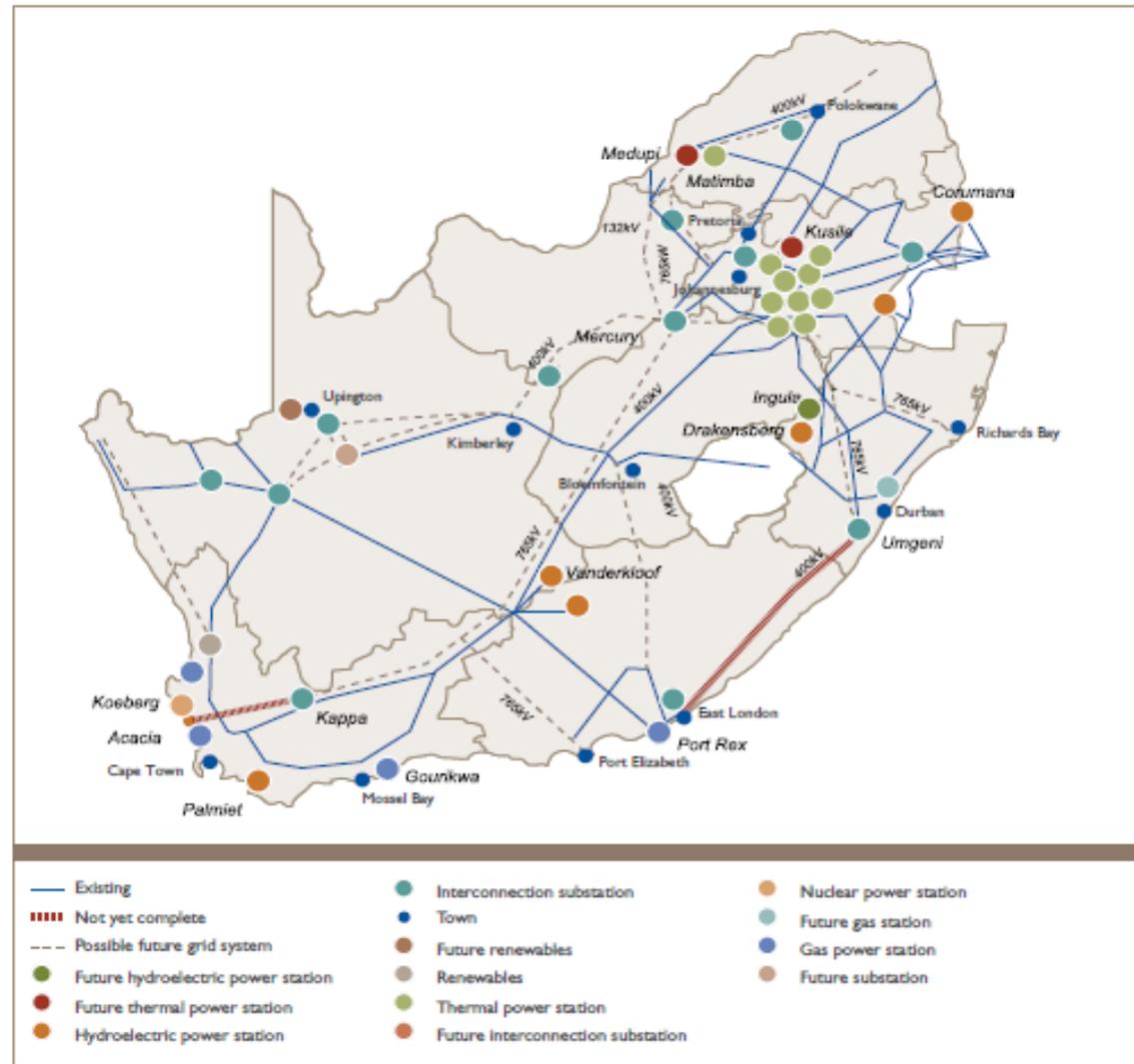


Structure of electrical power supply



High Voltage Grid

Our Transmission projects as at 31 March 2015



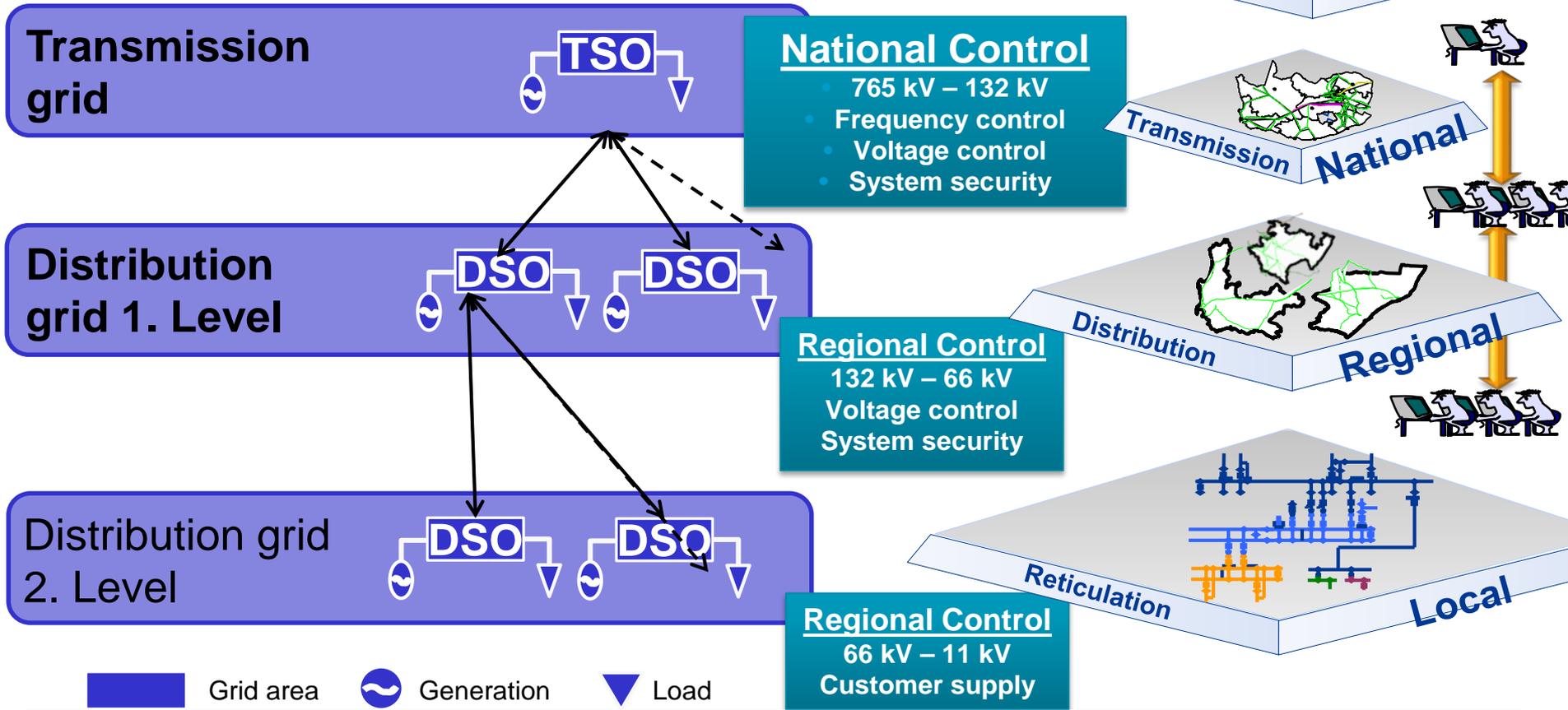
Source : Eskom Annual Report 2015





Cooperation of TSO and DSO: Cascade in Generation Dispatching of Renewables

In case of (n-1)- security violations in the EHV-grid due to high dispersed generation TSO and DSO collaborate to lower the infeed of renewable generation in DSOs grid. TSO initiates and DSOs operate these measures according following cascade:



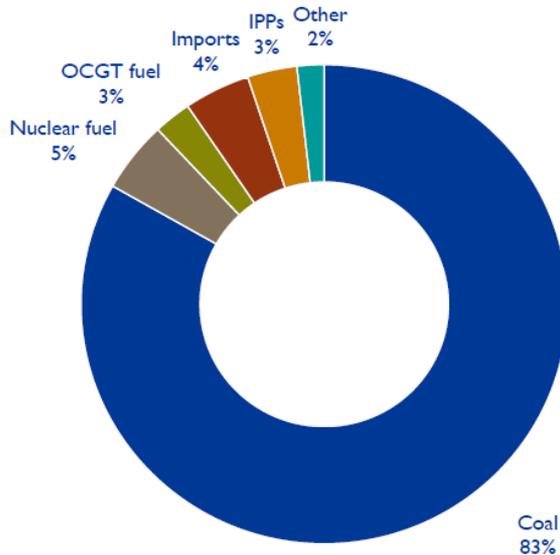


Installed capacity with reference to primary resources

Power station capacities at 31 March 2015

The difference between installed and nominal capacity reflects auxiliary power consumption and reduced capacity caused by the age of plant.

Production source



| Name of station | Location | Years commissioned first to last unit | Number and installed capacity of generator sets MW | Total installed capacity MW | Total nominal capacity MW |
|---|--------------|---------------------------------------|--|-----------------------------|---------------------------|
| Base-load stations | | | | 37 754 | 35 721 |
| Coal-fired (13) | | | | | |
| Arnot | Middelburg | Sep 1971 to Aug 1975 | 1x370; 1x390; 2x396; 2x400 | 2 352 | 2 232 |
| Camden ^{1,2} | Ermelo | Mar 2005 to Jun 2008 | 3x200; 1x196; 2x195; 1x190; 1x185 | 1 561 | 1 481 |
| Duvha | eMalahleni | Aug 1980 to Feb 1984 | 6x600 | 3 600 | 3 450 |
| Grootvlei ¹ | Balfour | Apr 2008 to Mar 2011 | 4x200; 2x190 | 1 180 | 1 120 |
| Hendrina ² | Middelburg | May 1970 to Dec 1976 | 5x200; 2x195; 2x170; 1x168 | 1 893 | 1 793 |
| Kendal ¹ | eMalahleni | Oct 1988 to Dec 1992 | 6x686 | 4 116 | 3 840 |
| Komati ^{1,2} | Middelburg | Mar 2009 to Oct 2013 | 4x100; 4x125; 1x90 | 990 | 904 |
| Kriel | Bethal | May 1976 to Mar 1979 | 6x500 | 3 000 | 2 850 |
| Lethabo | Vereeniging | Dec 1985 to Dec 1990 | 6x618 | 3 708 | 3 558 |
| Majuba ² | Volksrust | Apr 1996 to Apr 2001 | 3x657; 3x713 | 4 110 | 3 843 |
| Matimba ² | Lephalale | Dec 1987 to Oct 1991 | 6x665 | 3 990 | 3 690 |
| Matla | Bethal | Sep 1979 to Jul 1983 | 6x600 | 3 600 | 3 450 |
| Tutuka | Standerton | Jun 1985 to Jun 1990 | 6x609 | 3 654 | 3 510 |
| Kusile ² | Ogies | Under construction | 6x800 | – | – |
| Medupi ² | Lephalale | Under construction | 6x794 | – | – |
| Nuclear (1) | | | | 1 940 | 1 860 |
| Koeberg | Cape Town | Jul 1984 to Nov 1985 | 2x970 | – | – |
| Peaking stations | | | | 2 426 | 2 409 |
| Gas/liquid fuel turbine stations (4) | | | | | |
| Acacia | Cape Town | May 1976 to Jul 1976 | 3x57 | 171 | 171 |
| Ankerlig | Atlantis | Mar 2007 to Mar 2009 | 4x149.2; 5x148.3 | 1 338 | 1 327 |
| Gourikwa | Mossel Bay | Jul 2007 to Nov 2008 | 5x149.2 | 746 | 740 |
| Port Rex | East London | Sep 1976 to Oct 1976 | 3x57 | 171 | 171 |
| Pumped storage schemes (2)⁴ | | | | 1 400 | 1 400 |
| Drakensberg | Bergville | Jun 1981 to Apr 1982 | 4x250 | 1 000 | 1 000 |
| Palmiet | Grabouw | Apr 1988 to May 1988 | 2x200 | 400 | 400 |
| Ingula | Ladysmith | Under construction | 4x333 | – | – |
| Hydroelectric stations (2)⁵ | | | | 600 | 600 |
| Gariep | Norvalspont | Sep 1971 to Mar 1976 | 4x90 | 360 | 360 |
| Vanderkloof | Petrusville | Jan 1977 to Feb 1977 | 2x120 | 240 | 240 |
| Wind energy (1)⁶ | | | | 100 | 100 |
| Sere | Vredenburg | Mar 2015 | 46x2.2 | – | – |
| Solar energy | | | | – | – |
| Concentrating solar power | Upington | Under construction | 100 | – | – |
| Other hydroelectric stations (4)⁷ | | | | 61 | – |
| Colley Wobbles | Mbashe River | | 3x14 | 42 | – |
| First Falls | Umtata River | | 2x3 | 6 | – |
| Ncora | Ncora River | | 2x0.4; 1x1.3 | 2 | – |
| Second Falls | Umtata River | | 2x5.5 | 11 | – |
| Total power station capacities (23) | | | | 44 281 | 42 090 |
| Available nominal capacity | | | | – | 95.05% |





