

Biogas Potential and Current Reality of Biowaste Management in South Africa

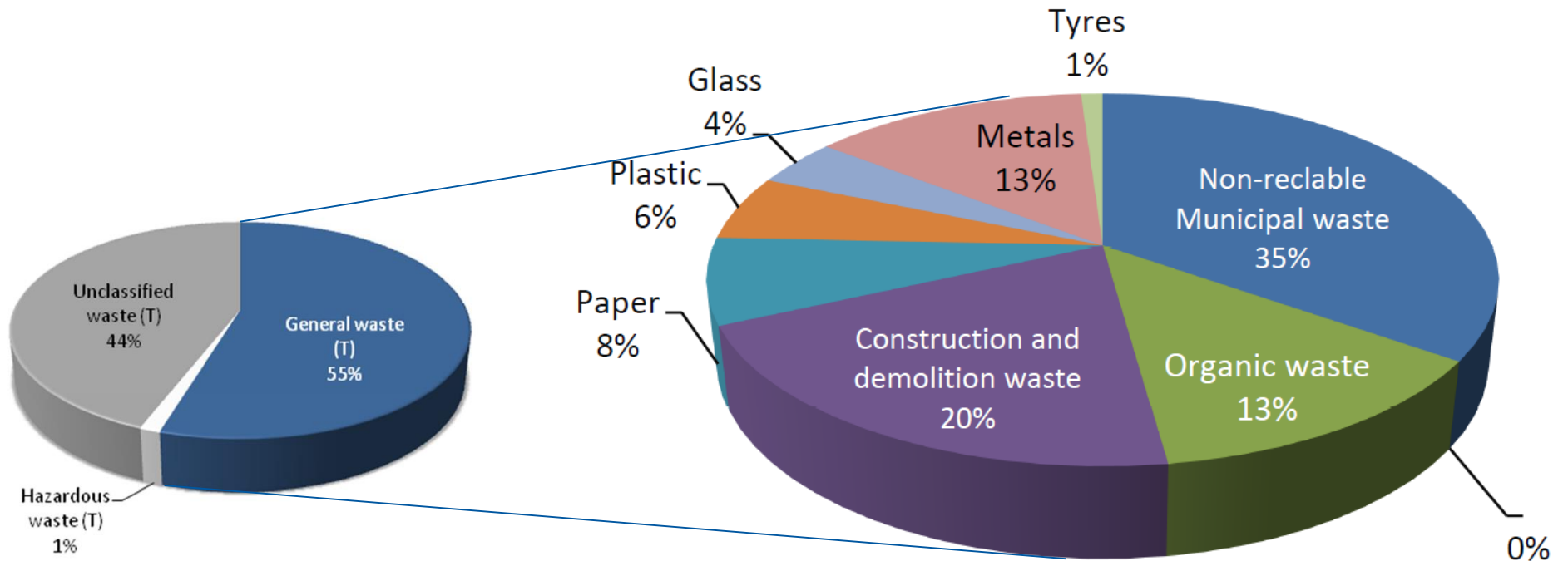
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