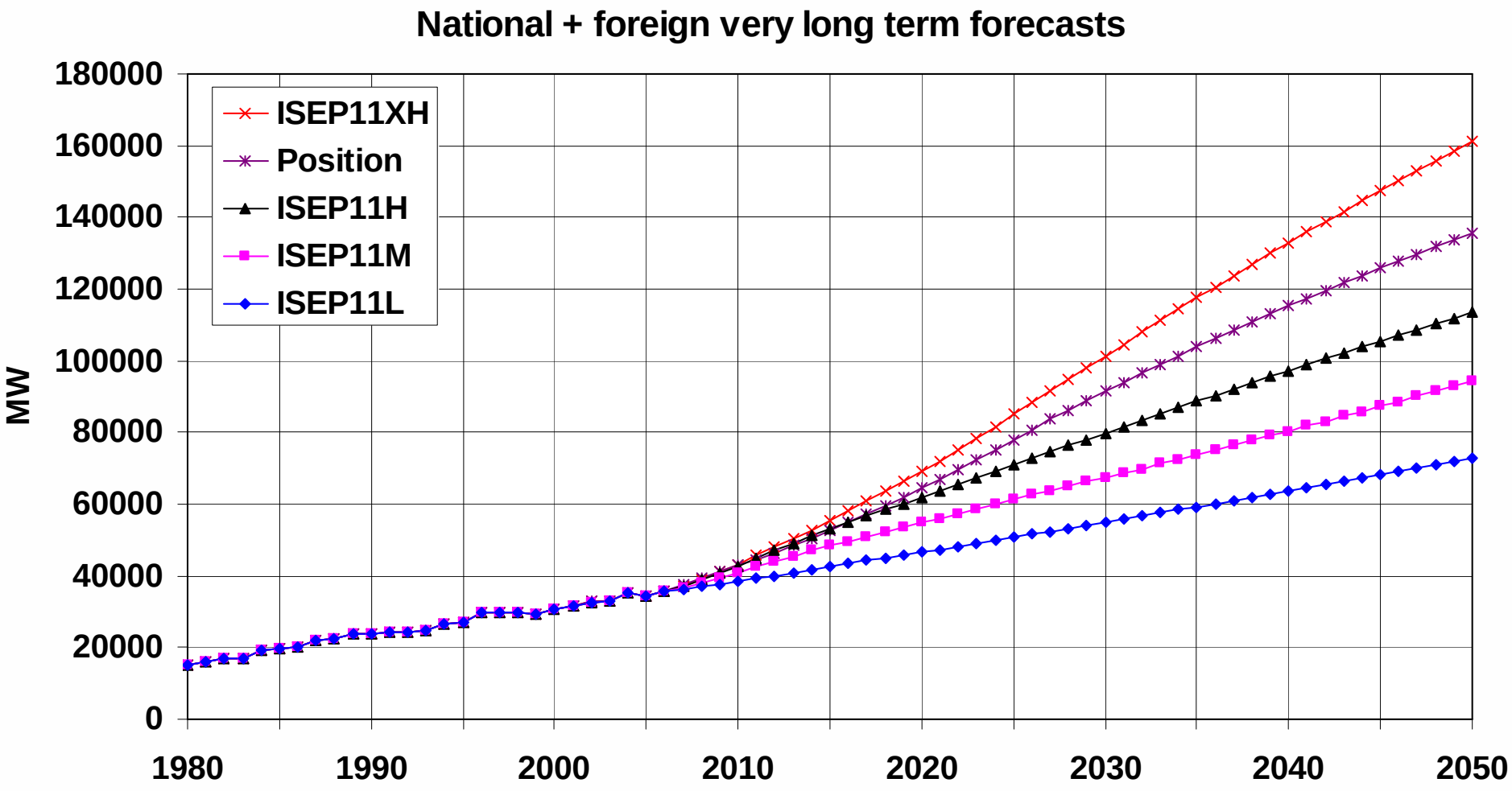
Water for Electricity needs

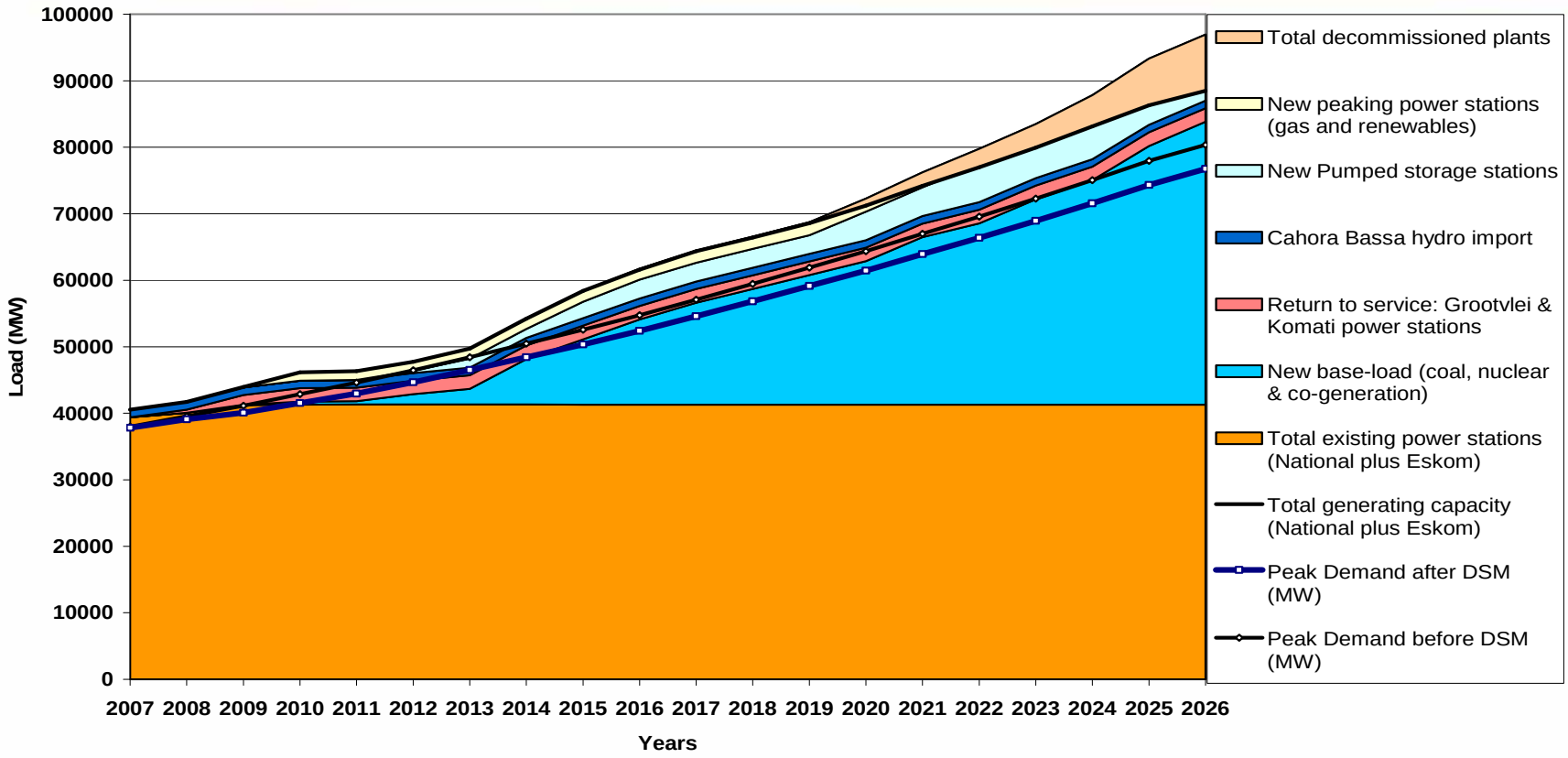
09 November 2008

ISEP and Beyond (Electricity Growth)



2

Electricity Capacity Outlook 2007 to 2026



- Structure of the economy is such that 4% GDP growth results in 2.3% electricity growth, whilst 6% GDP growth results in 4% electricity growth;
- Projected electricity requirement is between 56 710 MW and 77 960 MW based on the growth trajectory;
- Electricity demand side program projects to save 8000 MW by 2025;

3

Future Generation Portfolio

- Mix of various generating technologies but largest proportion will still be coal.