Energy production with reference to primary resources

Eskom's energy flow diagram

The energy wheel shows the volume of electricity that flowed from local and international power stations and independent power producers (IPPs) to Eskom's distribution and export points during the past two years, including the losses incurred in reaching those customers.

All figures in GWh

| Generation of electricity | 2014/15 | 2013/14 |
|---------------------------|----------------|----------------|
| Generation | 222 591 | 227 508 |
| OCGT | 3 709 | 3 621 |
| IPPs | 6 022 | 3 671 |
| Subtotal | 232 322 | 234 800 |
| Pumping | (4 114) | (3 862) |
| Total | 228 208 | 230 938 |



| Available for distribution | 2014/15 | 2013/14 |
|-----------------------------|----------------|----------------|
| Generation (including IPPs) | 232 322 | 234 800 |
| International purchases | 10 731 | 9 425 |
| Wheeling ¹ | 3 623 | 3 353 |
| Subtotal | 246 676 | 247 578 |
| Pumping | (4 114) | (3 862) |
| Total | 242 562 | 243 716 |



| Total imports | 2014/15 | 2013/14 |
|-------------------------|---------------|---------------|
| International purchases | 10 731 | 9 425 |
| Wheeling ¹ | 3 623 | 3 353 |
| Total | 14 354 | 12 778 |



| Internal use | 2014/15 | 2013/14 |
|--------------|------------|------------|
| Internal use | 791 | 465 |
| Generated | (53) | (129) |
| Total | 738 | 336 |



| Demand | 2014/15 | 2013/14 |
|----------------------------|----------------|----------------|
| External sales | 216 274 | 217 903 |
| Technical and other losses | 20 940 | 21 488 |
| Internal use | 791 | 465 |
| Generated | (53) | (129) |
| Wheeling ¹ | 3 623 | 3 353 |
| Unaccounted/rephasing | 988 | 636 |
| Total | 242 562 | 243 716 |



| Total exports | 2014/15 | 2013/14 |
|----------------------------------|---------------|---------------|
| International sales ² | 12 000 | 12 469 |
| Wheeling ¹ | 3 623 | 3 353 |
| Total | 15 623 | 15 822 |

