Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Building Climate-Resilient W²EF Infrastructure through Evidence-Based Decision Support Tools

Prof Cristina Trois – Centre for Renewable and Sustainable Energy Studies (CRSES)

Photo by Ignus Dreyer

South Africa is a wonderful country…

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT



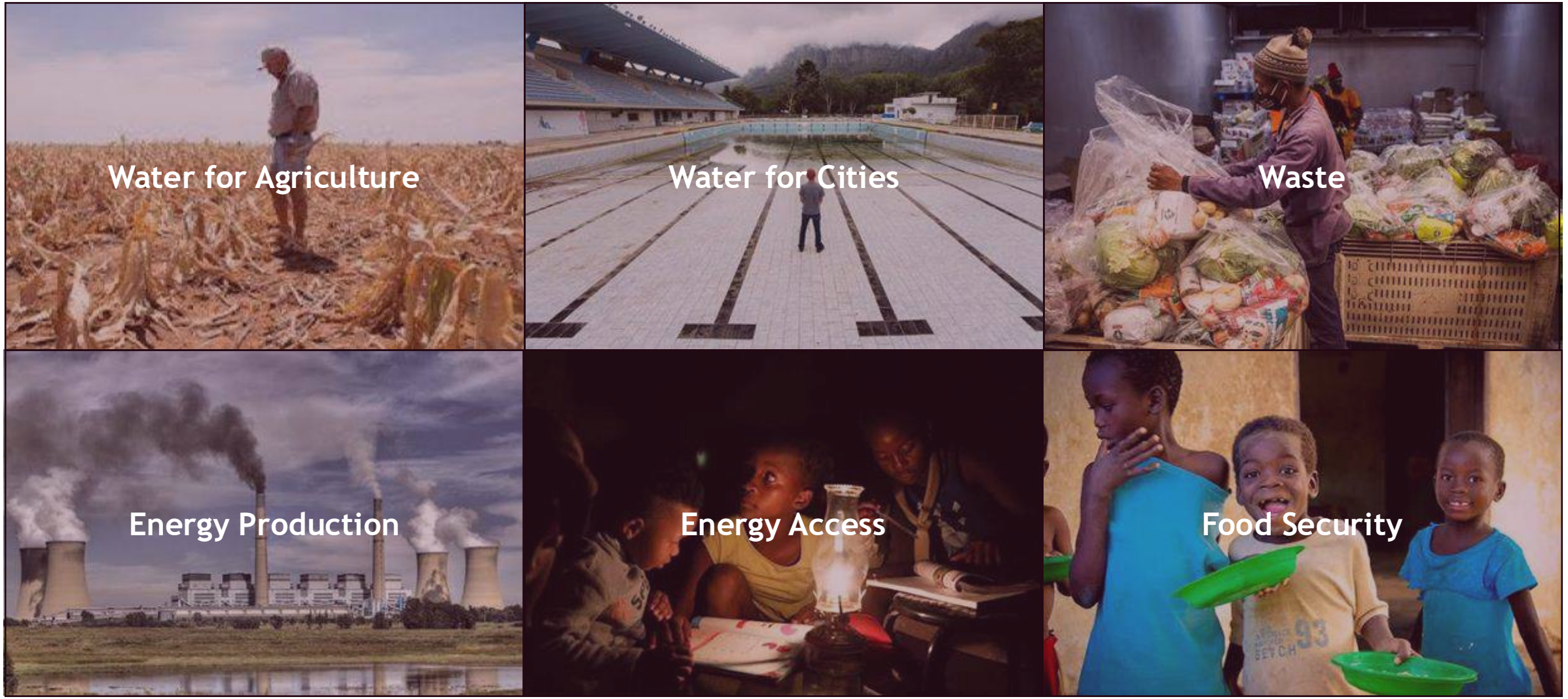





… that faces W²EF challenges on a daily basis

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT



Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Waste management in an emerging economy is a complex social, technical, and environmental challenge

The Challenge in SA

>100M

tonnes of waste disposed yearly

80%

waste to landfill/dumps

6.5%

carbon emissions from waste

..... and Globally

>2b

tonnes of waste generated

>30%

Ends up in dumps

3%

carbon emissions from waste

WROSE MODEL www.wrose.co.za

Waste Resource Optimisation and Scenario Evaluation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Key features of the model

Waste data and emission factors

LCA integrated with MCDA

Context specific solution

WROSE MODEL www.wrose.co.za

Waste Resource Optimisation and Scenario Evaluation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

MODEL INPUTS

- **Quantity of Waste**
- **Quality of Waste**
- **Definition of Appropriate Strategies**

EVALUATION DIMENSIONS

ENVIRONMENTAL

- GHG emissions/Reductions
- Landfill airspace savings
- Energy production/consumption
- Waste Diversion Rate