Table 1: Indicative Generation Portfolio by 2026

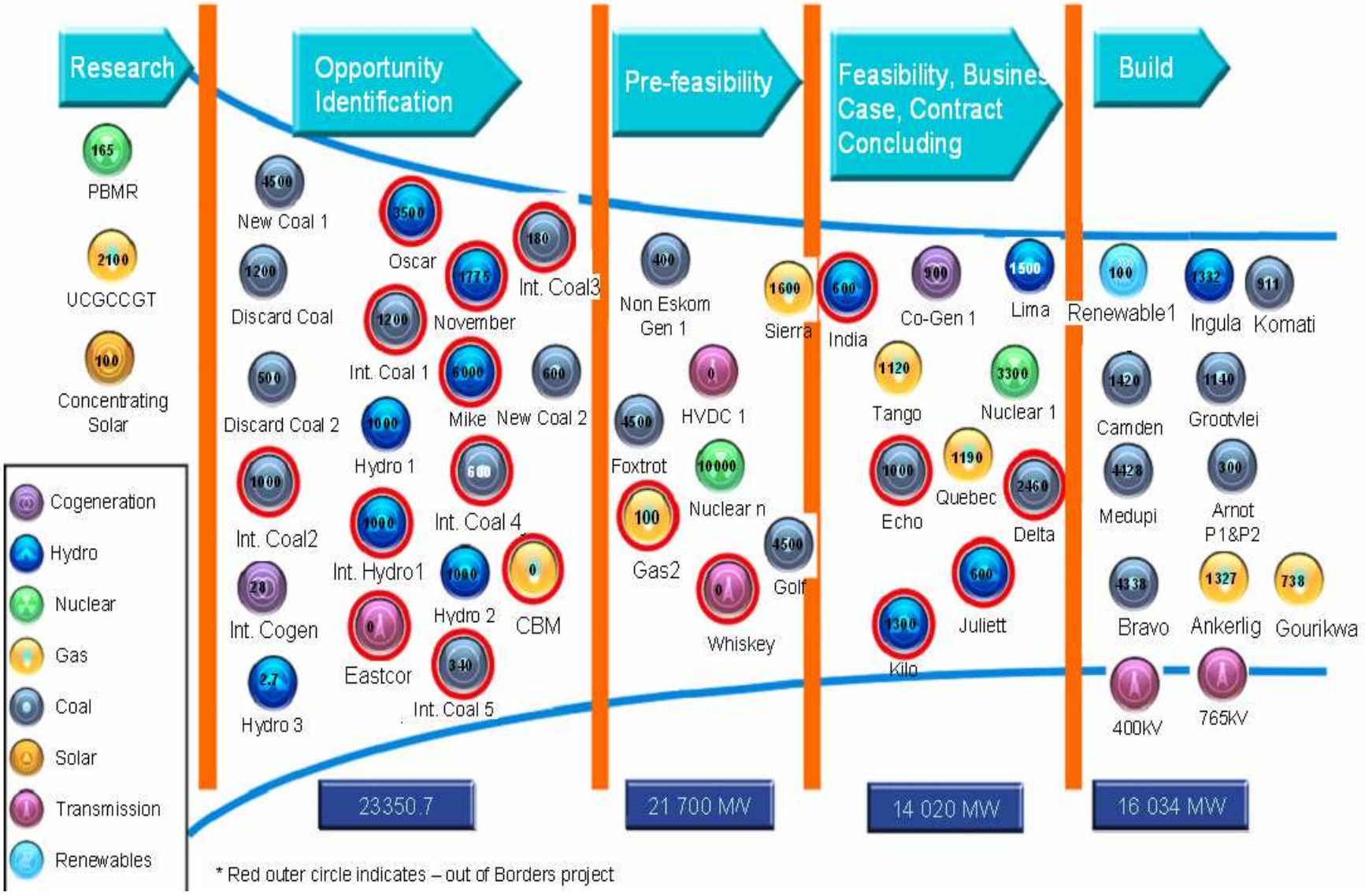
Generation Mix	Target ranges
Coal-fired generation	< 70%
Combined cycle gas turbine	Only use for peak supply when needed
Nuclear energy	17-28%
Renewable energy	> 2%
Imports	2-15%
Open cycle gas turbine	Only use for peak supply when needed
Pumped storage	4-10%

Table 2: Indicative Specific Freshwater Requirements of Various Technologies

Type of Power Station	Specific Water Consumption (l/USO)
Wet Cooled	1.9 - 2.1
Dry Cooled	0.12 - 0.16
Dry Cooled with FGD (CCS)	0.37 - 0.41- (0.52)
Nuclear	0.05
Gas	>0.01

4

New Build Options



Drivers of Uncertainty

1. GDP Growth
   - Electricity growth (ISEP)
2. Nuclear Program incl. PBMR
3. UCG
   - CCGT
4. Locality of IPP's
5. Lifex & Decommissioning
6. Location of new power stations
7. Technology options (PF with FGD, FBC, CCS, Coal washing etc.)
8. Generation mix (Coal, UCG, Nuclear, Hydro, Gas, Renewables)
9. Environmental requirements & constraints

Some guiding parameters

Name		LOW	MODERATE	HIGH
Max Demand - MW		**72,898**	**94,247**	**113,425**
	% Ranges			
COAL MW	< 70%	**51,029**	**65,973**	**79,398**
Nuclear LB	17%	**12,393**	**16,022**	**19,282**
Nuclear UB	28%	**20,412**	**26,389**	**31,759**
Other low	2%	**1,458**	**1,885**	**2,269**
Other high	15%	**10,935**	**14,137**	**17,014**

