

A decorative graphic on the left side of the slide, consisting of three overlapping circular frames. The top frame shows a high-voltage power transmission tower. The middle frame shows a large industrial facility with several tall cooling towers and a body of water in the foreground. The bottom frame shows a white wind turbine against a blue sky.

Eskom's revised Coal Ash Strategy and Implementation Progress

Nico Singh and Kelley Reynolds-Clausen
8th November 2016

In 2014 – 15 Eskom:

- Burnt 120Mt of coal in 13 power stations. **This excludes Medupi PS which is already producing ash.**
- Produced 35 000MW of electricity.
- Formed 34.4Mt of ash.

2015 SA authorities escalated the use of ash as a strategic priority.

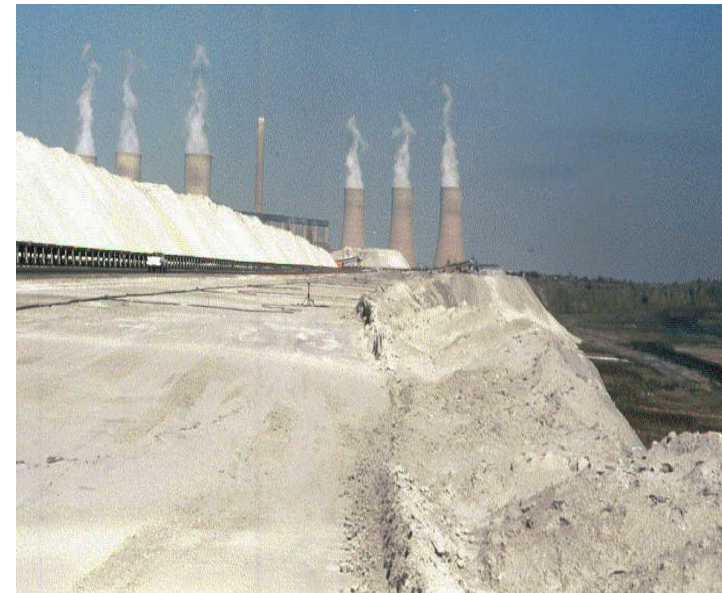
- To improve business development.
- Increase infrastructure development.
- Create jobs.
- Create social upliftment.
- Allow for skills development.





- At present approximately 7% of the ash produced is utilised in construction/**cement** industry in comparison with a **world average total use of about 50-60%**.
- This industry is operating on historical permits.
- In 2008, legislation classified ash as a hazardous waste.
 - Dumping sites require a Class C liner.
 - New businesses require a waste management license.
 - Expensive
 - Time consuming
 - Limits³new technologies

- Eskom operates on a ZLED policy.
- To preserve available fresh water resources.
- All water retained on site.
- Cascading quality → final to ashing system.
- Acts as a salt sink for saline effluents.
- 74% of ash produced acts as a salt sink.
- **With about 7%** being sold, it leaves about 19% available to sell.
- If more ash required, water treatment will have to install – needs investment



Eskom utilises two different means of ash handling.