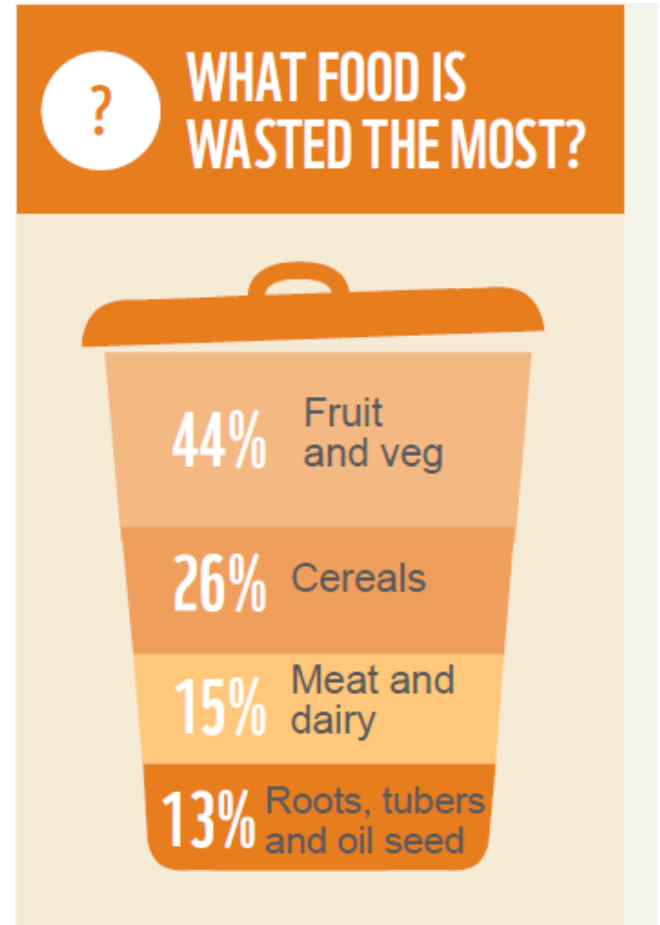
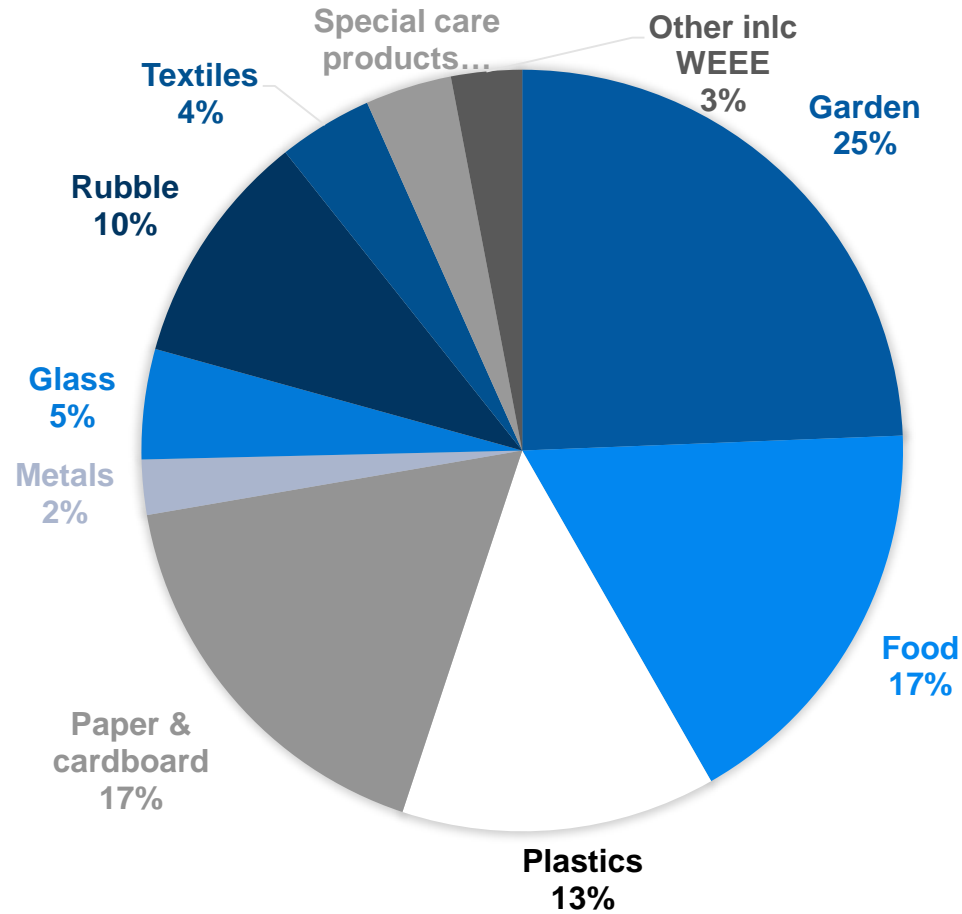
Extraordinary Professor, Unit for Environmental Sciences and Management,
NWU