- Position by 2050

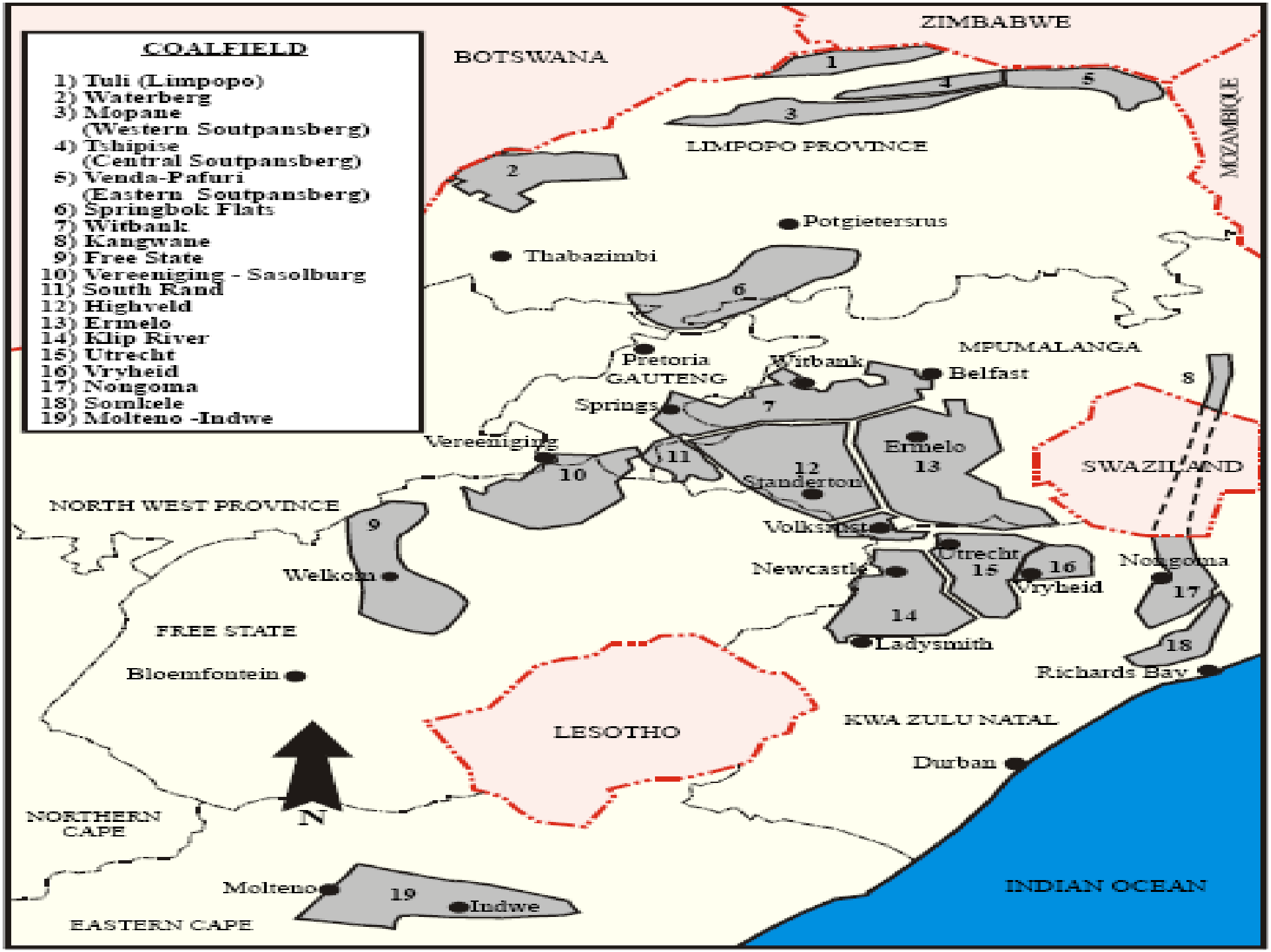
7

Matrix: New Coal Capacity

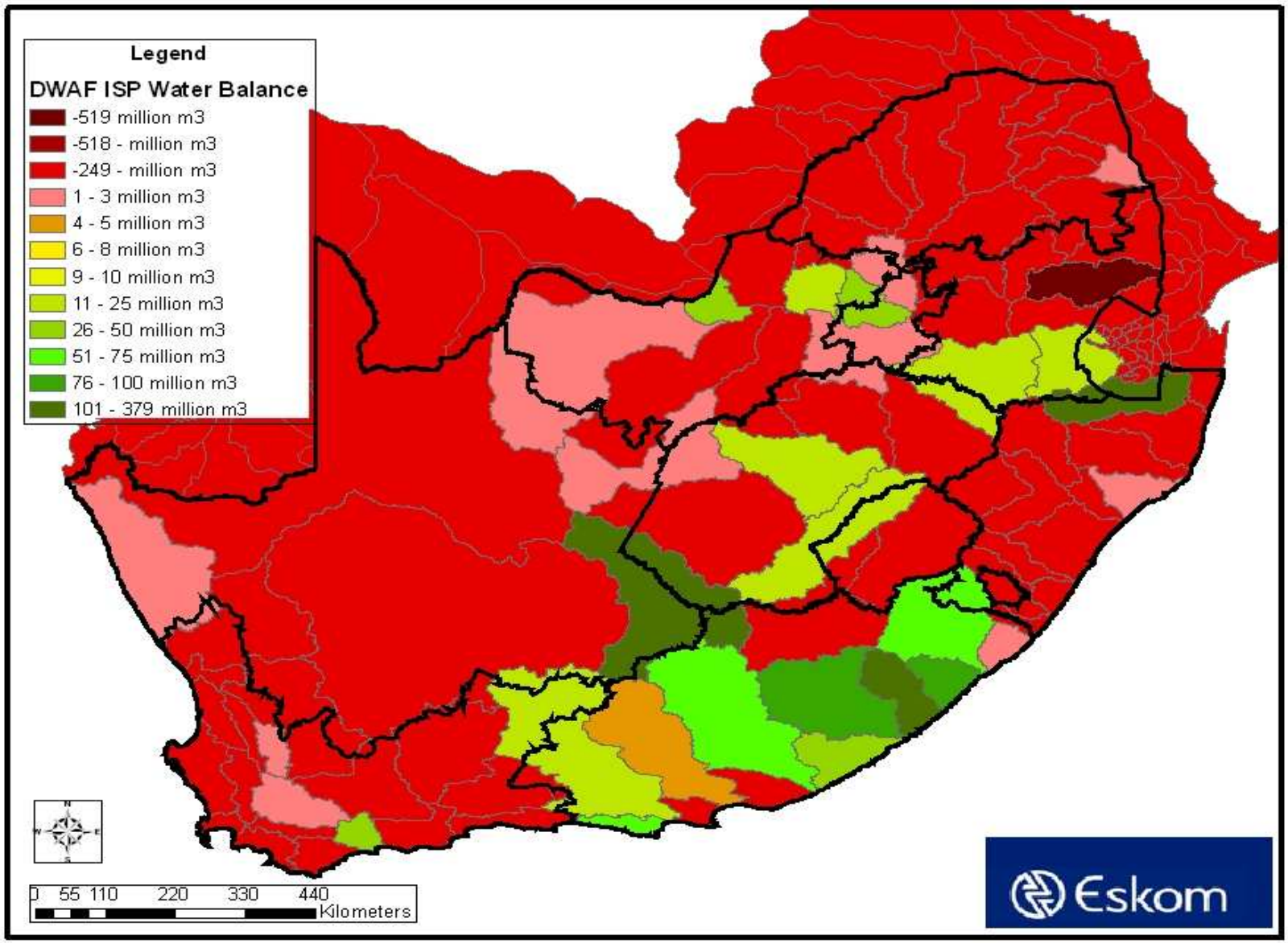
	I	II	III	IV
Growth	LCP	Lo	Mod	Inland
Nuclear	No	LB	LB	No
Medupi	2012	2012	2012	2012
Bravo				
NC-3	2015	2022	2015	2016
NC-4	2017	2030	2017	2019
NC-5	2019	2037	2023	
NC-6	2021	2044	2031	2023
NC-7	2022	2046	2033	
NC-8	2023		2034	2024
NC-9	2025		2040	2027
NC-10	2026		2044	2029
NC-11	2027		2046	
NC-12	2029		2050	2034
NC-13	2030			
NC-14	2032			2037
NC-15	2033			
NC-16	2036			2039
NC-17	2039			2040
NC-18	2042			
NC-19	2043			
NC-20	2048			
Coal:	**97 242**	**31 092**	**48 894**	
Nuclear:	0	14 000	19 000	0

