Biogas Potential and Current Reality of Biowaste Management in South Africa

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General Waste Profile for South Africa

- Organic waste: 34.6%
- Bottom ash: 11.7%
- Municipal waste: 8.7%
- Slag: 8.7%
- Construction and demolition waste: 8.1%
- Fly ash and dust: 7.8%
- Metals: 7.3%
- Glass: 4.9%
- Paper: 4.0%
- Plastic: 2.0%
- Other: 1.3%
- Commercial and industrial waste: 0.6%
- Tyres: 0.3%

Total: 19,247,851 Tonnes

DEA, 2018
Organic waste profile

- **Garden waste**
  - approximately 18.3% of MSW or 4.2 million tonnes

- **Food waste**
  - approximately 10.8% of MSW or 2.5 million tonnes

- **Wood waste**
  - Approximately 990 400 tonnes of wood chips
  - 369 000 tonnes of bark
  - 1 million tonnes of sawdust
  - Black liquor
  - Sludge
  - Bark
MSW Pathways

- MSW
  - Separation
    - Recyclables
    - Dry organics
  - Wet organics
    - Compost
    - Anaerobic digestion
  - Glass, metals, etc
    - Pyrolysis
    - Gasification
  - RDF
    - Combustion
  - Landfill

Conversion to Energy
- Incineration
SA’s Management Options for Organic Waste

- Open-windrow composting
- In-vessel composting
- Vermi-composting
- Containerised composting
- Anaerobic digestion
- Nutrient upcycling

- Potential to divert 6.7 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
# Biogas potential of different waste streams

<table>
<thead>
<tr>
<th>Biowaste</th>
<th>Biogas yield/tonne fresh matter (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle dung</td>
<td>55-68</td>
</tr>
<tr>
<td>Chicken litter</td>
<td>126</td>
</tr>
<tr>
<td>Fat</td>
<td>826-1200</td>
</tr>
<tr>
<td><strong>Food waste (disinfected)</strong></td>
<td>110</td>
</tr>
<tr>
<td>Fruit waste</td>
<td>74</td>
</tr>
<tr>
<td>Horse manure</td>
<td>56</td>
</tr>
<tr>
<td>Maize silage</td>
<td>200/220</td>
</tr>
<tr>
<td><strong>Municipal solid waste</strong></td>
<td>101.5</td>
</tr>
<tr>
<td>Pig slurry</td>
<td>11-25</td>
</tr>
<tr>
<td>Sewage sludge</td>
<td>47</td>
</tr>
</tbody>
</table>

Bioenergy atlas for SA
# Biowaste sources in South Africa

<table>
<thead>
<tr>
<th>Source</th>
<th>Potential (dry mass) Tg/a</th>
<th>Re-use (Tg/a)</th>
<th>Unavailable (dry mass) Tg/a</th>
<th>Energy use (Tg/a)</th>
<th>Not available (dry mass) Tg/a</th>
<th>Available now (dry mass) Tg/a</th>
<th>Potential additional availability (dry mass) Tg/a</th>
<th>Energy density (PJ/Tg) (10)</th>
<th>Moisture content estimate (%) (11)</th>
<th>Energy equivalent available now (PJ/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural residues</td>
<td>36.22</td>
<td></td>
<td>30.42</td>
<td>30.42</td>
<td>5.80</td>
<td>2.90</td>
<td>10.00</td>
<td>42%</td>
<td>57.95</td>
<td></td>
</tr>
<tr>
<td>Sugar cane field residues</td>
<td>5.06</td>
<td></td>
<td>5.06</td>
<td>5.06</td>
<td>0.00</td>
<td>2.53</td>
<td>10.00</td>
<td>42%</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Sugar cane bagasse</td>
<td>5.35</td>
<td>0.2</td>
<td>4.54</td>
<td>4.74</td>
<td>0.60</td>
<td>2.34</td>
<td>10.00</td>
<td>42%</td>
<td>6.02</td>
<td></td>
</tr>
<tr>
<td>Plantation residue</td>
<td>6.70</td>
<td></td>
<td>5.20</td>
<td>5.20</td>
<td>1.50</td>
<td>0.00</td>
<td>12.50</td>
<td>30%</td>
<td>18.75</td>
<td></td>
</tr>
<tr>
<td>Pulp and paper mill residues</td>
<td>0.69</td>
<td></td>
<td>0.69</td>
<td>0.69</td>
<td>0.01</td>
<td>0.35</td>
<td>12.50</td>
<td>30%</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Black liquor</td>
<td>1.50</td>
<td></td>
<td>1.49</td>
<td>1.49</td>
<td>0.00</td>
<td>0.77</td>
<td>6.30</td>
<td>59%</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Sawmill waste (bark included)</td>
<td>3.10</td>
<td>0.15</td>
<td>2.00</td>
<td>2.15</td>
<td>0.95</td>
<td>1.03</td>
<td>10.40</td>
<td>40%</td>
<td>9.88</td>
<td></td>
</tr>
<tr>
<td>Invasive species</td>
<td>11.30</td>
<td></td>
<td>3.23</td>
<td>3.23</td>
<td>8.07</td>
<td>1.16</td>
<td>14.70</td>
<td>20%</td>
<td>118.63</td>
<td></td>
</tr>
<tr>
<td>Fuelwood</td>
<td>14.00</td>
<td></td>
<td>10.00</td>
<td>10.00</td>
<td>4.00</td>
<td>12.00</td>
<td>14.70</td>
<td>20%</td>
<td>58.80</td>
<td></td>
</tr>
<tr>
<td>Organic solid waste component</td>
<td>6.47</td>
<td></td>
<td>0.65</td>
<td>0.65</td>
<td>5.82</td>
<td>0.00</td>
<td>10.00</td>
<td>20%</td>
<td>58.23</td>
<td></td>
</tr>
<tr>
<td>Organic sewage sludge</td>
<td>2.53</td>
<td></td>
<td>0.25</td>
<td>0.25</td>
<td>2.28</td>
<td>0.00</td>
<td>10.00</td>
<td>20%</td>
<td>22.77</td>
<td></td>
</tr>
<tr>
<td>Purposely cultivated crops</td>
<td>0.26</td>
<td></td>
<td>0.00</td>
<td>0.26</td>
<td>0.00</td>
<td>0.00</td>
<td>14.70</td>
<td>42%</td>
<td>136.12</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>83.91</strong></td>
<td><strong>0.35</strong></td>
<td><strong>43.91</strong></td>
<td><strong>18.72</strong></td>
<td><strong>62.97</strong></td>
<td><strong>20.92</strong></td>
<td><strong>23.08</strong></td>
<td><strong>487.24</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Options and opportunities
## Potential for household and communal digesters