Waste Profile for South Africa



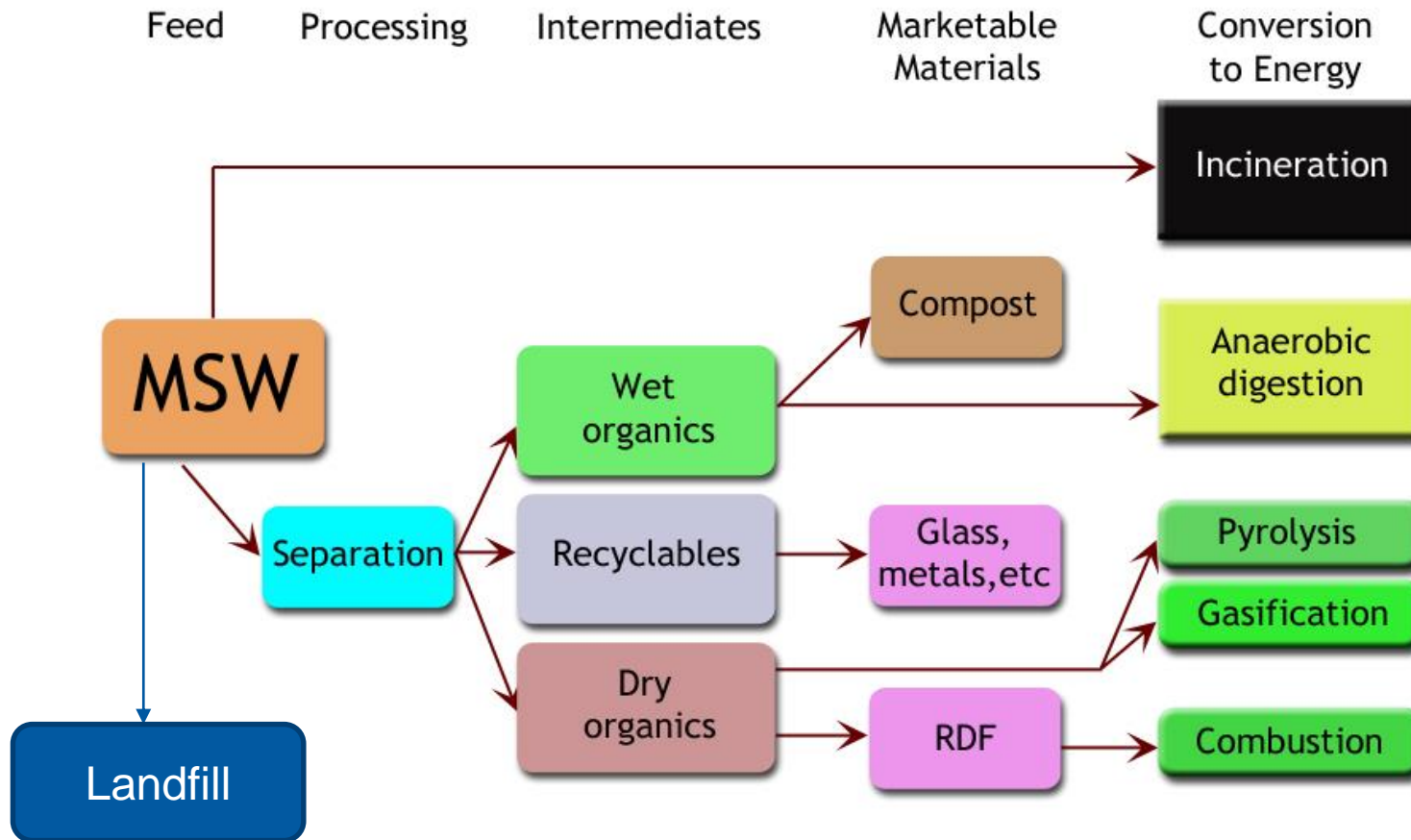
DEA, 2012

Municipal Solid Waste in South Africa

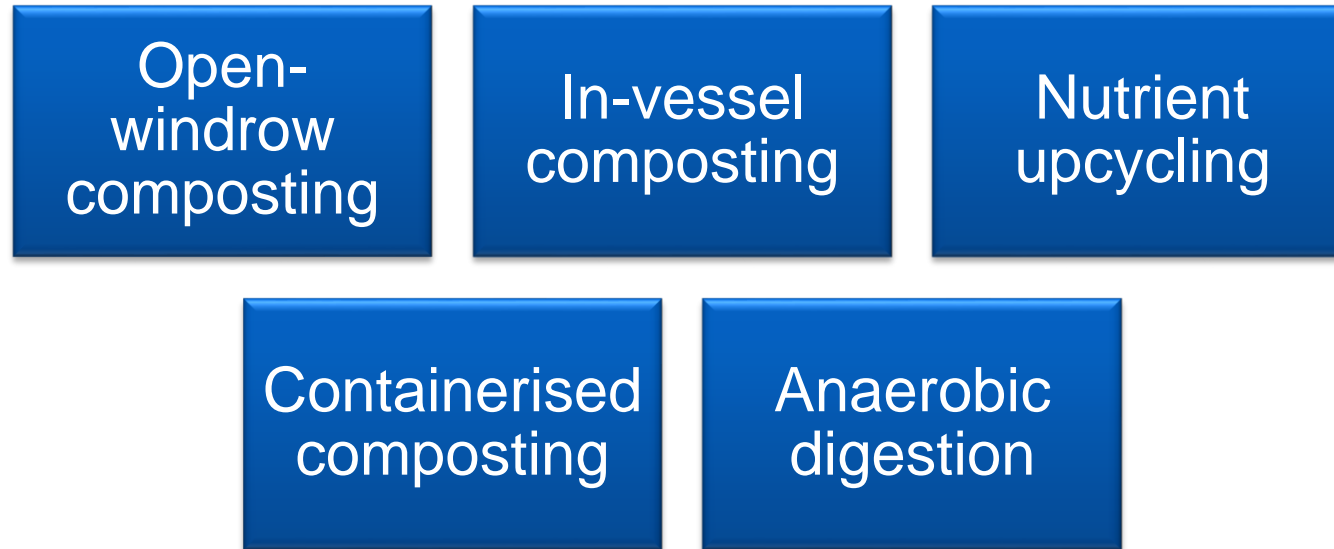


Organic Fraction = 42%

MSW Pathways



SA's Management Options for Organic Waste



- Potential to divert 3.1 million tonnes of organic waste per year
- Reducing GHG emissions by 4 million tCO₂e per year
- ~20% reduction in GHG emission from waste
- Potential to generate biogas