Provisional, for discussion purposes

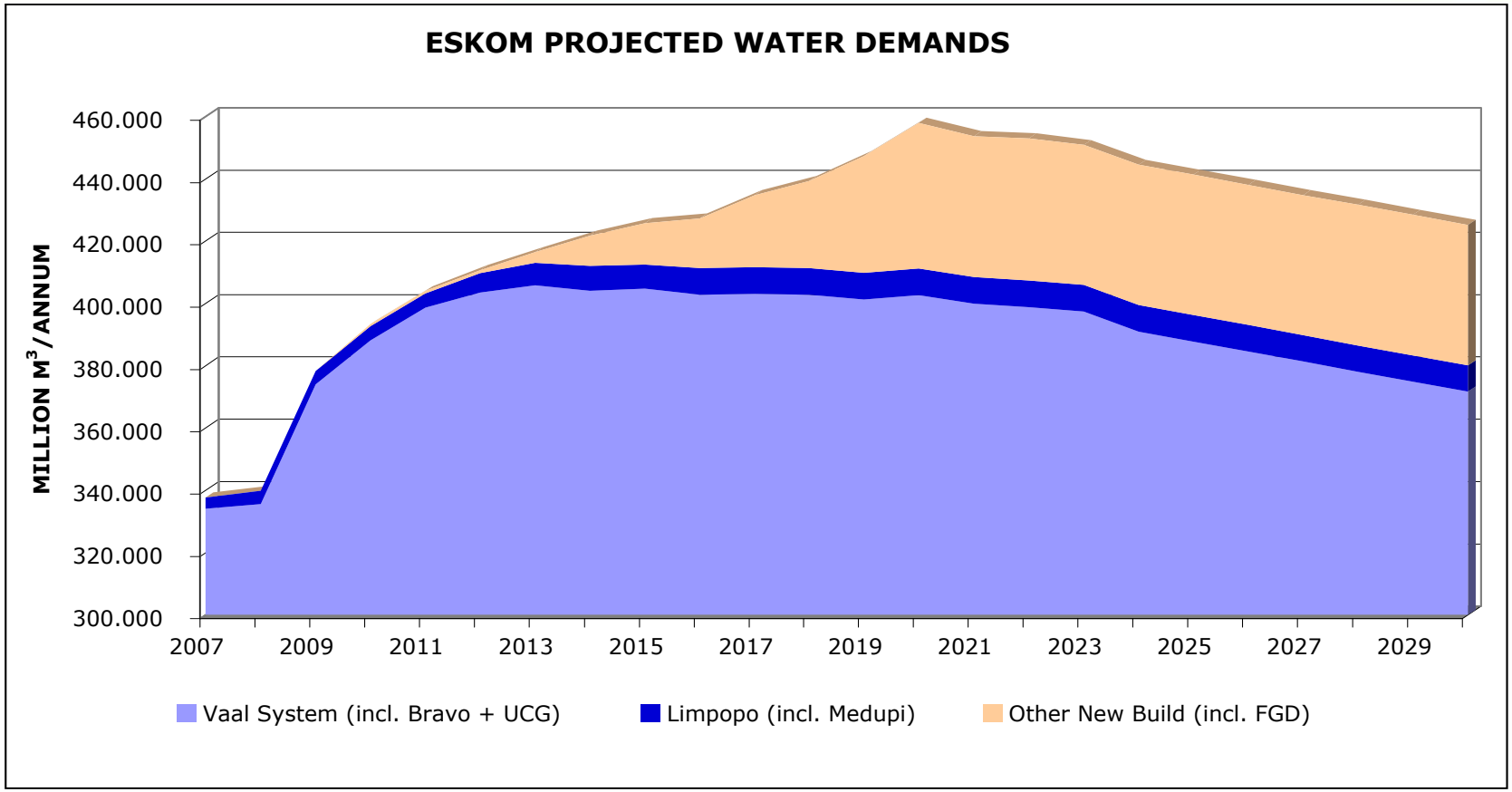
Eskom


COALFIELD
1) Tuli (Limpopo)
2) Waterberg
3) Mopane (Western Soutpansberg)
4) Tshipise (Central Soutpansberg)
5) Venda-Pafuri (Eastern Soutpansberg)
6) Springbok Flats
7) Witbank
8) Kangwane
9) Free State
10) Vereeniging - Sasolburg
11) South Rand
12) Highveld
13) Ermelo
14) Klip River
15) Utrecht
16) Vryheid
17) Nongoma
18) Somkele
19) Molteno -Indwe
ZIMBABWE
BOTSWANA
MOZAMBIQUE
LIMPOPO PROVINCE
Potgietersrus
Thabazimbi
Pretoria
GAUTENG
Witbank
Belfast
MPUMALANGA
Springs
Vereeniging
Ermelo
SWAZILAND
Standerton
NORTH WEST PROVINCE
Volksrust
Utrecht
Newcastle
Vryheid
Nongoma
Welkom
FREE STATE
Ladysmith
Bloemfontein
Richards Bay
LESOTHO
KWA ZULU NATAL
Durban
N
NORTHERN CAPE
Molteno
Indwe
INDIAN OCEAN
EASTERN CAPE

Water Management Areas



Water Requirements to Support Capacity Plan



- Current demand requirement is approximately 325 million cubic metres/annum;
- Peak demand will be approximately 460 million cubic metres/annum (2021);
- De-commissioning of older wet cooled plant will reduce water requirement.

11

New Build Water Balance

Waterberg

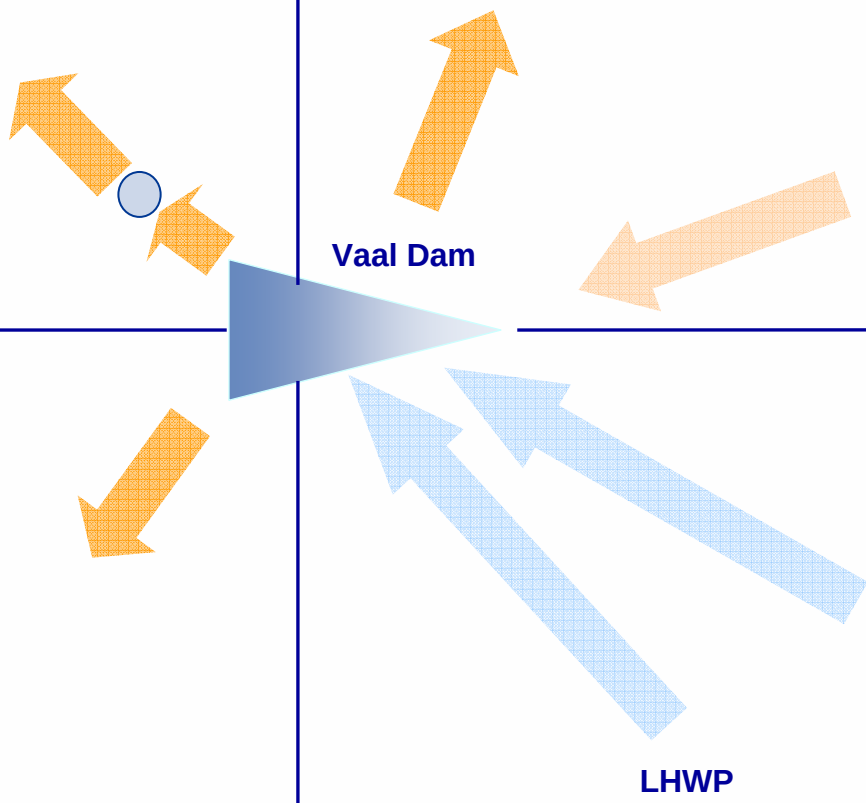
	Min use	Max use
1	92	181
2	53	80
3	43	51
4	82	148