ECONOMIC

- Costs and revenues

SOCIAL

- Job creation

INSTITUTIONAL

- Policy framework

INDICATORS OF BEST SOLUTION

WROSE MODEL www.wrose.co.za

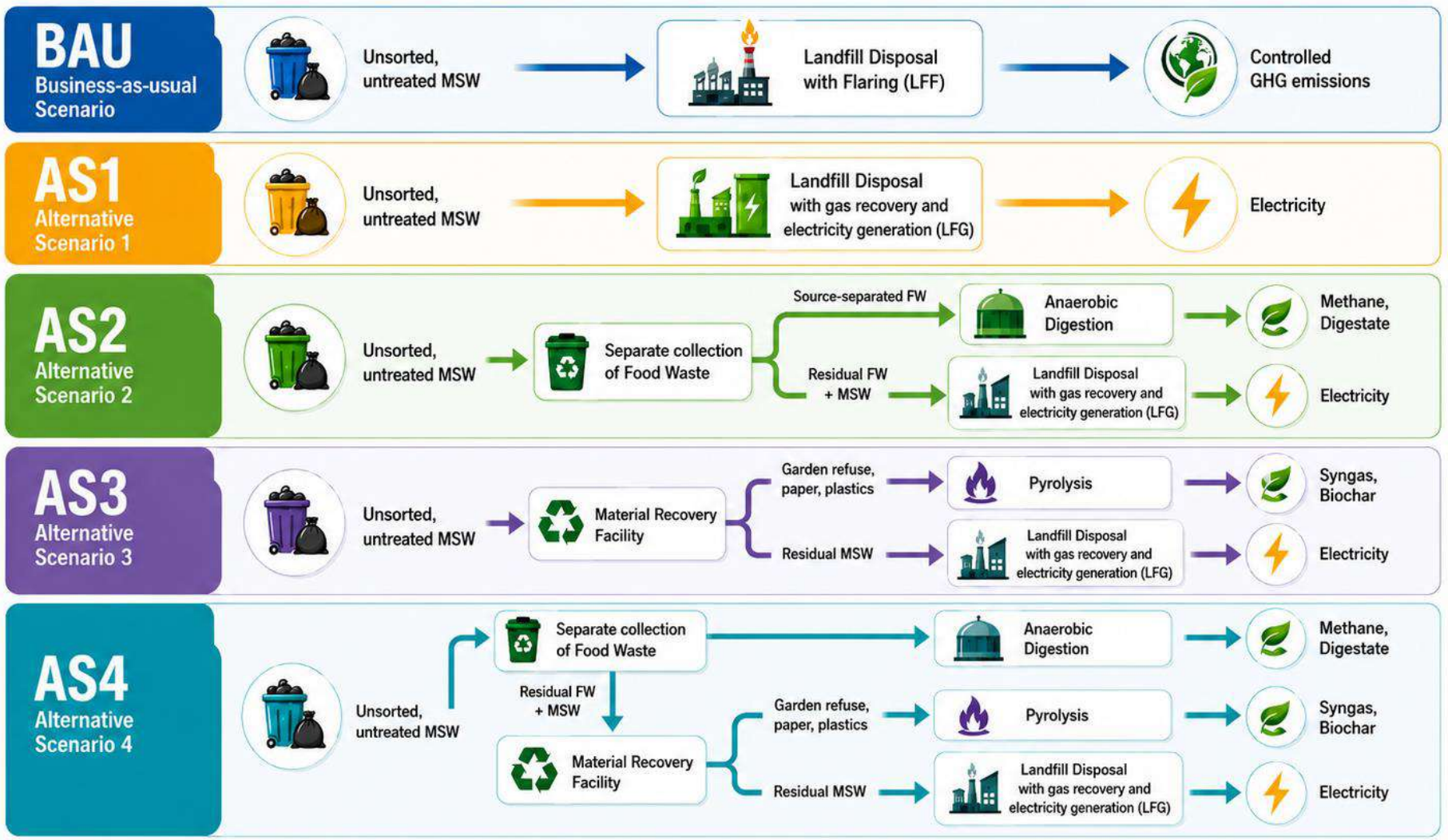
Waste Resource Optimisation and Scenario Evaluation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Indicators

- **Environmental indicators**
  - Greenhouse gas emissions
  - Landfill airspace savings
  - Landfill monetary savings
  - Waste diversion rate
- **Energy consumption/production**
- **Economic indicators**
- **Social indicators**
- **Institutional indicators**