Mitigation achieved by major response measures since 2000

Sector	Response measure	Cumulative mitigation in MtCO ₂ e from 2000	
		To 2012	To 2014
Waste	Biogas (AD)	0.4	0.5
	Composting	0.5	0.9
	Landfill gas extraction	2.1	3.4
	Materials recovery for recycling	0.02	0.04

Source: DEA, 2017

Sustainable Development Benefits Achieved

Response measure	No of Jobs	Electricity generated (GWh)	SMME projects initiated	Waste diverted from landfill (t)	Coal saved (kt)
	Socio-economic			Environmental	Resource savings
Biogas (AD)	409	46	N/E	4 380	7
Composting	N/E	N/A	N/E	506 668	N/A
Landfill gas extraction	48	285	N/E	N/A	41
MRF	337	N/A	3	35 403	N/A
Total	794	331	3	546 451	48

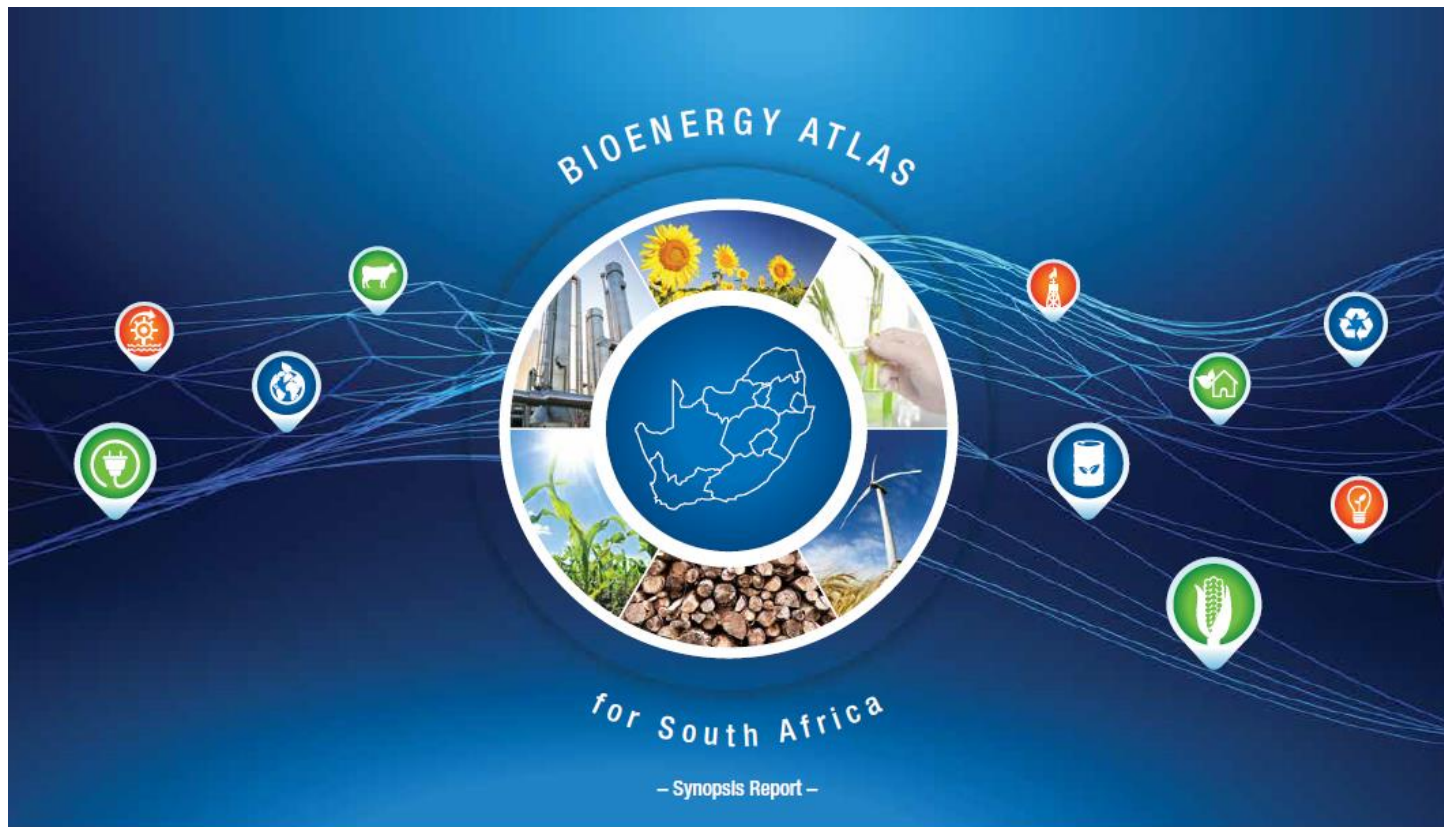
Source: DEA, 2017

Biogas potential of different waste streams

Biowaste	Biogas yield/tonne fresh matter (m ³)
Cattle dung	55-68
Chicken litter	126
Fat	826-1200
Food waste (disinfected)	110
Fruit waste	74
Horse manure	56
Maize silage	200/220
Municipal solid waste	101.5
Pig slurry	11-25
Sewage sludge	47

Source: Achinas et al, 2017.