Free-State

	Min use	Max use
2 x PF (with FGD)	0	30

Mpumalanga

1 x PF (with FGD) 15 mcm/a

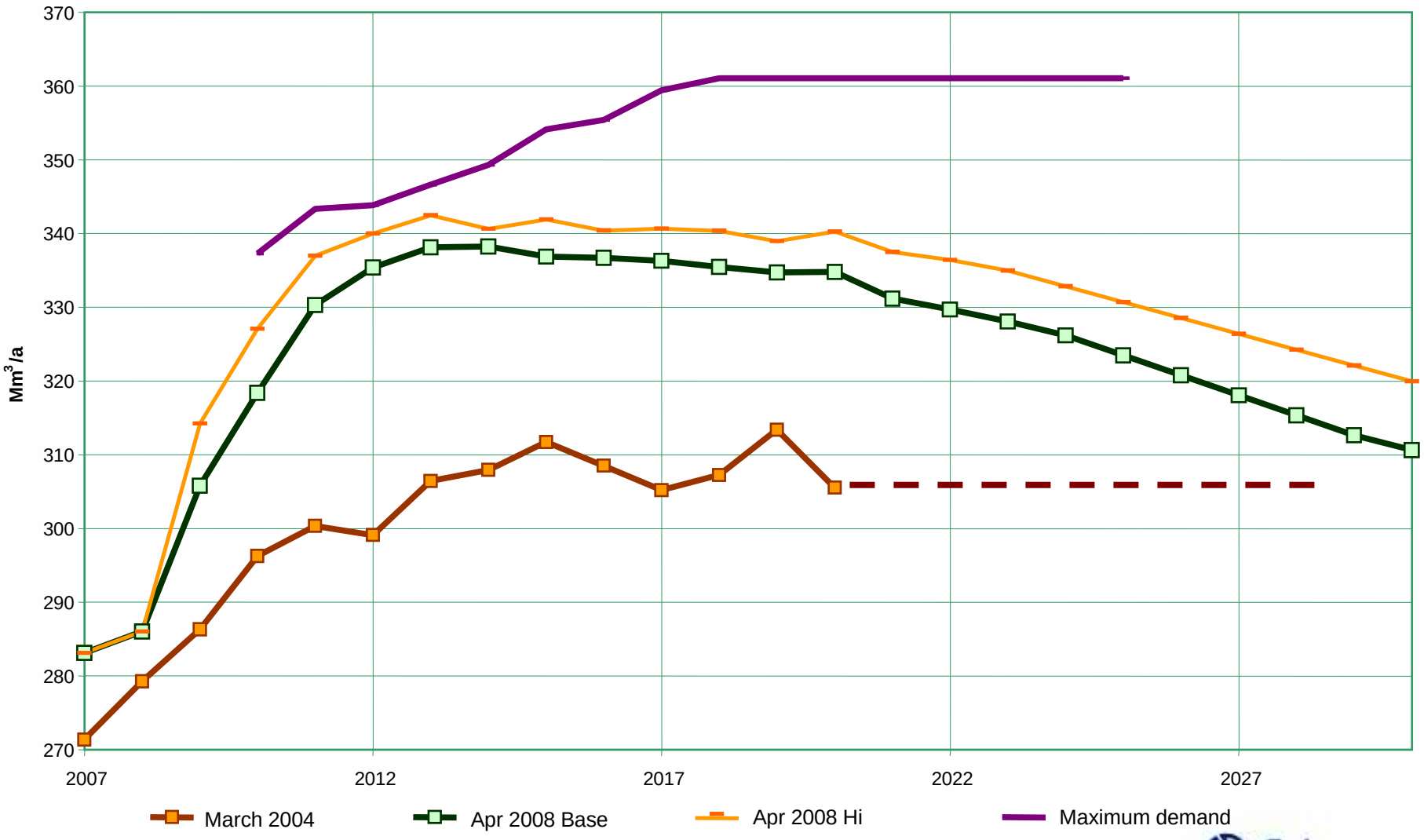


Decommissioning:

RTS: 2025-2030: 30
He: 2030-2035: 30
Ar: 2035-2040: 35
95

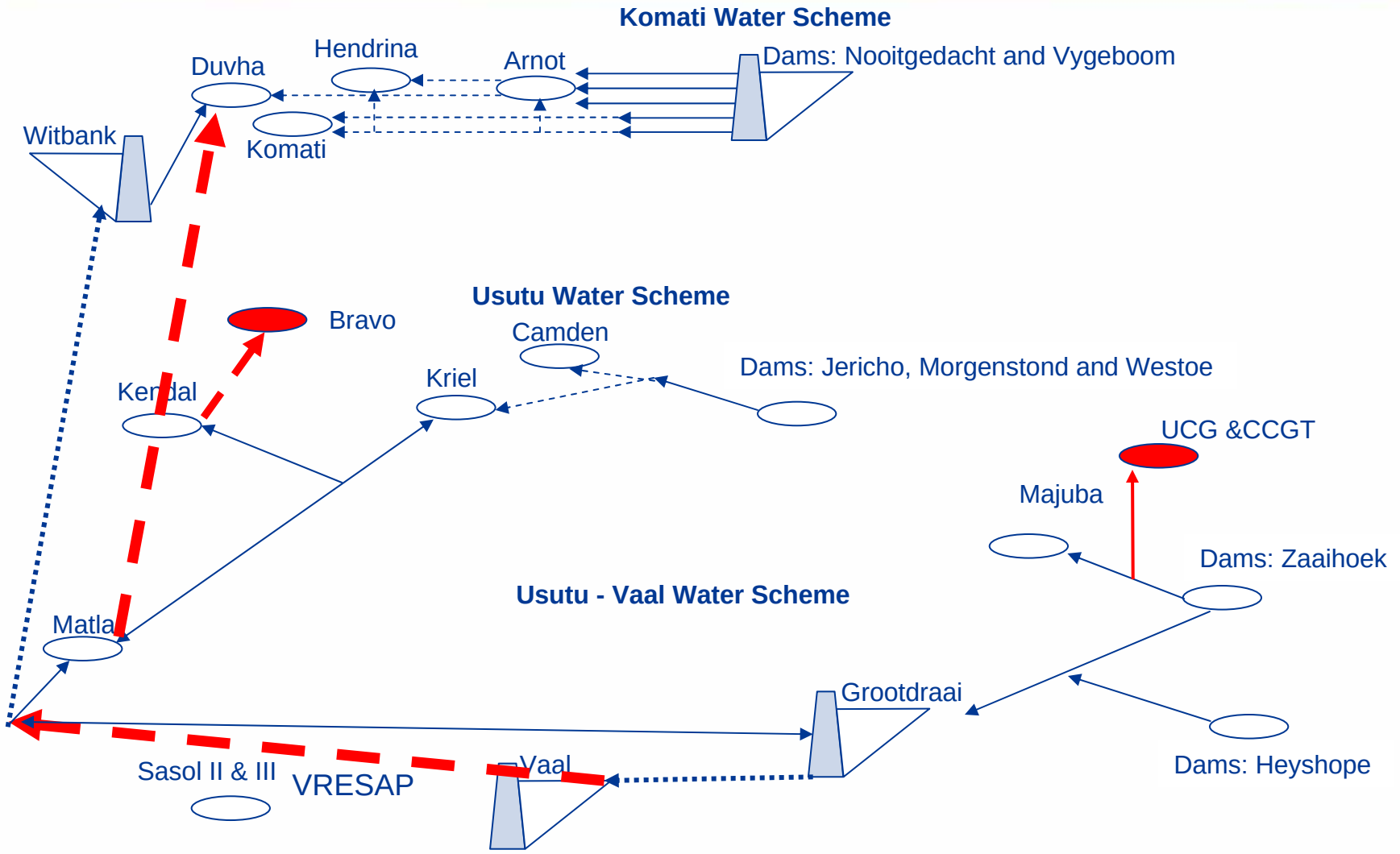
Eskom

Eastern sub-system



[13] 60 year life assumed

Water Availability: VRESS Map

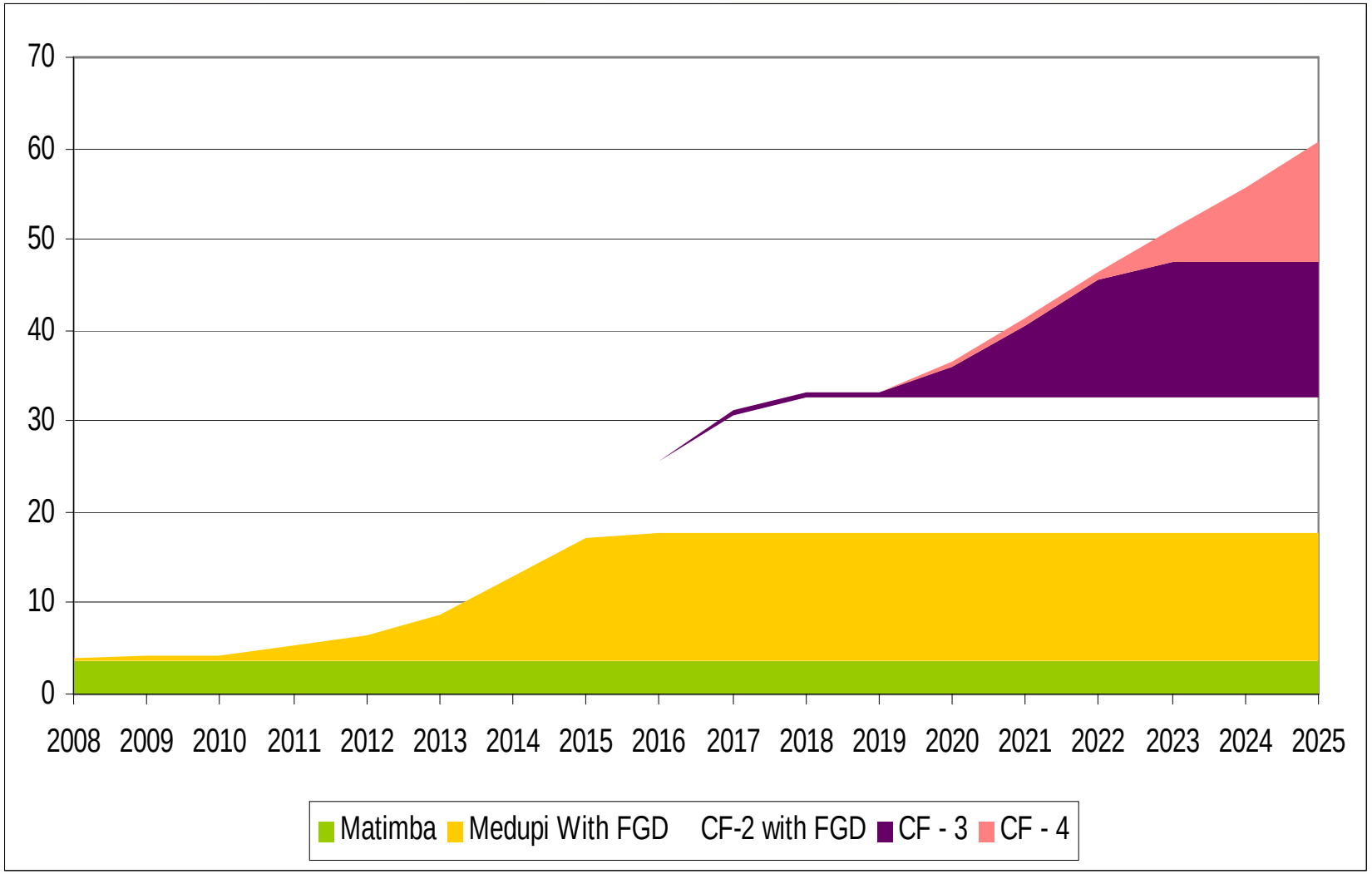


Eskom

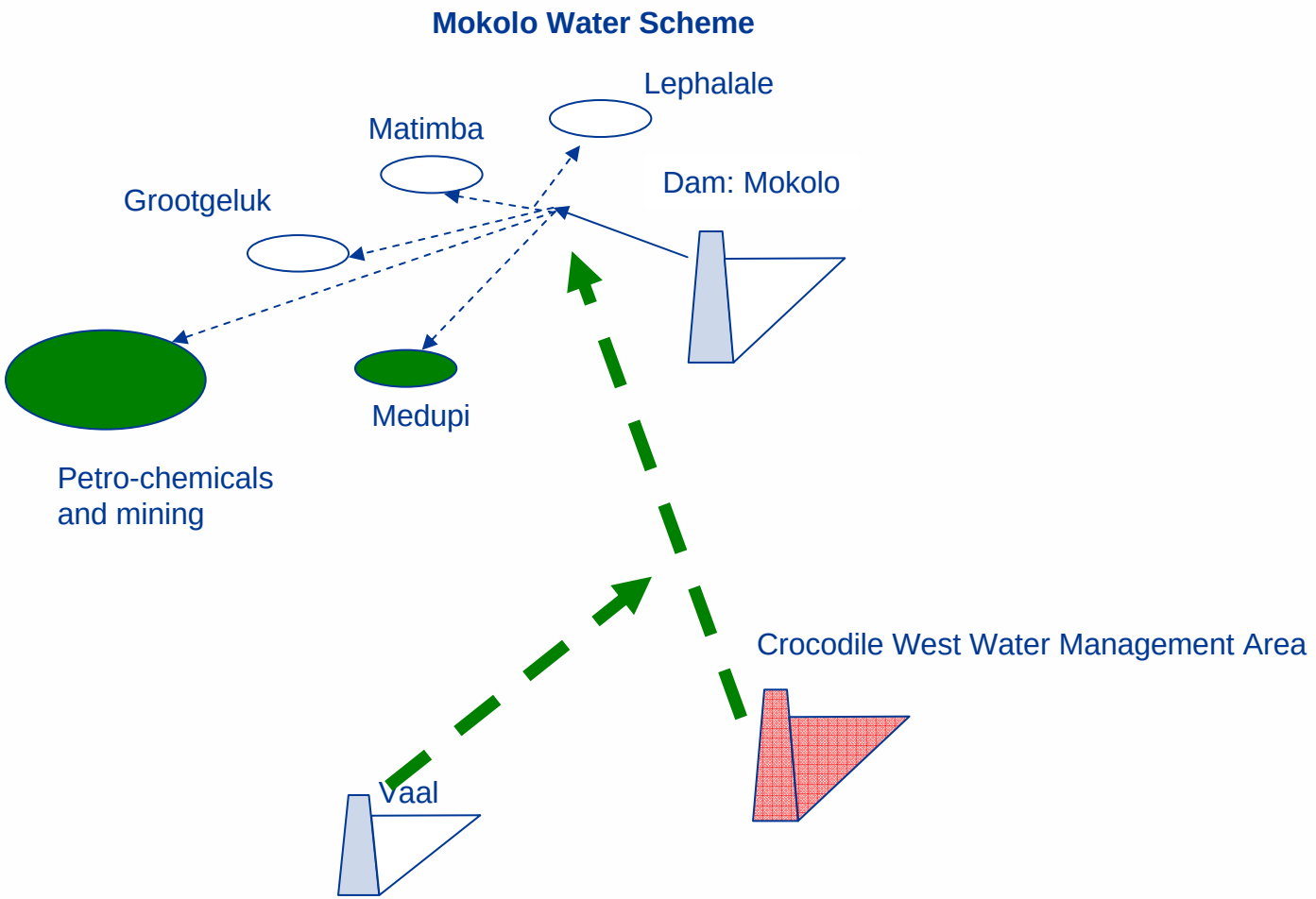
Water Supply Demands

- Water demands in Waterberg will increase due to:
  - Eskom's new power stations
  - Independent Power Producers
  - Increased mining activities:
    - Exxaro and others
  - Population growth and development
  - Coal to Liquid Plants