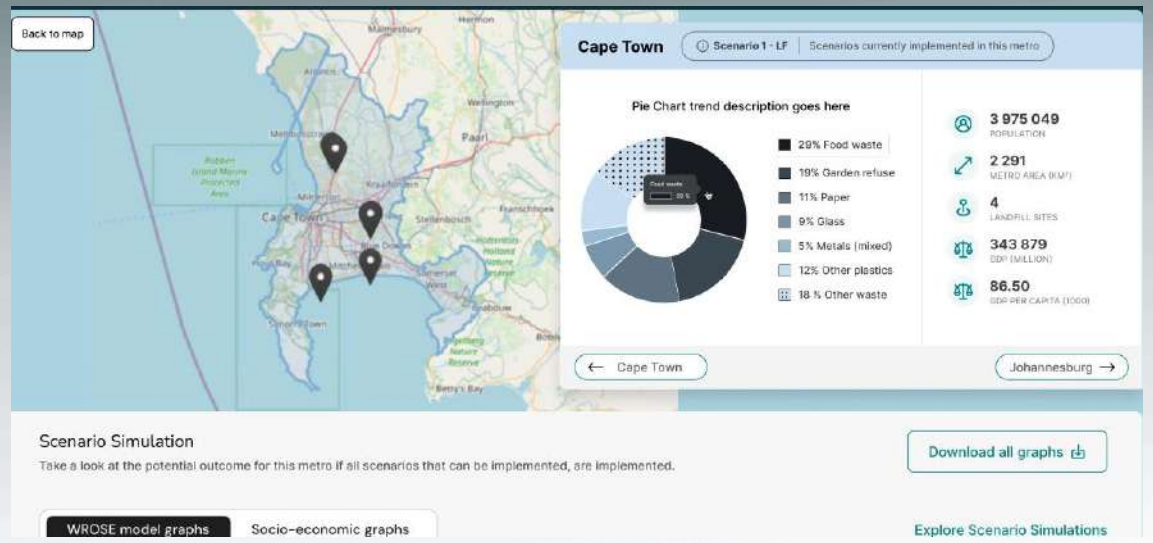
WROSE MODEL www.wrose.co.za

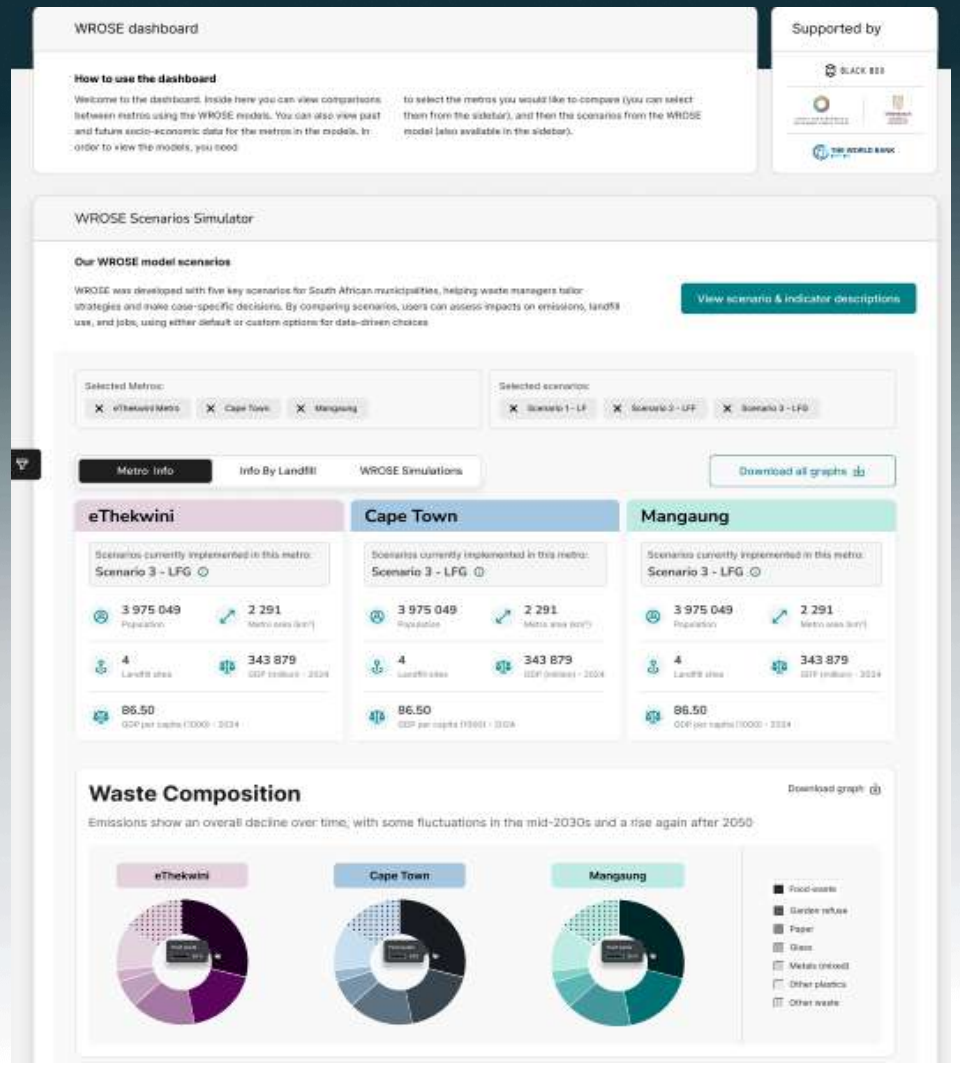
Waste Resource Optimisation and Scenario Evaluation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Software package