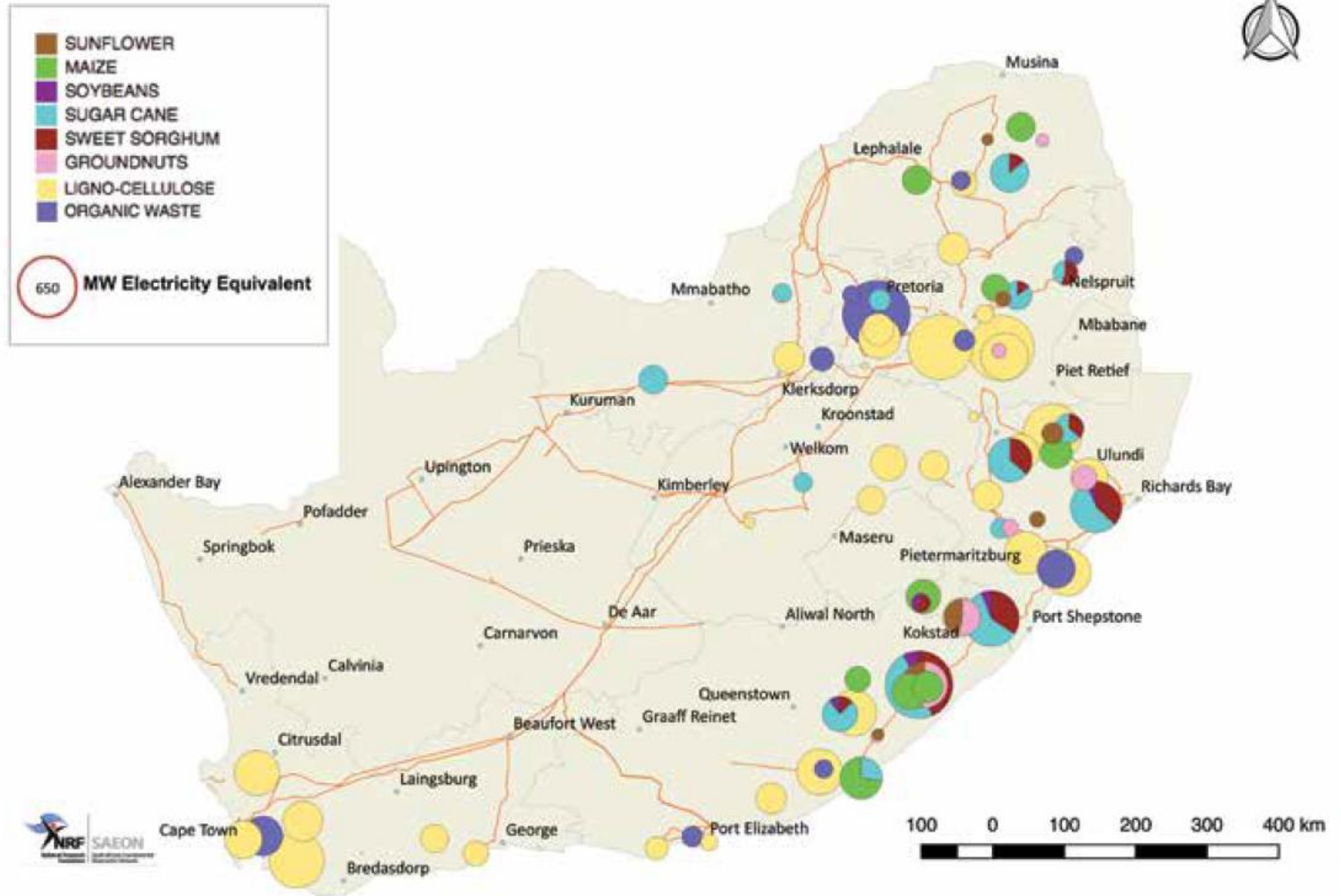
Bioenergy atlas for SA



Biowaste sources in South Africa

Source	Estimates of availability or potential										
	Potential (dry mass) Tg/a	Allocated already (dry mass)			Not available (dry mass) Tg/a	Available now (dry mass) Tg/a	Potential additional availability (dry mass) Tg/a		Energy density (PJ/Tg) (10)	Moisture content estimate (%) (11)	Energy equivalent available now (PJ/a)
		Re-use (Tg/a)	Unavailable (Tg/a)	Energy use (Tg/a)							
Agricultural residues	36.22		30.42		30.42	5.80	2.90	1	10.00	42%	57.95
Sugar cane field residues	5.06		5.06		5.06	0.00	2.53	2	10.00	42%	0.00
Sugar cane bagasse	5.35	0.2		4.54	4.74	0.60	2.34	3	10.00	42%	6.02
Plantation residue	6.70		5.20		5.20	1.50	0.00	4	12.50	30%	18.75
Pulp and paper mill residues	0.69			0.69	0.69	0.01	0.35	5	12.50	30%	0.09
Black liquor	1.50			1.49	1.49	0.00	0.77	6	6.30	59%	0.00
Sawmill waste (bark included)	3.10	0.15		2.00	2.15	0.95	1.03	7	10.40	40%	9.88
Invasive species	11.30		3.23		3.23	8.07	1.16	8	14.70	20%	118.63
Fuelwood	14.00			10.00	10.00	4.00	12.00	9	14.70	20%	58.80
Organic solid waste component	6.47			0.65	0.65	5.82	0.00	12	10.00	20%	58.23
Organic sewage sludge	2.53			0.25	0.25	2.28	0.00	13	10.00	20%	22.77
Purposely cultivated crops	9.26				0.00	9.26	0.00	14	14.70	42%	136.12
Total	83.91	0.35	43.91	18.72	62.97	20.92	23.08				487.24

Options and opportunities



Potential for household and communal digesters

Province	District	Organic waste used (t/a)	Aggregate project size (MW)	Number of digesters	Low-income households	Households using cattle dung	Potential users	Percent satisfied