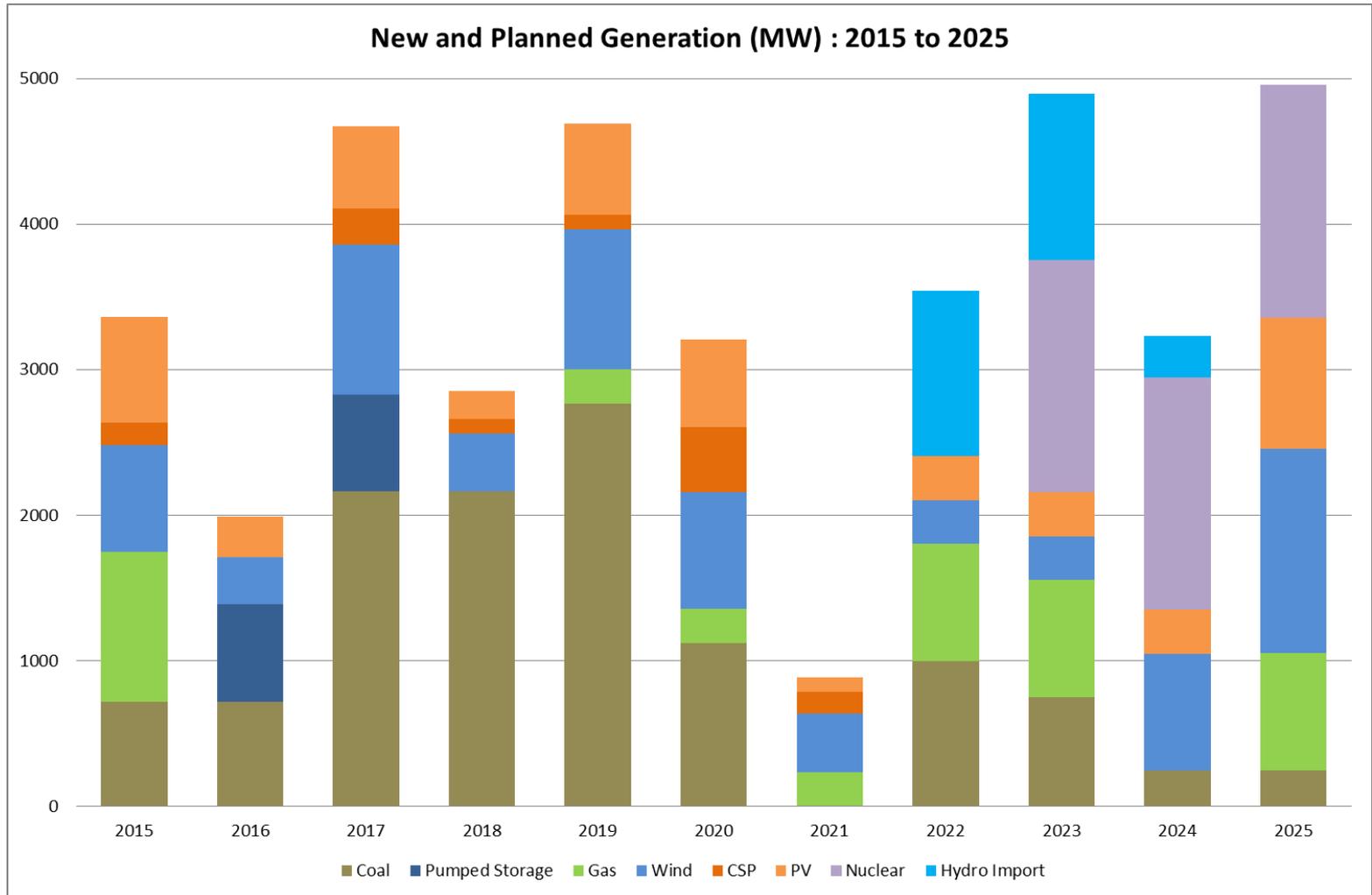


| External sales | 2014/15 | 2013/14 |
|----------------------------------|----------------|----------------|
| Local sales | 204 274 | 205 434 |
| International sales ² | 12 000 | 12 469 |
| Total | 216 274 | 217 903 |

| Technical and other losses | 2014/15 | 2013/14 |
|----------------------------|---------------|---------------|