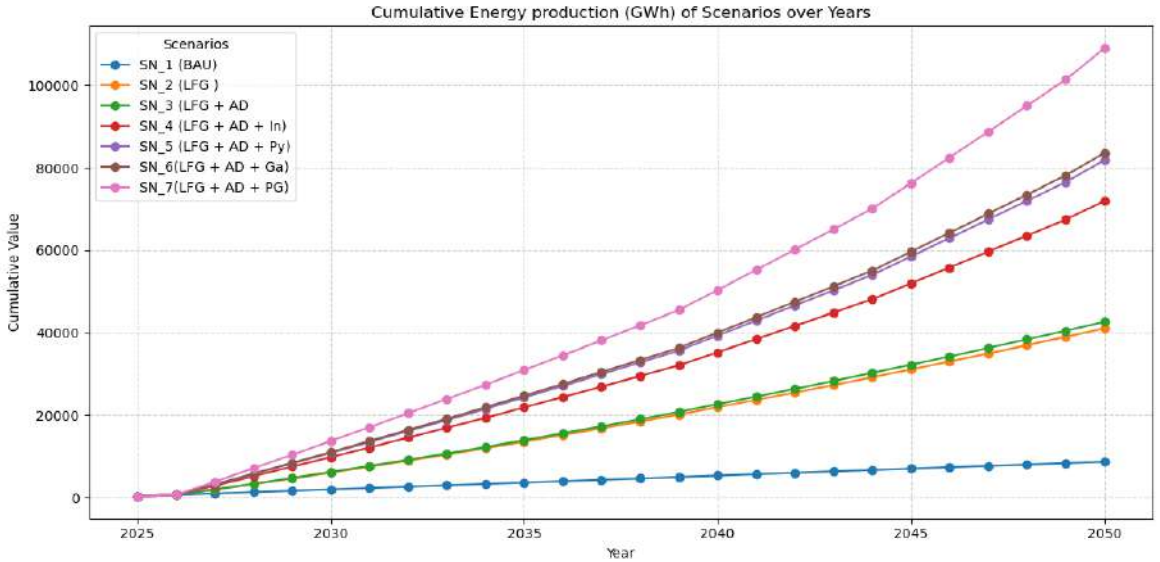


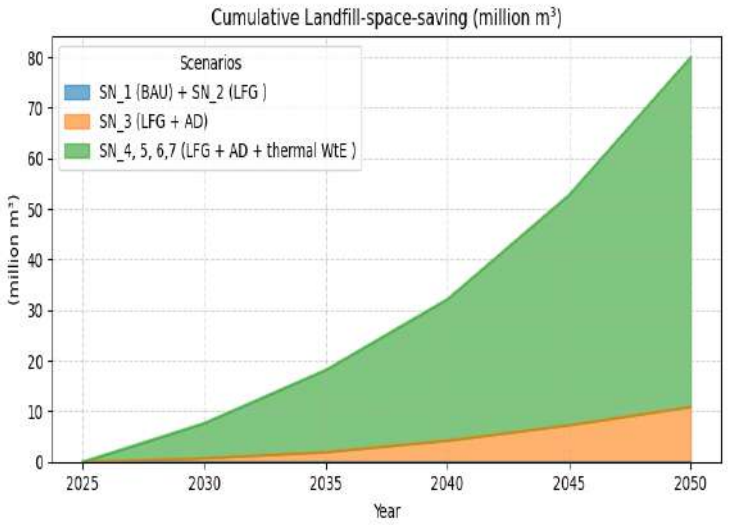
WROSE MODEL OUTPUTS

Waste Resource Optimisation and Scenario Evaluation

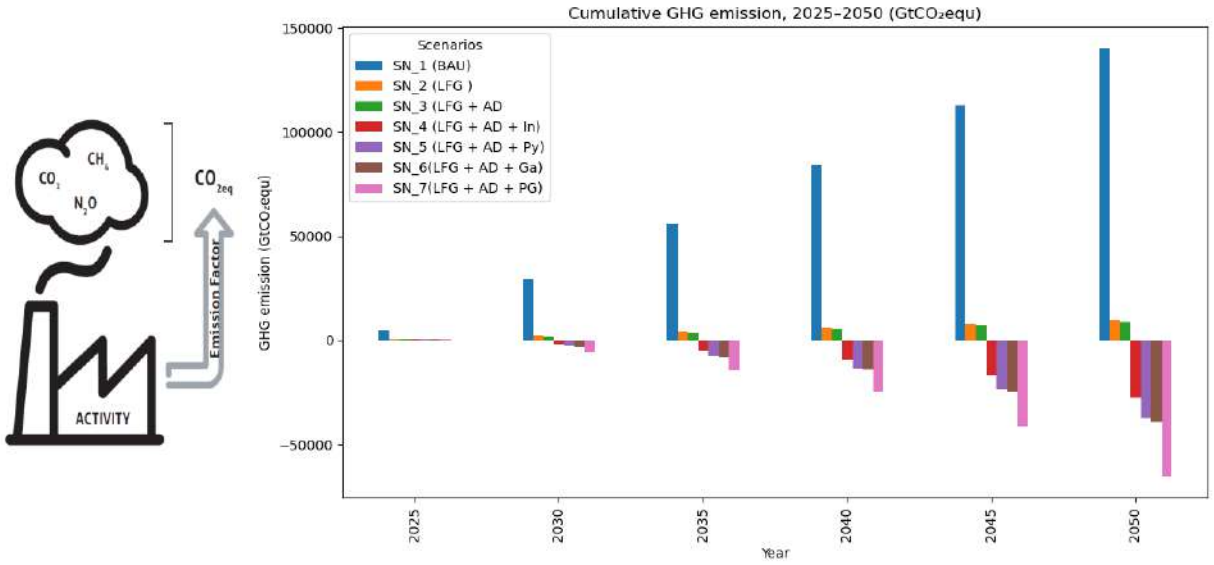
CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

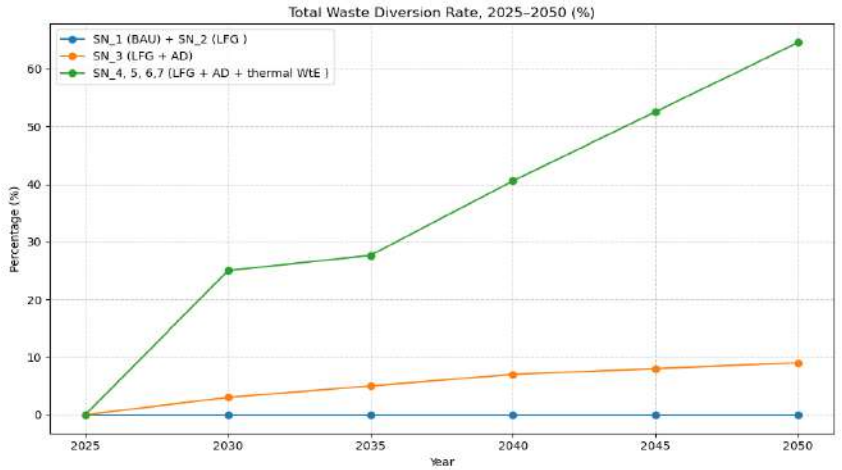
Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