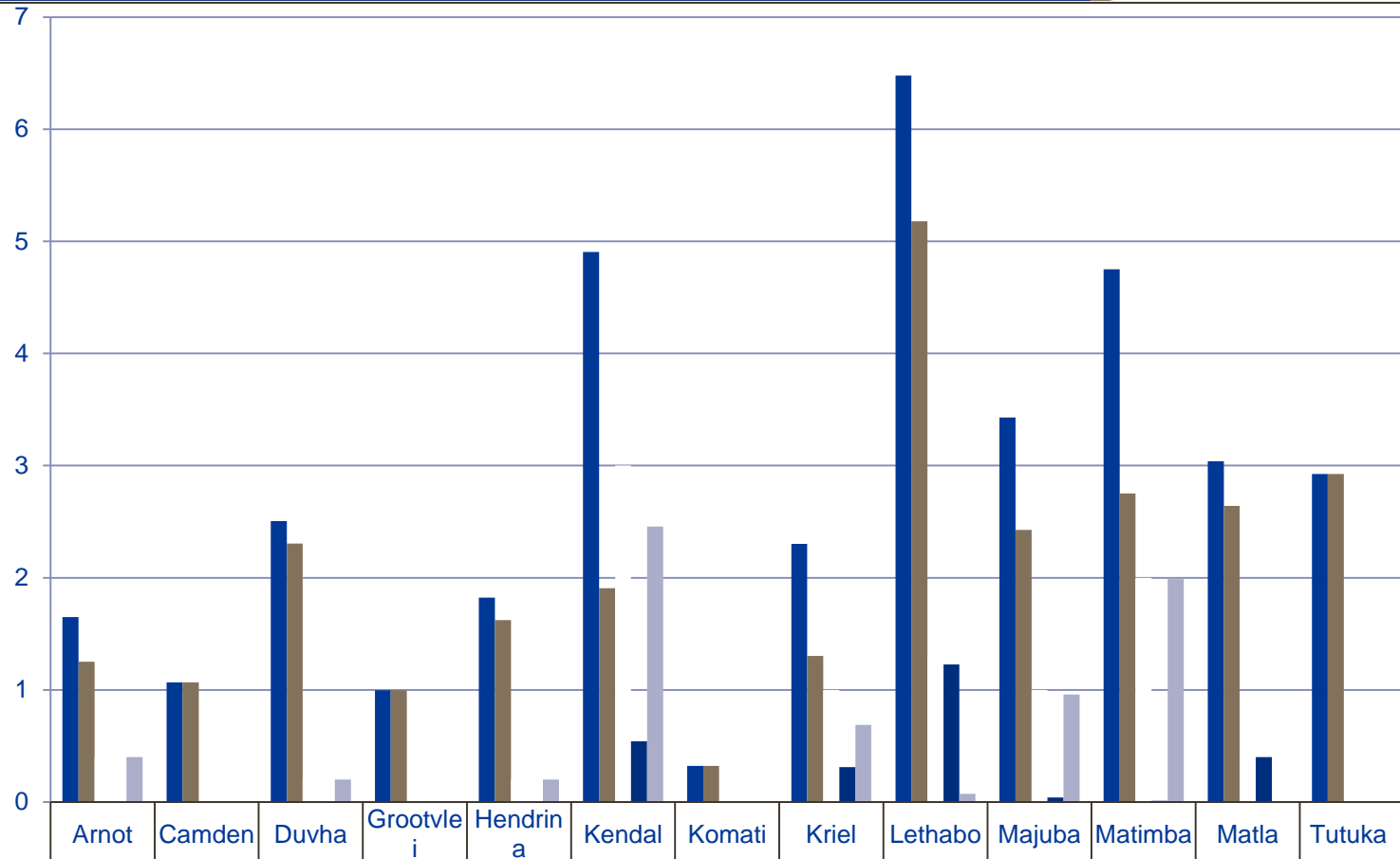
- Wet ashing
 - Ash transported in a slurry with effluent water.
 - Pumped to handling facility and allowed to settle, stacking.
 - Water recirculated.
- Dry ashing
 - Ash transported conditioned (10% water).
 - Placed at front end of dump.
 - Dust suppression with effluent water.



Coal blending

- Combustion of coal from various sources leads to different ash qualities.
- Causes ash to react differently in various technologies.

Volumes of ash available per power station



Estimated ash volumes available per power station. This table is under review and may be subject to change thus impacting ash availability, location to market and possibly market forces.

Eskom Ash Strategy

Avoid high cost of ash storage facilities –capex can be released for production assets

Reduce environmental footprint of Eskom and of ash users

Drive additional revenue through sales of ash



Manage high volumes of ash to avoid operational impacts and loss of production

Support for small business development, localisation and job creation

Reduced environmental impact, job creation and social development

Development of new applications, business ventures, skills and capacity

Strategy details:

- Adoption of cost avoidance rather than revenue model.
- Development of a strategy per power station.
- Consultation with DEA and related government departments → change ash classification.
- Submission of documents, on behalf of industry, to ease legislative constraints.
- Unlock legislative constraints – testing.
- Explore all relevant ash technologies and applications.
- Collaborate with industrial stakeholders.
- Develop customer interfaces for sales, take off points etc.
- **Conduct research and development including pilots**
- Stakeholder engagement to increase ash awareness.