		[A]	[B]	[C]	[D]	[E]	[F]	[G]
Limpopo	Vhembe	58 695	4.22	11 739	125 531	66%	82 606	14%
Limpopo	Greater Sekhukhune (1)	84 125	6.05	16 825	95 186	43%	40 994	41%
Limpopo	Greater Sekhukhune (2)	30 536	2.19	6 107	62 313	62%	38 635	16%
Limpopo	Mopani	74 043	5.32	14 808	72 658	34%	24 844	60%
KwaZulu-Natal	Uthukela	33 085	2.38	6 617	64 810	34%	22 019	30%
KwaZulu-Natal	Zululand	19 121	1.37	3 824	27 663	77%	21 423	18%
Limpopo	Mopani	18 881	1.36	3 776	30 977	68%	21 063	18%
Mpumalanga	Gert Sibande	26 560	1.91	5 312	41 795	49%	20 451	26%
Limpopo	Ehlanzeni	25 725	1.85	5 145	55 095	33%	18 166	28%
Eastern Cape	Amathole	48 632	3.50	9 726	95 219	19%	17 832	55%
Total		419 403	30.14	83 879	671 247	46%	308 032	27%

Household Biogas Feasibility - 2008

- 310 000 households (9.5% of SA's rural households) showing technical viability from rural biogas programmes
 - 4 cows or more
 - No access to grid electricity
 - Within 1km radius of water
- Capital subsidy of 30%
- 5 year programme
 - 12 000 households
 - Households pay 10% of monthly income during the 5 years + 10% upfront payment
 - KZN and Eastern Cape

Biogas utilisation South Africa

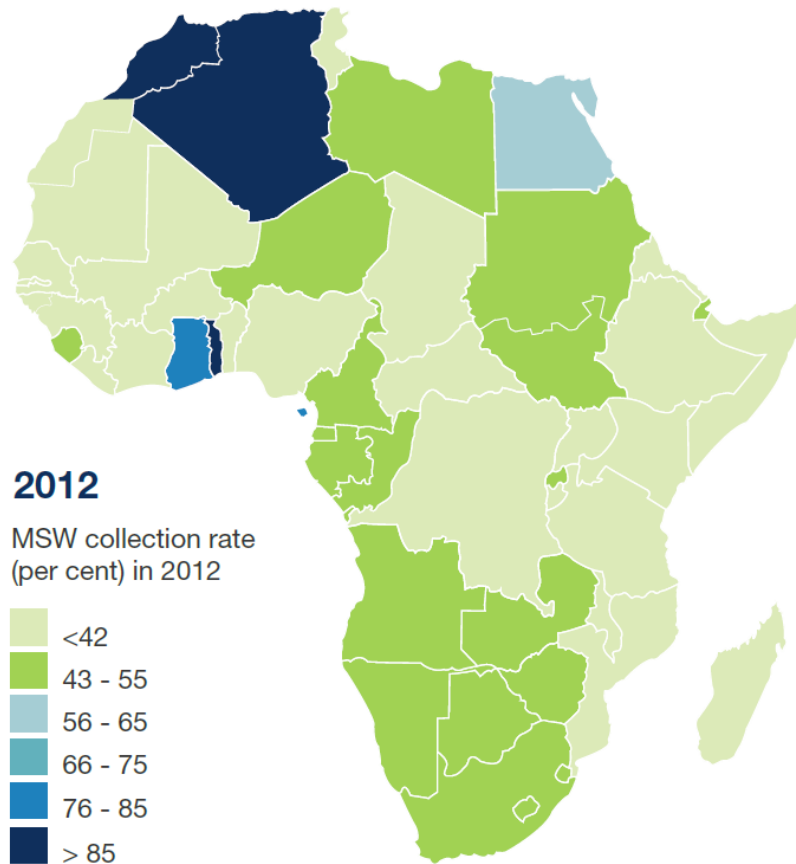
- 31 installations covering
 - Landfill gas to electricity
 - Digesters generating cooking fuel in rural areas
 - Commercial scale digesters
- Ranging in size from:
 - small scale (manure from 2 cows, school organic waste and sewage waste)
 - 19 MW electricity generation