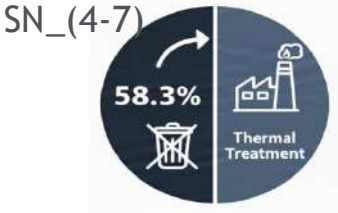




Prolong the landfill lifespan







From national data to global insight through institutional endorsement

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

- Waste RDI Roadmap (grants 42 and 51)

Waste Research, Development and Innovation Roadmap
A waste R&D and innovation programme for South Africa

CSIR

THE OCEAN CLEANUP

From national data to global insight through institutional endorsement

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

PLACE MARKS

SARCHI Chair WASTE AND CLIMATE CHANGE

UNIVERSITY OF KWAZULU-NATAL INYUVESI YAKWAZULU-NATALI

Umlazi river – Mega city 14-4-22

From national data to global insight through institutional endorsement

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

PLACE MARKS

SARCHI Chair WASTE AND CLIMATE CHANGE

UNIVERSITY OF KWAZULU-NATAL INYUVESI YAKWAZULU-NATALI

From national data to global insight through institutional endorsement

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

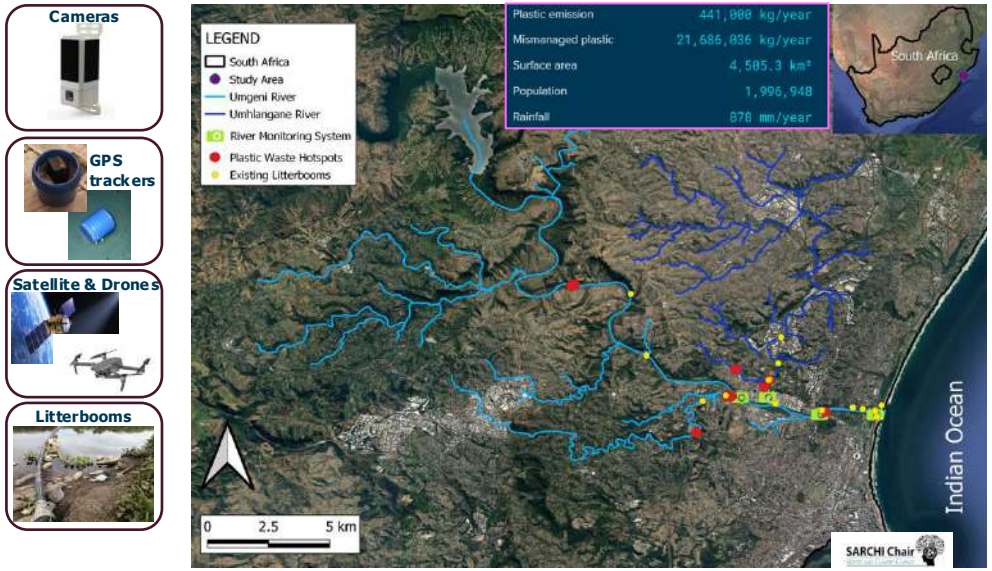
Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

- Waste RDI Roadmap (grants 42 and 51)

Waste Research, Development and Innovation Roadmap
A waste R&D and innovation programme for South Africa

CSIR

THE OCEAN CLEANUP



Tagging Stocks of Anthropogenic Debris with Coded Polygons

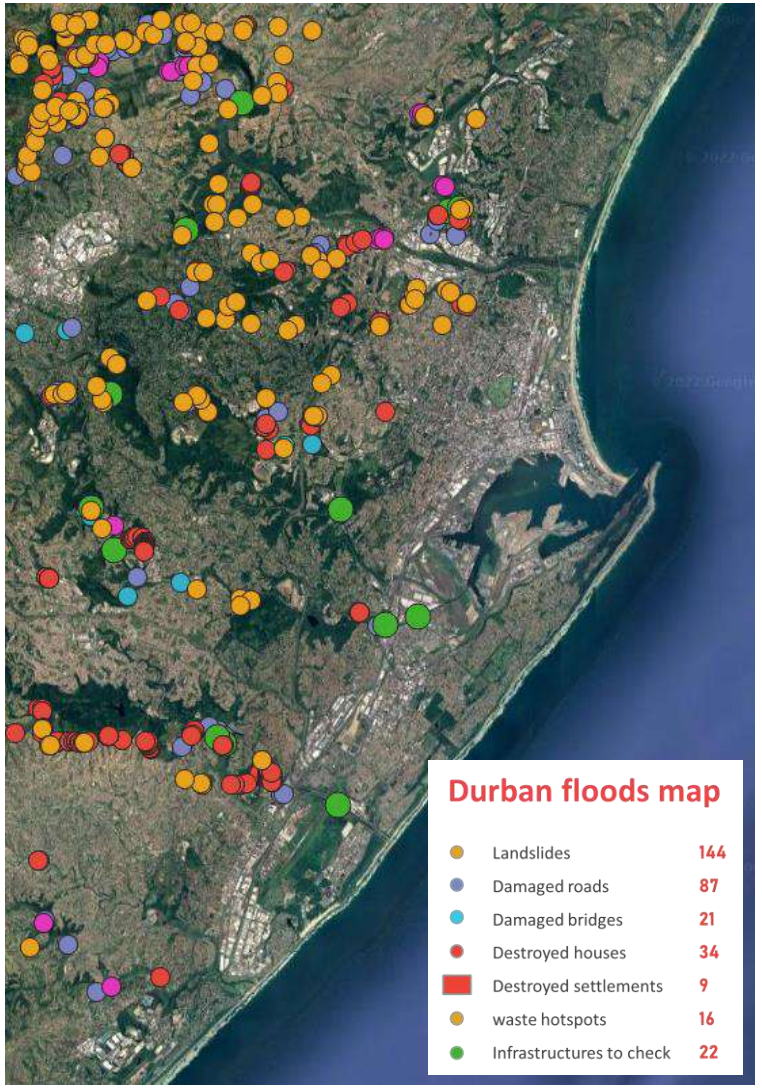
Code	Description
0	“dense” cluster
1	“scattered” cluster
2	building/construction “rubble” cluster