- Eskom's focus is to increase ash utilisation in current technologies.
- Avoided cost has been calculated, institutionalised and reported.
- Possible areas
 - Avoid future CAPEX, delay or lack of liners.
 - Ash handling plant extensions delayed
 - Decreased handling volumes
- Determine exact amount of ash available per station.



- All ash applications use one or more of ash's unique properties:
 - pH – above 11.5 when fresh, weathers to 8.5 over time.
 - Spherical shape – improves flow characteristics and allows for effective compaction.
 - Wide range of particle sizes – increases surface area.
 - Pozzalanic nature – setting of the ash once wet.
- Several applications – low cost/high volume to high cost/low volume.
 - Rare earth extraction
 - Mine backfilling
 - Mine drainage treatment
 - Soil amelioration/Land reclamation
 - Road construction
 - Paint fillers
 - Rubber fillers
 - Zeolite production
 - Geopolymers



Applications and products where ash is used around the world – BIG FIVE



Brick manufacturing



Mine backfilling
Treatment of acid mine drainage and water



Road and embankment construction



Agriculture and soil amelioration

NEW APPLICATIONS

Rubber, adhesives, paint etc,,,

The utilisation of coal ash is still dominated by its application in the cement and concrete industries in South Africa



Slide courtesy Ash Resources

- Hazardous Classification must be addressed for applications to progress.
- Eskom submitted Regulation 9 – Exclusion from the need for a waste management license.
 - Mine backfilling/ AMD treatment
 - Cementitious applications
 - **Road construction**
 - Soil amelioration.



- Coal ash is currently classified as hazardous waste under the National Environmental Management Act : Waste Act (NEM:WA)
- This requires potential users of ash to apply for waste management licenses, supported by either an Environmental Impact Assessment (EIA) or Basic Assessment (BA)
- Without a waste management license, businesses will not be able to “trade” in ash
 - This significantly impacts the ability to develop new businesses and jobs
 - Multiple parties will have to apply for either a waste management license or exemptions thereto.

All persons wanting to beneficiate waste require a waste license achieved through either an Environmental Impact Assessment or a Basic Assessment. Should any person want to be exempted or excluded from the requirements of a waste license, 3 options are available.....

Draft Exclusion regulations

- First draft November 2014 - No confirmed date of release for revised draft.
- Certain specified fly ash applications will be unconditionally excluded from the definition of Waste ?
- Eskom will still need to demonstrate safe use

Regulation 9 of the Waste Classification and Management Regulations

- A provision which excludes any person from the requirements of a waste license
- Applicant needs to demonstrate that the ash activity can be implemented and conducted consistently and in a controlled manner without unacceptable impact on, or risk to, the environment or health

Section 74 of NEM:WA provides for an exemption application.

- A temporary conditional exemption from the waste Act.
- Applicant needs to demonstrate that the ash activity can be implemented and conducted consistently and in a controlled manner without unacceptable impact on, or risk to, the environment or health

The focus of Eskom's ash strategy

Focus	Description
Develop new markets	<ul style="list-style-type: none"> • Detailed market study on ash markets and the potential thereof its sales and development • Review volumes its government projects (e.g. IDPs, SANRAL, DPW etc.) • Identify and actively drive specific sales opportunities • Develop mass usage markets (road construction, agricultural and rehabilitation) through Industry collaboration, consolidate research and unlocked legislative issues • TFR opportunities for cement to coastal regions
Keep price to the end user of ash as low as possible	<ul style="list-style-type: none"> • Defined the role of Eskom as a facilitator to drive ash utilization vs revenue realisation • Develop a preferred market structure to ensure competition - thus keeping the price low • Adhere to contracting and pricing guidelines and principles to facilitate open market and competition
Leverage Eskom Procurement process	<ul style="list-style-type: none"> • Renewals and new contracts to entrench SD&L and CSI targets, monitoring and reporting. • Large players to contribute in terms of business development, job creation, technical support etc.
Increase accessibility of ash to smaller players	<ul style="list-style-type: none"> • Investigate options to make ash logistically available to smaller player • Leverage Eskom supply contracts to cement industry and large players to make access • Open additional ash access points at power stations
Leverage policy / legislation to develop new markets	<ul style="list-style-type: none"> • Use of ash for road construction could be mandatory in close proximity of the power stations • Engage national agencies to set targets for ash utilisation e.g. municipalities, local government and national agencies e.g. SANRAL
Drive specific social development initiatives	<ul style="list-style-type: none"> • Initiate pilot programmes <ul style="list-style-type: none"> • New market and business development • Expedite job creation and localisation (Mpumalanga) in targeted sector (youth and women). • Expand Corporate Social Investment