| Distribution | 14 920 (6.8%) | 15 824 (7.1%) |
| Transmission | 6 020 (2.5%) | 5 664 (2.3%) |
| Total | 20 940 | 21 488 |

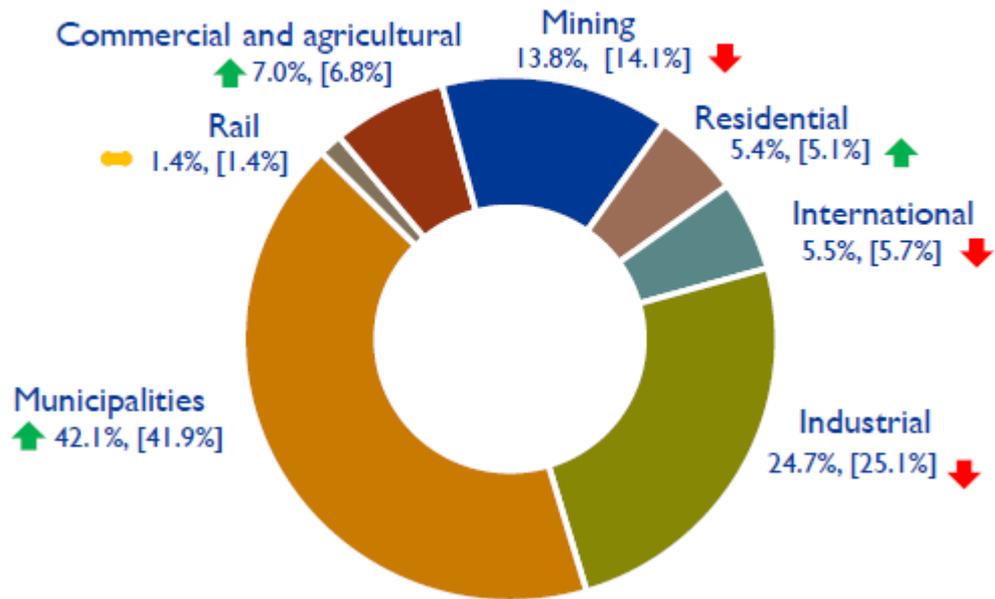


Development of Generation Capacity 2015 to 2025



Consumption

Electricity volumes by customer type¹



1. Percentages reflect the sales proportions for the current period. Percentages in brackets are those for the year to 31 March 2014.