SARCHI Chair

From national data to global insight through institutional endorsement

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT



From national data to global insight through institutional endorsement

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

- DSTI Waste RDI Roadmap (grants 42 and 51)

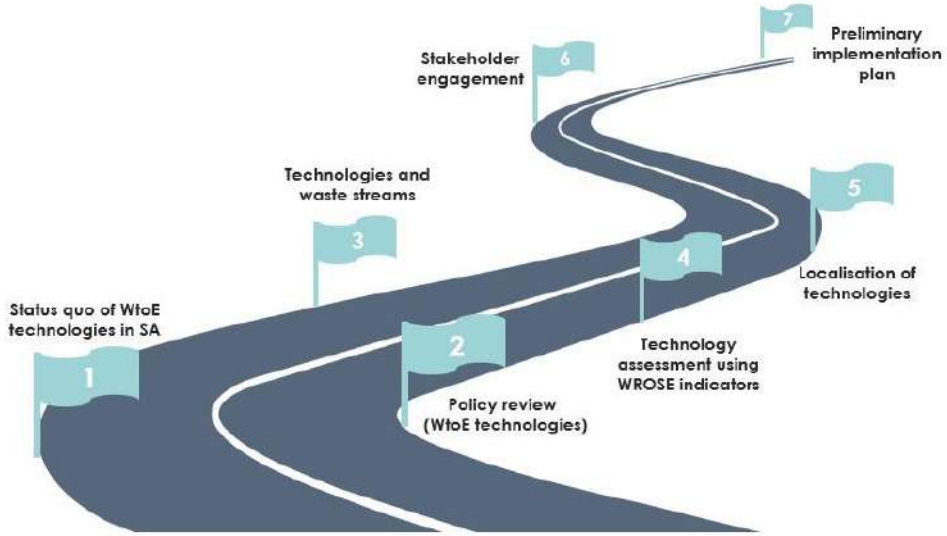
THE OCEAN CLEANUP

- SANEDI Waste-to-Energy Roadmap

sanedi South African National Energy Development Institute

IEA Bioenergy Technology Collaboration Programme

NRF National Research Foundation



From national data to global insight through institutional endorsement

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

- DSTI Waste RDI Roadmap (grants 42 and 51)

THE OCEAN CLEANUP

- SANEDI Waste-to-Energy Roadmap

sanedi South African National Energy Development Institute

IEA Bioenergy Technology Collaboration Programme

NRF National Research Foundation

- World Bank study
  - "South Africa: Assessment of Emission Reduction Potential from Organic Municipal Solid Waste and Possible Mitigation Pathways"

THE WORLD BANK IBRD • IDA | WORLD BANK GROUP

International Institute for Applied Systems Analysis IIASA www.iiasa.ac.at

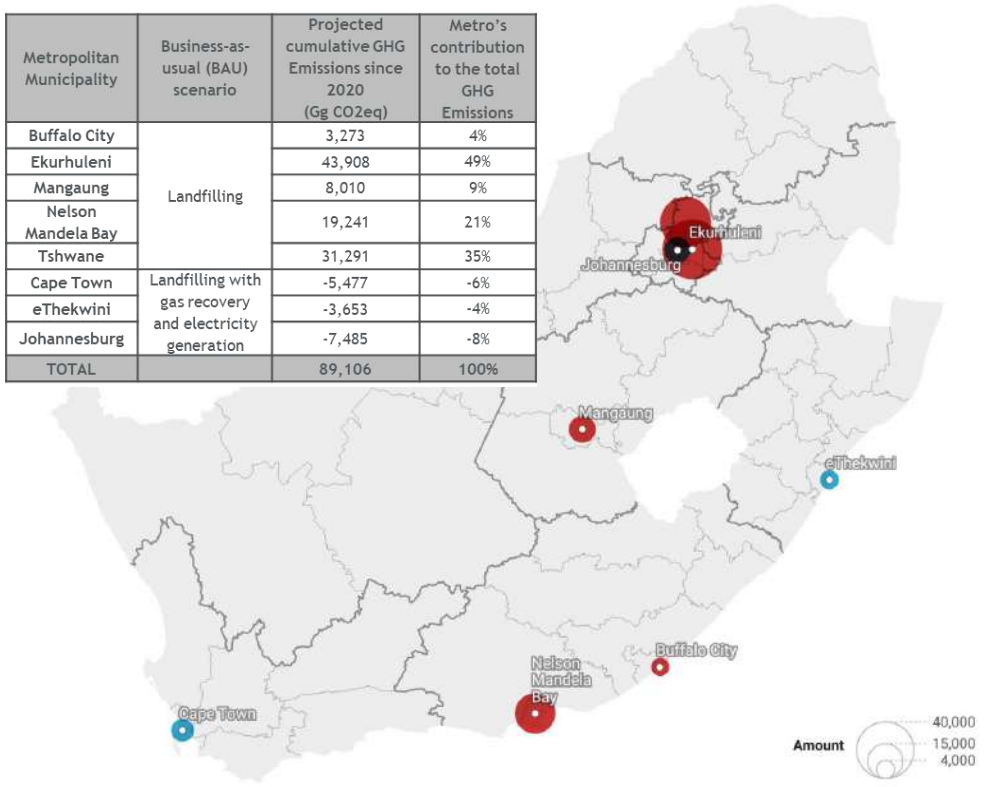
SARCHI Chair Waste and Climate Change

UNIVERSITY OF KWAZULU-NATAL INYUVESI YAKWAZULU-NATALI

2020-2050 Projected Cumulative GHG Emissions (Gg CO2eq) for the business-as-usual (BAU) scenario