Regulation 9: *“Any person may submit a motivation to the Minister to list a specific waste management activity that does not require a waste license in terms of section 19 of the Act*”

It will be required that, for each application, it be demonstrated that our intended application:

- Can be implemented consistently
- In a controlled manner
- Has no unacceptable risk to human health
- Has no unacceptable impact to the environment

	Regulation 9	Section 74
Mandate	Exclusion from the requirements of a waste licence	Exemption from the Waste Act
Approval	Minister of Environmental Affairs	Minister of Environmental Affairs / MEC
Duration	permanent	temporary
Target stakeholders	All stakeholders /ash application	Specific stakeholders
Requirements of Stakeholders	Comply with Norms and Standards	Audit of facilities prior approval Comply with Norms and Standards
Timeframes for DEA approval of Eskom submission	Unclear – several months - year	3-4 months

Eskom have completed a Section 74 application for a list of emerging brick makers.
Section 74 application submitted to DEA in October

	Decision timeframes	Agreement at the Eskom/DEA meeting 24 October
<p>Regulation 9</p>	<ul style="list-style-type: none"> Timeframes are not legislated. 	<ul style="list-style-type: none"> Following approval, there will be no waste license required for all Industries engaging with Eskom for the provision of ash for the included applications. The 4 beneficial uses applied for, will be adjudicated independently
<p>Section 74</p>	<ul style="list-style-type: none"> Decision on Eskom's Section 74 application in November 2016 	<ul style="list-style-type: none"> DEA will grant conditional exemption to off-takers with the pre-requisite that the N&S are complied with DEA to schedule 'audits' of off taker sites as sites indicate they are 'ready'. DEA to process further additional off takers in a structured approach Off takers found not to be compliant to the N&S to be scheduled for a re-audit. Off takers will not be forming an Association <u>The requirements of the Section 74 process to be work shopped with off-takers and DEA on November 14.</u> <u>Investigate Section 74 for other applications?</u>

- Hazardous nature of ash is unique world wide and the SA classification of waste the strictest in the world.
- Internationally ash is classified as a by-product or a resource.

- NEMWA
 - Full elemental analysis
 - Full leachables analysis
 - Concentrations classify waste into Type
- All ash is Type 3 low risk waste

Criteria	Risk Level	Description of Risk associated with Disposal to Landfill
LC > LCT2, or TC > TCT2	<u>Type 1:</u> High Risk	Considered high risk waste with a very high potential for contaminant release. Requires very high level of control and ongoing management to protect health and the environment
LC > LCT 1 and < LCT 2 or TC > TCT 1 and < TCT 2	<u>Type 2:</u> Moderate Risk	Considered moderate risk waste with high potential for contaminant release. Requires high level of control and ongoing management to protect health and the environment
LC > LCT 0 and < LCT 1 or TC > TCT 0 and < TCT 1	<u>Type 3:</u> Low Risk	Considered low risk waste with some potential for contaminant release. Requires proper control and ongoing management to protect health and the environment
LC < LCT 0 or TC < TCT 0	<u>Type 4:</u> Very Low Risk	Very low risk waste with low potential for contaminant release. Requires some level of control and ongoing management to protect health and the environment

Allowable concentrations per element.