Source: Mutungwasi et al, 2018

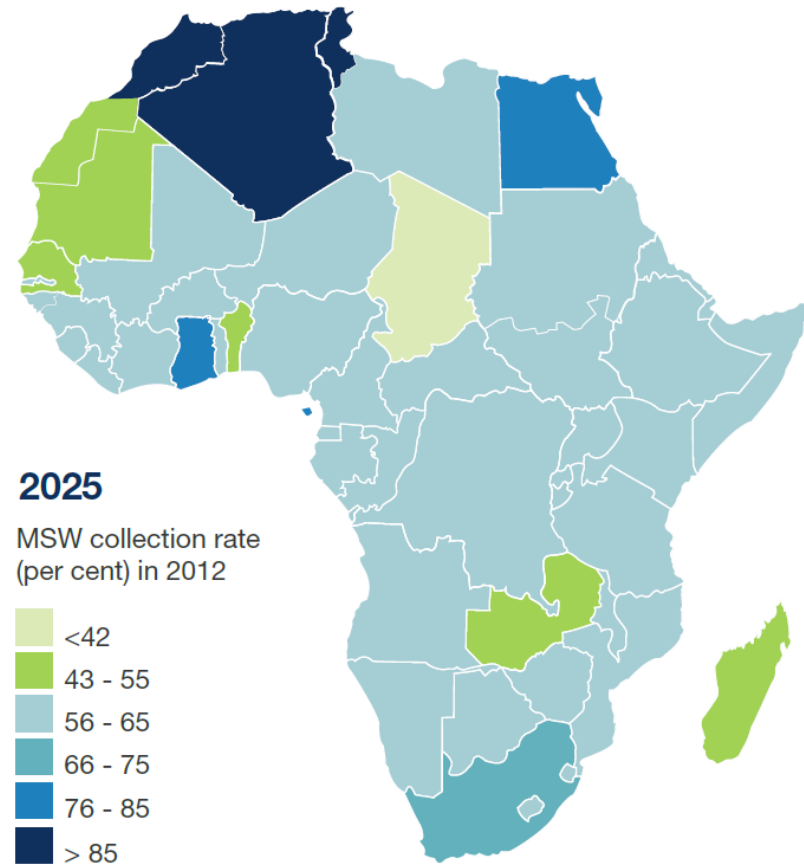
Current reality of waste management in SA