Negative emissions Positive emissions

Metropolitan Municipality	Business-as-usual (BAU) scenario	Projected cumulative GHG Emissions since 2020 (Gg CO2eq)	Metro's contribution to the total GHG Emissions
Buffalo City	Landfilling	3,273	4%
Ekurhuleni		43,908	49%
Mangaung		8,010	9%
Nelson Mandela Bay		19,241	21%
Tshwane		31,291	35%
Cape Town	Landfilling with gas recovery and electricity generation	-5,477	-6%
eThekwini		-3,653	-4%
Johannesburg		-7,485	-8%
TOTAL		89,106	100%



Map: SARChI Chair in Waste and Climate Change • Created with Datawrapper

From national data to global insight through institutional endorsement

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

- DSTI Waste RDI Roadmap (grants 42 and 51)

Waste Research, Development and Innovation Roadmap
A waste R&D and innovation programme for South Africa

THE OCEAN CLEANUP

- SANEDI Waste-to-Energy Roadmap

sanedi South African National Energy Development Institute

IEA Bioenergy Technology Collaboration Programme

NRF National Research Foundation

- World Bank study
  - "South Africa: Assessment of Emission Reduction Potential from Organic Municipal Solid Waste and Possible Mitigation Pathways"

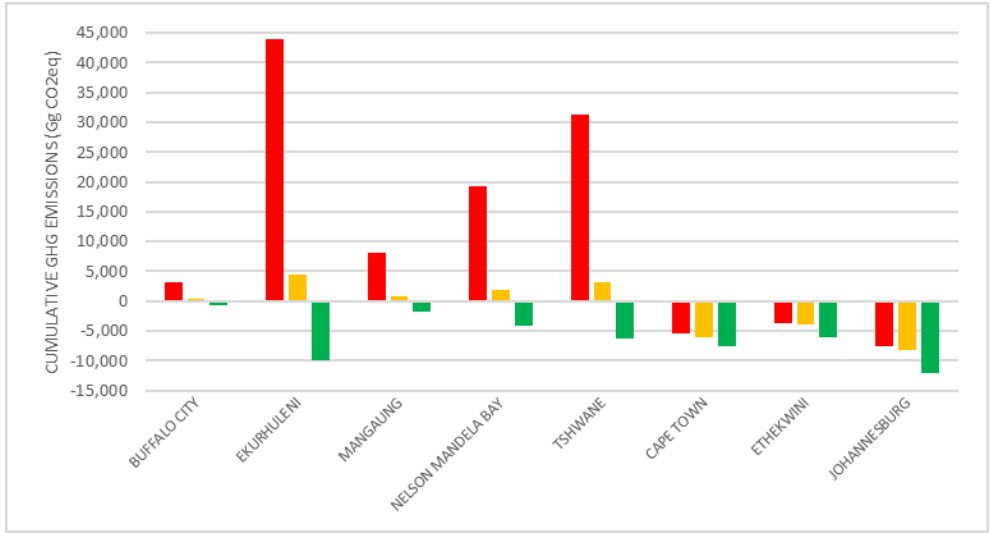
THE WORLD BANK IBRD • IDA | WORLD BANK GROUP

International Institute for Applied Systems Analysis IIASA www.iiasa.ac.at

SARCHI Chair Waste and Climate Change

UNIVERSITY OF KWAZULU-NATAL INYUVESI YAKWAZULU-NATALI

Metropolitan Municipality	WEM (BAU)	WAM (fixed RR = 5 percent)	WAM (progressively increasing RR (5 to 40 percent), every five years)
Buffalo City	Landfilling *(Scenario 1)*	Landfilling with gas recovery and electricity generation + recycling + anaerobic digestion *(Scenario 5)*	Landfilling with gas recovery and electricity generation + recycling + anaerobic digestion *(Scenario 5)*
Ekurhuleni			
Mangaung			
Nelson Mandela Bay			
Tshwane			
Cape Town	Landfilling with gas recovery and electricity generation *(Scenario 3)*		
eThekwini			
Johannesburg			