Contaminants in Waste	TCT0 mg/kg	TCT1 mg/kg	TCT2 mg/kg	LCT0 mg/l	LCT1 mg/l	LCT2 mg/l
Metal Ion Contaminants						
As, Arsenic	5.8	500	2000	0.01	0.5	1
B, Boron	150	15 000	60 000	0.5	25	50
Ba, Barium	62.5	6 250	25 000	0.7	35	70
Cd, Cadmium	7.5	260	1 040	0.005	0.25	0.5
Co, Cobalt	50	5 000	20 000	0.5	25	50
Cr _{Total} , Chromium Total	46 000	800 000	N/A	0.1	5	10
Cr(VI), Chromium (VI)	6.5	500	2 000	0.05	2.5	5
Cu, Copper	16	19 500	78 000	1	50	100
Hg, Mercury	0.93	160	640	0.001	0.05	0.1
Mn, Manganese	1 000	25 000	100 000	0.4	20	40
Mo, Molybdenum	40	1 000	4 000	0.07	3.5	7
Ni, Nickel	91	10 600	42 400	0.07	3.5	7
Pb, Lead	20	1 900	7 600	0.01	0.5	1
Sb, Antimony	10	75	300	0.01	0.5	1
Se, Selenium	10	50	200	0.01	0.5	1
V, Vanadium	150	2 680	10 720	0.1	5	10
Zn, Zinc	240	160 000	640 000	3	150	300
Inorganic Anions						
TDS	N/A	N/A	N/A	1 100	12 500	25 000
Chloride	N/A	N/A	N/A	300	15 000	30 000
Sulphate	N/A	N/A	N/A	250	12 500	25 000
NO ₃ as N, Nitrate-N	N/A	N/A	N/A	11	550	1 100
CN ⁻ (total), Cyanide Total	14	10 500	42 000	0.07	3.5	7

Total concentrations of various elements in Eskom ashes.



Element	TCT0 mg/kg	TCT1 mg/kg	TCT2 mg/kg	1	2	3	4	5
				TC mg/kg	TC mg/kg	TC mg/kg	TC mg/kg	TC mg/kg
As	5.8	500	2 000	10.46	10.81	11.75	5.31	11.11
B	150	15 000	60 000	150	117	160	93	36
Ba	62.5	6 250	25 000	213.85	485.33	926.06	607.11	450.03
Cd	7.5	260	1 040	2.46	2.65	1.94	2.35	1.4
Co	50	5 000	20 000	9.15	8.14	11.64	10.3	11.27
Cr	46 000	800 000	N/A	176.04	125.65	119.15	120.13	141.95
Hg	16	19500	78 000	0.1	0.44	0.31	0.41	0.23
Cu	0.93	160	640	23.94	27.58	34.77	32.47	51.04
Mn	1 000	25 000	100 000	220	221	200	290	390
Mo	40	1 000	4 000	5.58	9.02	3.33	6.25	2.72
Ni	91	10 600	42 400	38.78	34.18	41.02	54.34	66.17
Pb	20	1 900	7 600	70.42	82.83	60.16	89.59	98.15
Sb	10	75	300	1.42	1	0.37	0.72	1.09
Se	10	50	200	1.12	1.5	1.01	1.98	1.19
V	150	2 680	10 720	77.64	117.52	70.64	71.23	110.59
Zn	240	160 000	640 000	63.06	38.61	36.06	35.36	164.03

Note:

	Below or equal to LCT 0
	Above LCT 0, below LCT 1
	Above LCT 1, below LCT 2
	Above LCT 2

Leachable concentrations of various elements in Eskom ashes.