<table>
<thead>
<tr>
<th>Province</th>
<th>District</th>
<th>Organic waste used (t/a)</th>
<th>Aggregate project size (MW)</th>
<th>Number of digesters</th>
<th>Low-income households</th>
<th>Households using cattle dung</th>
<th>Potential users</th>
<th>Percent satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limpopo</td>
<td>Vhembe</td>
<td>58 695</td>
<td>4.22</td>
<td>11 739</td>
<td>125 531</td>
<td>66%</td>
<td>82 606</td>
<td>14%</td>
</tr>
<tr>
<td>Limpopo</td>
<td>Greater Sekhukhune (1)</td>
<td>84 125</td>
<td>6.05</td>
<td>16 825</td>
<td>95 186</td>
<td>43%</td>
<td>40 994</td>
<td>41%</td>
</tr>
<tr>
<td>Limpopo</td>
<td>Greater Sekhukhune (2)</td>
<td>30 536</td>
<td>2.19</td>
<td>6 107</td>
<td>62 313</td>
<td>62%</td>
<td>38 635</td>
<td>16%</td>
</tr>
<tr>
<td>Limpopo</td>
<td>Mopani</td>
<td>74 043</td>
<td>5.32</td>
<td>14 808</td>
<td>72 658</td>
<td>34%</td>
<td>24 844</td>
<td>60%</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>Uthukela</td>
<td>33 085</td>
<td>2.38</td>
<td>6 617</td>
<td>64 810</td>
<td>34%</td>
<td>22 019</td>
<td>30%</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>Zululand</td>
<td>19 121</td>
<td>1.37</td>
<td>3 824</td>
<td>27 663</td>
<td>77%</td>
<td>21 423</td>
<td>18%</td>
</tr>
<tr>
<td>Limpopo</td>
<td>Mopani</td>
<td>18 881</td>
<td>1.36</td>
<td>3 776</td>
<td>30 977</td>
<td>68%</td>
<td>21 063</td>
<td>18%</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>Gert Sibande</td>
<td>26 560</td>
<td>1.91</td>
<td>5 312</td>
<td>41 795</td>
<td>49%</td>
<td>20 451</td>
<td>26%</td>
</tr>
<tr>
<td>Limpopo</td>
<td>Ehlanzeni</td>
<td>25 725</td>
<td>1.85</td>
<td>5 145</td>
<td>55 095</td>
<td>33%</td>
<td>18 166</td>
<td>28%</td>
</tr>
<tr>
<td>Eastern Cape</td>
<td>Amathole</td>
<td>48 632</td>
<td>3.50</td>
<td>9 726</td>
<td>95 219</td>
<td>19%</td>
<td>17 832</td>
<td>55%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>419 403</strong></td>
<td><strong>30.14</strong></td>
<td><strong>83 879</strong></td>
<td><strong>671 247</strong></td>
<td><strong>46%</strong></td>
<td><strong>308 032</strong></td>
<td><strong>27%</strong></td>
</tr>
</tbody>
</table>
Household Biogas Feasibility - 2008

- 310 000 households (9.5% of SA's rural households) showing technical viability for 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%
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 gate fees
- 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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