Projected Water Demand Scenarios incl FGD

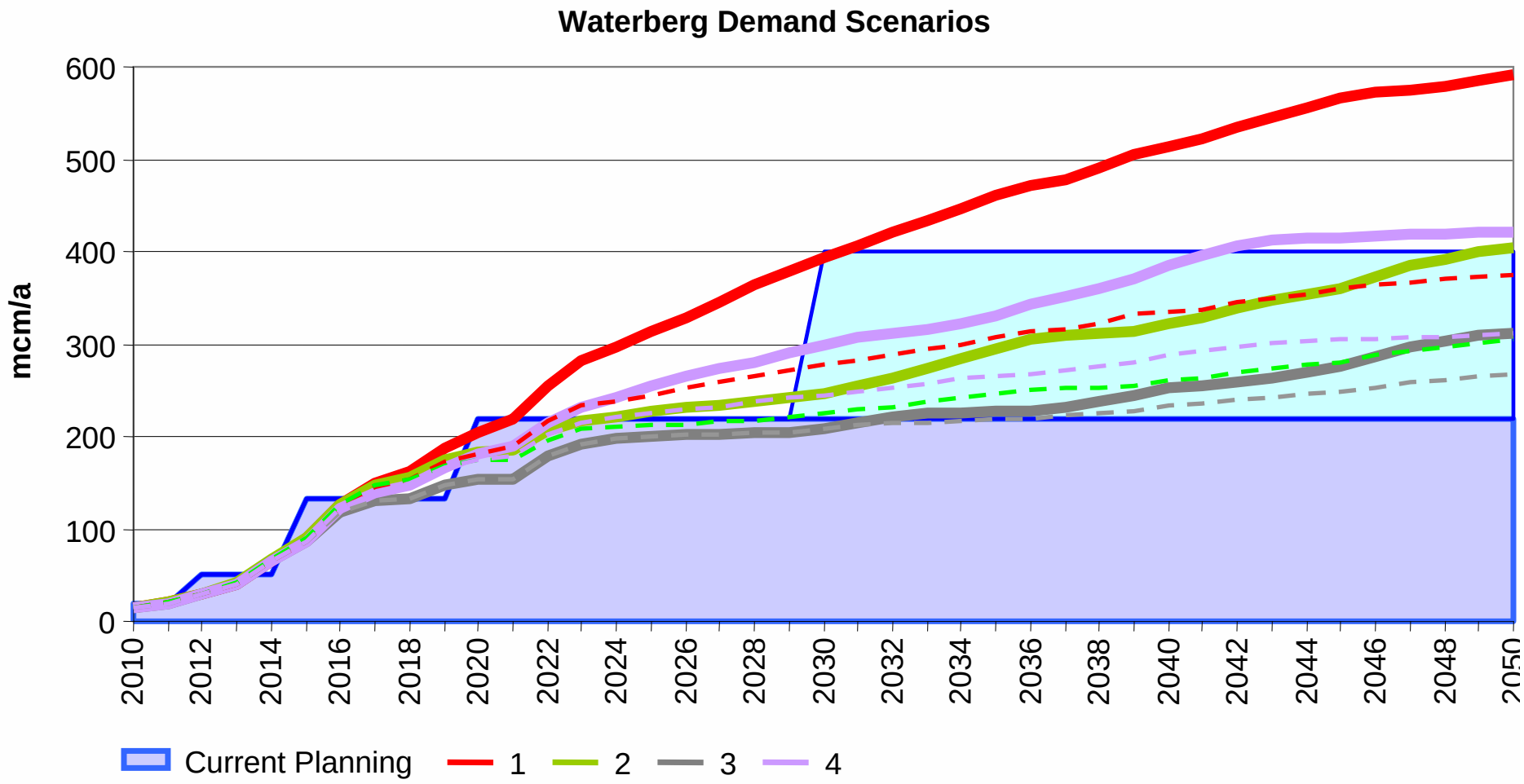


Schematic of Water Supply to Mogol System



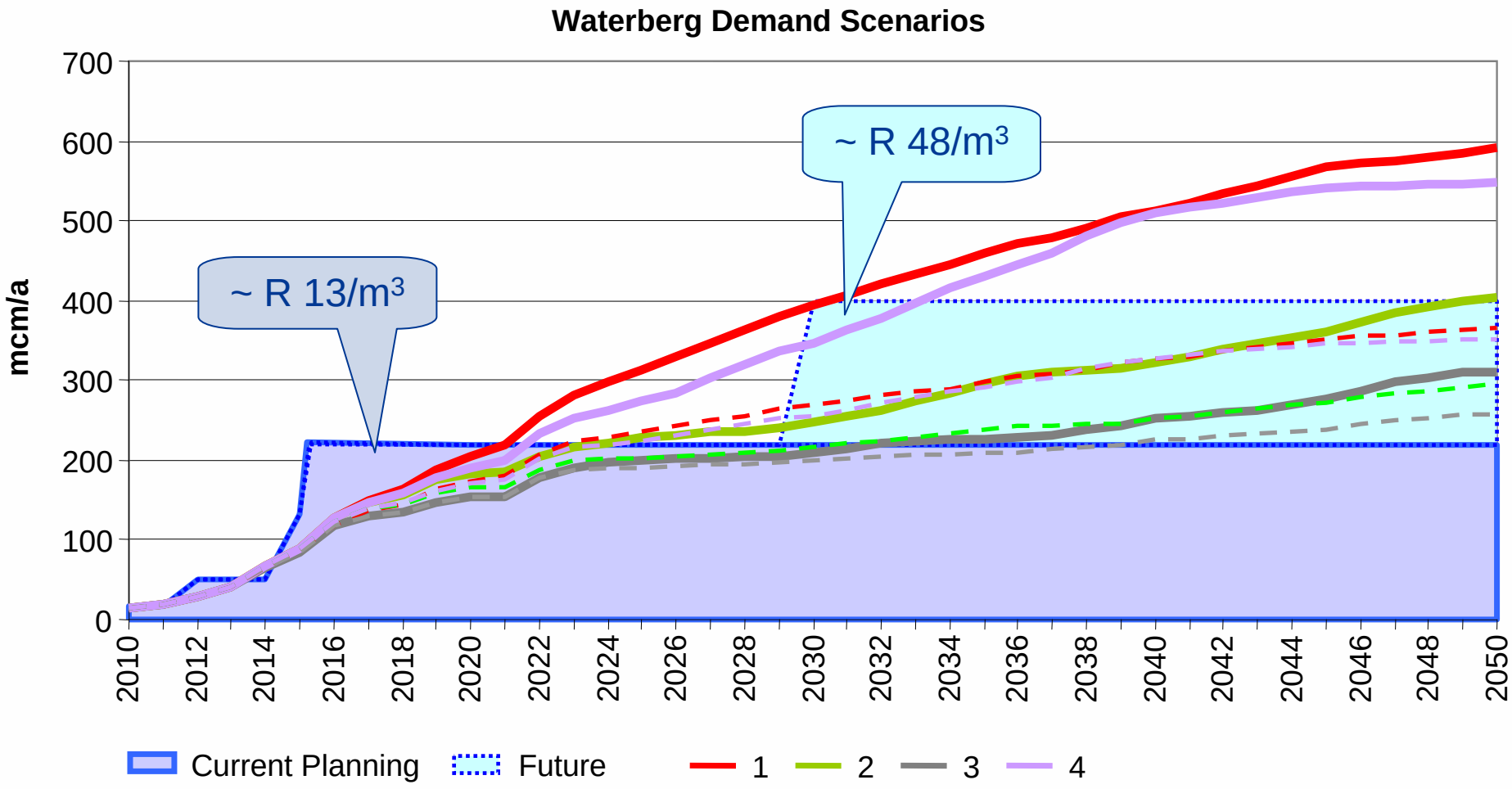
Eskom

Scenario Overview



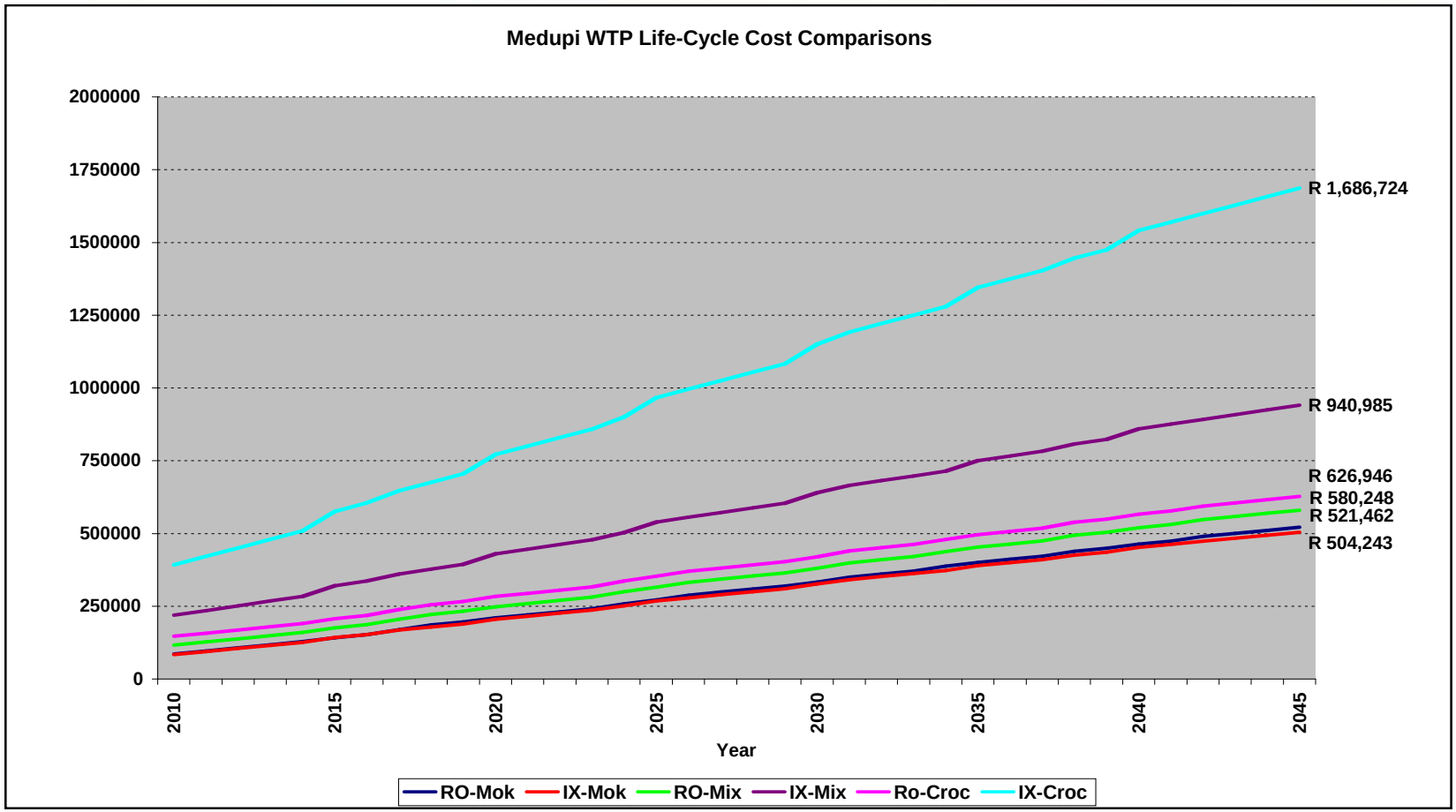
Dotted lines are the (b) scenarios

Scenario Overview



Dotted lines are the (b) scenarios

Medupi Power Station treatment costs



- From the above, based on moving water abstraction from the ideal quality (Mogol water) to impacted water quality (Crocodile West) requires additional treatment costs.