Element	LCT0 mg/l	LCT1 mg/l	LCT2 mg/l	1	2	3	4	5
				LC mg/kg	LC mg/kg	LC mg/kg	LC mg/kg	LC mg/kg
As	0.01	0.5	1	0.39	0.13	0.47	0.44	0.43
B	0.5	25	50	10	3.5	13	5.1	2.2
Ba	0.7	35	70	0.14	0.32	0.23	0.27	0.19
Cd	0.005	0.25	0.5	0.002	<0.002	0.003	0.003	0.003
Co	0.5	25	50	0.005	0.007	0.02	0.02	0.02
Cr	0.1	5	10	0.39	0.05	0.27	0.86	0.1
Cr6+	0.05	2.5	5	0.03	0.02	0.07	0.06	<0.02
Hg	1	50	100	0.003	0.004	0.003	0.004	0.004
Cu	0.001	0.05	0.1	0.02	0.01	0.01	0.05	0.07
Mn	0.4	20	40	0.37	0.54	0.13	1.67	0.91
Mo	0.07	3.5	7	0.09	0.06	0.11	0.13	0.15
Ni	0.07	3.5	7	0.04	0.04	0.09	0.09	0.07
Pb	0.01	0.5	1	<0.005	<0.005	<0.005	0.005	<0.005
Sb	0.01	0.5	1	<0.02	<0.02	<0.02	0.06	<0.02
Se	0.01	0.5	1	0.026	0.032	0.019	0.05	0.02
V	0.1	5	10	1	0.34	1	1.1	0.89
Zn	3	150	300	0.02	0.04	0.07	0.03	0.12
TDS g/l	1	12.5	25	7.5	8.36	8.8	7.17	6.8
Chloride	300	15 000	30 000	7.3	6	<5	3.7	<5
NO ₃ as N	11	550	1100	1	0.84	0.2	0.9	0.2
Cyanide	0.07	3.5	7	0.01	<0.01	<0.01	0.02	0.01
Sulphate	250	12 500	25 000	130	270	365	188	198

Note:

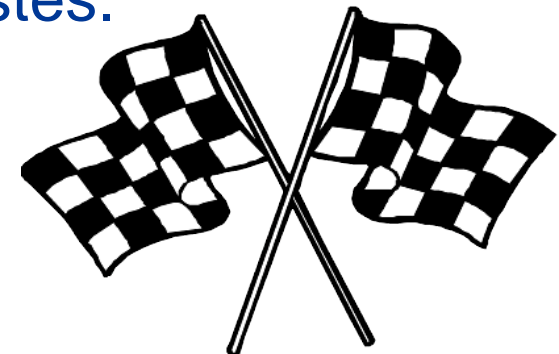
	Below or equal to LCT 0
	Above LCT 0, below LCT 1
	Above LCT 1, below LCT 2
	Above LCT 2

- Sampled all power stations (FA, BBA, Fresh and weathered ash).
- Analysed according to:
 - SANS 10234 for hazardous nature.
 - LEAF (Leaching Environmental Assessment Framework) protocol.
 - 3 pH levels.
- Will compare to international concentrations and associated risks
→ may lead to exclusion of ash from waste classification.
- **JUST IN**
 - All ashes classify as Type 3 (low risk) wastes.
 - Only ashes with a pH above 11.5 are hazardous according to SANS 10234.
 - WET testing completed on a 9:1 ratio of FA:BBA. Toxic to Daphnia
 - LEAF leaching will be conducted on a 1:9 coarse : fly ash composite for each site



- 2 projects
 - Laboratory and fundamental work at CSIR
 - Pilot trial at Camden PS
- Camden
 - Utilise Camden ash to construct layer in access road to new ash dump.
 - Ash from dump to be used.
 - Samples (FA and BBA) submitted to CSIR for grading. Both G7 or lower.
 - Plan to conduct blending tests to optimise grading.
- CSIR
 - Determine possible economic impact.
 - Sample ashes from all stations and classify.
 - Optimise blending of ashes.
 - Evaluate road stabiliser.
 - Include ash in asphalt design
 - Prove use in applications.
 - Heavy vehicle simulator and accelerated testing.
 - Development of a standard for the use of ash in roads.

- Coal ash can be used for several applications.
- Can develop jobs, skills and cause social upliftment.
- Eskom, on behalf of industry, is trying to reclassify ash or make it simpler to utilise.
- Many Eskom ashes, not fresh fly ash, classify as non-hazardous according to SANS 10234.
- All Eskom ashes are Type 3 (low risk) wastes.





Thank-you.



Questions?