Collection rate

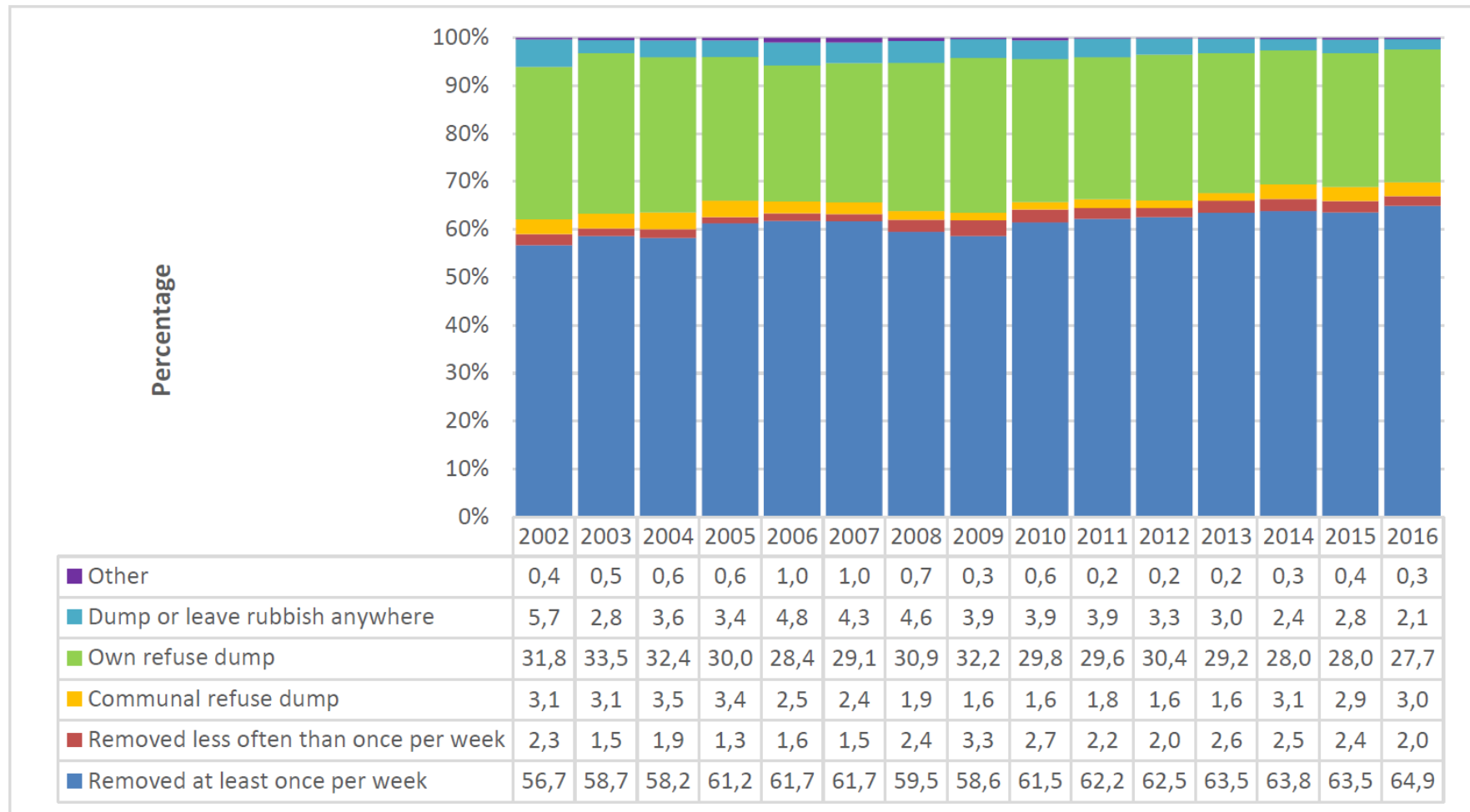


Average 44% ranging between 18-80%
SA: 66.9% in 2016



Average 69%

South African household waste disposal



In 2016 nearly 30% (5 million) households did not have access to waste collection services

Stats SA 2018

Illegal dumping and uncontrolled burning of waste



Barriers to waste diversion from landfill – Business

- Interpretation of the law by officials at all three spheres of government;
- Cost and time of the bureaucratic processes associated with –
 - Environment authorisations,
 - Municipal financial management
- Ownership of waste - impacts on feedstock agreements between business and municipalities;
- Zoning and rezoning of land is a barrier, especially where an activity is not listed in the regulations; and
- Inconsistencies between differing regulations

Barriers to waste diversion from landfill – households

- Perceived low cost of landfilling
- Perceived inconvenience for generators
- Lack of awareness
 - Impacts of waste on society
 - Impacts of waste on environment
 - Value of waste as resources
 - Entrepreneurial opportunities
- Low levels of trust - communities don't trust municipalities/service providers
- Waste collection service failures – services not being responsive to the needs of the communities
- Lack of markets for secondary resources
- Lack of law enforcement

Challenges in the waste sector

- Lack of accurate data collection and record keeping
- High frequency of illegal dumping
- Landfill is cheapest management option
- Resistance to change
- Onerous regulatory environment
 - Waste management
 - Energy generation and distribution

Opportunities in the waste sector

- Enforcement of information regulations will increase data
- Cost reflective charges
- Awareness raising about value of waste
 - Economic opportunities
 - Social opportunities
 - Poverty alleviation
 - Business opportunities
 - Job creation
- Building partnerships with NGO's, CBO's and communities

Conclusions

- Waste management in Africa and SA is characterised by backlogs in waste collection coverage, open dumps and unsanitary landfills
 - 5 million households in SA do not have access to waste collection services
- Biogas potential from biowaste is estimated at 487.24 PJ/a
 - Better management of organic waste has the potential to reduce GHG emissions from waste by 20%
 - Developing a secondary resources economy has the potential to introduce R17 million worth of resources back into the SA economy through recycling, reuse and energy recovery
- To tap into the biogas potential of organic waste
 - Separation of waste at source
 - Partnerships

Important considerations

- Full life cycle - Cradle to cradle
- Scarcity of water
- Education and skills level available for plant operations
- Composition of waste material
- Technical and financial constraints
- Maintenance problems with complex and expensive systems
- Particular needs of urban centres , i.e. additional energy
- Municipal solid waste generation rates
- Infrastructure requirements and waste management strategy
- Heat generated vs heat used for AD (economics)
- Long term foresight
- Digester design

Thank You

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