20

Medupi Environmental Impact Report

- Creation of employment opportunities. It was determined that the proposed power station would lead to the creation of a number of job opportunities, both during its construction and operation.
- Impacts on the local municipality. It was determined during the scoping study that the power station would bring about a significant increase in the demand for housing and infrastructure in the surrounding area. This increase would have a substantial impact on the local municipality.
- Impacts on public safety and daily movement patterns. It was determined that the construction and operation of the power station are likely to result in an increase in traffic volumes. This could lead to damage of local roads and increased speeding through town, thereby impacting on the safety and daily movement patterns of residents in surrounding communities.
- Social investment and infrastructural improvements. Social investment initiatives by Eskom, as well as by Exxaro, could have significant positive impacts on surrounding communities. Such initiatives could include upgrading of existing infrastructure such as services.

Medupi Environmental Impact Report

- Impacts on owners and residents of surrounding farms. It was determined that the power station could impact on surrounding communities' way of life and on the area's sense of place. This, in turn, could have a negative effect on property values and on the attractiveness of the area as a destination for hunters and tourists.
- Relocation of households. It was determined that the construction of the power station might necessitate the relocation of certain farm owners and/or farm residents.
- Influx of job seekers. Because of high unemployment rates in the region, it is possible that news of the proposed development could lead to an influx of job seekers into the area.
- Possible conflict between local residents and newcomers. If construction workers are not sourced locally, but are housed close to the site, this may give rise to conflict between local residents and newcomers. If the area experiences an influx of job seekers, competition over scarce employment opportunities may also lead to conflict with locals.
- Impacts on the residents of Marapong. It was determined during the scoping study that, if the proposed power station were to be located on one of the northern sites (Nelsonskop or Appelvlakte), the residents of Marapong might suffer significant negative effects in terms of changes in air quality, noise pollution and the like.

Water Resources and Waste Management I

	Activity	Activity Leader	Task	Task Leader	Budget	
W&W	**Water Research**	**M Michael**	**Surface Water Research**	**M Michael**	**R 865,000.00**	
			Scanning of Water Related Research	**G Gericke**	**R 50,000.00**	
			Impact of deteriorating water quality on Eskom	**T Jongwane**	**R 300,000.00**	
			Remediation of AMD with Flyash	**N Misheer**	**R 105,000.00**	
			Statistical Analysis of Production Risk Exposure to the Orange River Hydro Plant	**R Kydd**	**R 600,000.00**	
			AMD Recovery	**N Misheer**	**R 100,000.00**	**R 2,020,000.00**

Eskom

Water Resources and Waste Management II

Waste Research	G Gericke	Ash Applications	K Reynolds	R 2,500,000.00	
		Water/Salt Sinks for Ashless Power Stations	N Misheer	R 100,000.00	
		Feasibility of Application Of Zeolites made from Fly-Ash	N Misheer	R 500,000.00	
		Management of Waste Streams in Eskom	R Bothma	R 50,000.00	
		Recycling Opportunities related to E-Waste Streams in Eskom	R Bothma	R 50,000.00	
		Development of Appropriate Sampling and Analysis for Chromium in ash Dam tailings	T Jongwane	R 700,000.00	
		Impact of Road and Rail Transport of Coal	M Couto	R 50,000.00	
		Mercury Speciation	T Jongwane	R 450,000.00	
		Monitoring of Impacts of Mercury Deposition	M Couto	R 200,000.00	
		Eskom Sasol Joint Research: Brine	G Gericke	R 1,400,000.00	R 6,000,000.00
				R 8,020,000.00	R 8,020,000.00

Potential Risks

- Climate change impacts the available yields of water resources requiring greater flexibility on the water supply systems;
- Implementation of the Reserve impacts the water available for power generation and other users;
- Asset Management of bulk water schemes impacts the reliability and availability of water supply to the power stations;
- Water infrastructure development is not synergistic with power generation development;
  - Long lead times for augmentation schemes;
  - Other options such as water trading could take long to negotiate;
- Institutional reform impacts the current operations of the various schemes and ability to deliver on new augmentation schemes
  - DWAF increasing regulatory capacity;
  - SANWRIA establishment;
  - Catchment Management Agencies
- Deteriorating water quality increases water requirement and creates an induced water stress;
- Skills impact on the operational effectiveness of power generation facilities & water supply to the power generation facilities.
- Funding and implementation of raw water infrastructure will be done “off-budget” and by DWAF.

Conclusions

- Water will be crucial for the power generation sector in the long term;
- Planning needs to be co-ordinated between power generation and water sectors to ensure adequate water is made timeously to the power stations;
- Freshwater use is expected to increase in short and medium term but will decrease over the long term as the portfolio of power generation has more dry cooled plant;
- There is potential for regulatory and institutional reform to impact on water availability;
- Co-operative action is required to meet the challenges in the water sector;
- A number of risk mitigation strategies have been developed and are being implemented to ensure adequate water supply to the existing and new power stations.

26

Water Use Assumptions

	l/USO	Mcm/a
Dry Cooling	0.16	6
FGD	0.25	9
CCS	0.1	3

- PF plant with only FGD requires 15 mcm/a
- PF plant with CCS (and FGD) requires 18 mcm/a

- FBC plant requires 6 mcm/a
- FBC with CCS (and FGD) requires 9 mcm/a

WMA Reconciliations

WMA (in million cubic metres)	2025 Low Recon.	2025 High Recon.	Development Options Assessed & Unevaluated	Deficit/Shortfall
Limpopo	-47	-60	8(45)	-7
Luvuvhu/Letaba	43	43	102	145
Crocodile W & Marico	125	334	0	334 (already allocated)
Olifants	-241	-279	239	-40
Inkomati	-197	-232	104	-128
Usutu-Mhlathuze	311	238	110	348 (transfers to Olifants)
Thukela	-111	-150	598	448 (transfers to Upper Vaal)
Upper Vaal	-44	-765	50(475)	-240
Middle Vaal	8	4	0	4
Lower Vaal	57	70	0	70
Mvoti- Umzimkulu	-422	-789	1018	229
Mzimvubu-Keiskamma	458	437	1500	1937
Upper Orange	85	-45	900	855
Lower Orange	-8	-12	150	138
Fish-Tsitsikamma	67	46	85	131
Gouritz	-79	-158	110	-48
Olifants-Doring	-35	-40	185	145
Breede	38	-1	1	0
Berg	-68	-510	127	-383

Medupi Water Demands

- Medupi Power Station Water Consumption (14 Mm^3/a):
  - Construction water
  - Commissioning water
  - Ash conditioning
  - Potable water and demineralised water production
  - Flue Gas Desulphurisation (FGD): 9 Mm^3/a

- Crocodile River water quality is of a lower standard than Mokolo Dam water. Further treatment required to deal with organics.
- Water allocation from Mokolo Dam to be utilised across existing and new power stations as far as possible together with Crocodile River water.

End-notes

- Water into the future
  - Old review
  - New Build Programme
  - Existing Fleet
  - Nuclear
  - Desalination
- Partnerships
  - DWAF
  - Mines
  - Water Research Commission
    - MoU
    - Existing representation at WRC Steering Committees
    - Renewal of MoU
    - Joint Workshop