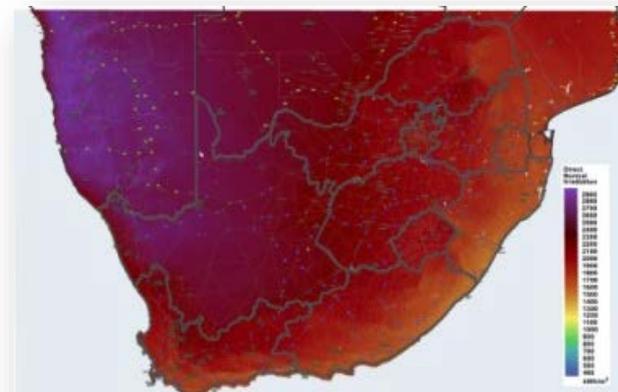
Renewables



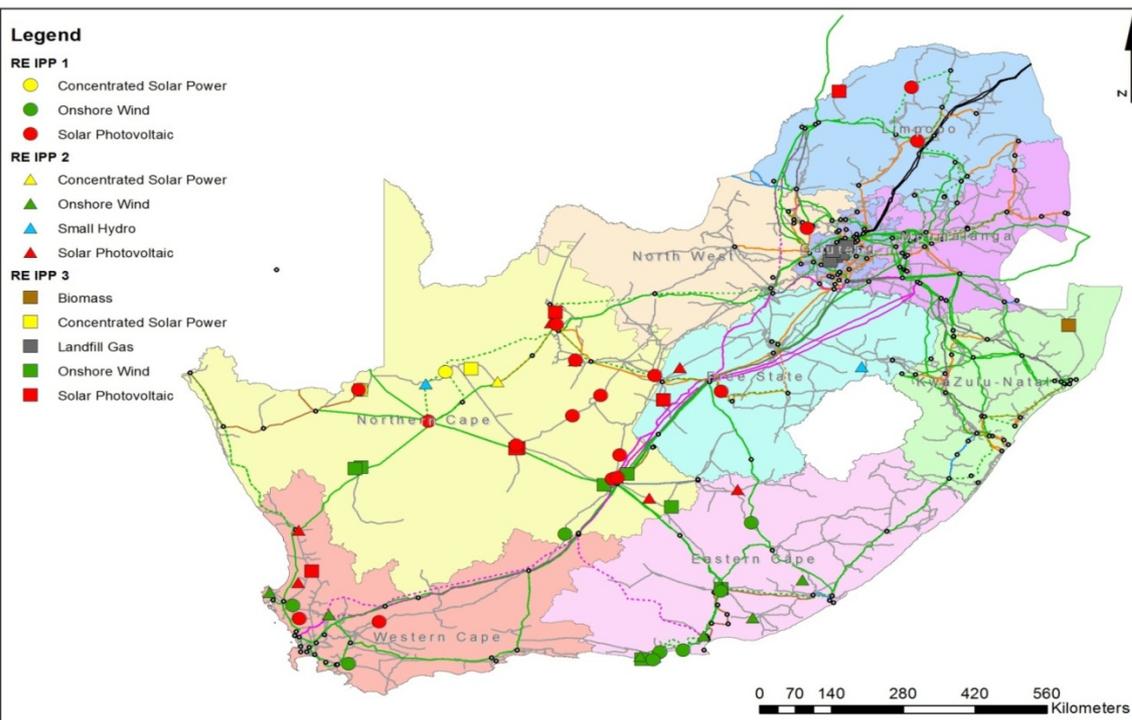
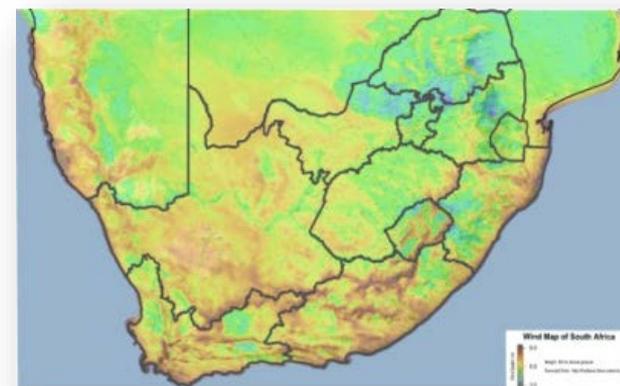
Location of Renewable Energy Sources

Location of RE projects from first 3 rounds of the RE IPP procurement programme in South Africa

Solar Irradiation map of South Africa



Wind resource map of South Africa





Market



Electricity Industry Structure in South Africa



Electricity Industry in South Africa