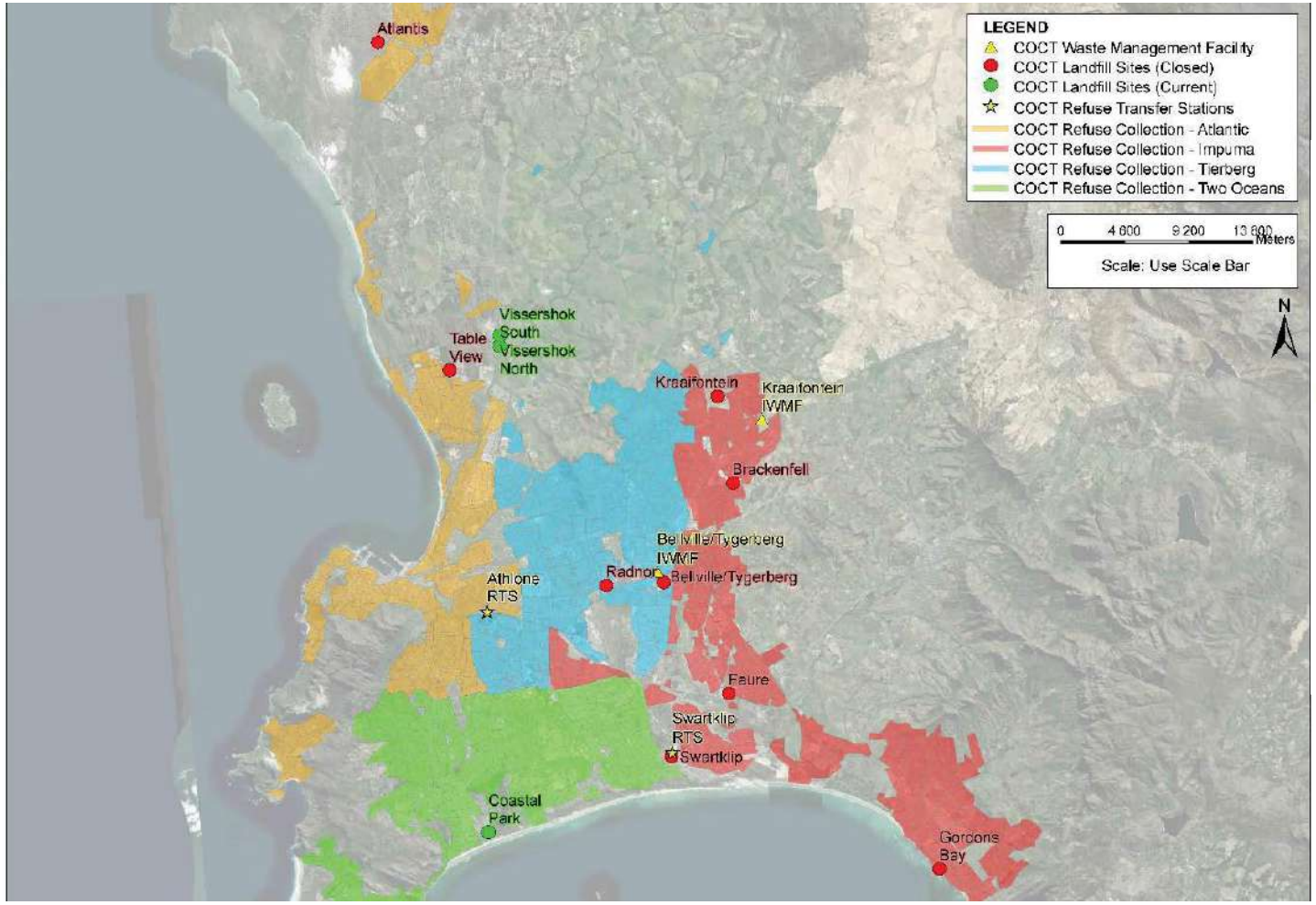


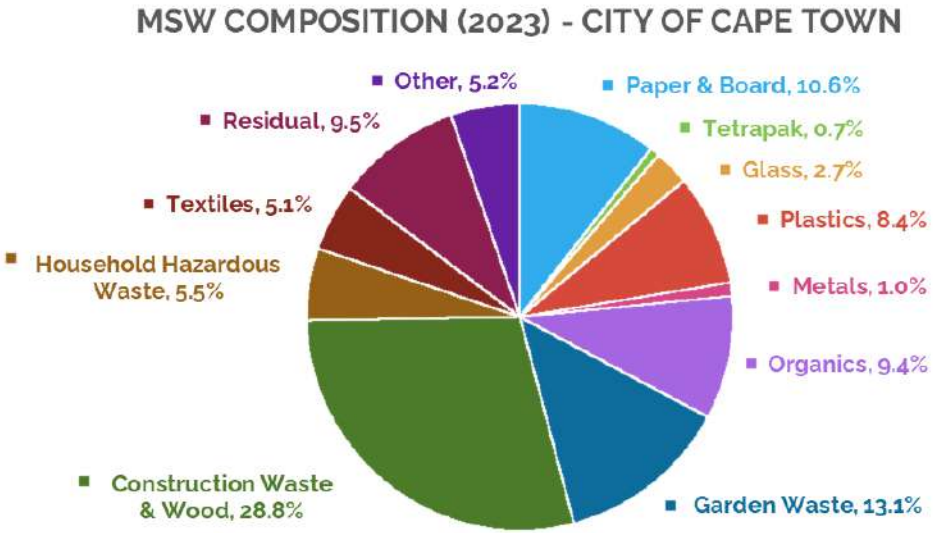
Empowering municipal strategy through data

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

WROSE model application and scenario analysis for the City of Cape Town regional waste management facility





CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD

ENGINEERING ADVICE & SERVICES

INGEROP Inventing for tomorrow

Empowering municipal strategy through data

WROSE model application and scenario analysis for the City of Cape Town regional waste management facility

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

	Scenario 1A	Scenario 1B	Scenario 1C	Scenario 1D	Scenario 2A	Scenario 2B	Scenario 2C	Scenario 3A	Scenario 3B	Scenario 3C	Scenario 3D	Scenario 4A	Scenario 4B	Scenario 4C	Scenario 4D	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9	Scenario 10	Scenario 11
2025	RC (43,875) AC (102,592) RU (189,716) LF (1,461,302)	RC (43,875) AC (102,592) RU (189,716) LFF (1,461,302)	RC (43,875) AC (102,592) RU (189,716) LFG-EL (1,461,302)	RC (43,875) AC (102,592) RU (189,716) LFG-CHP (1,461,302)	RC (58,500) AC (102,592) RU (192,348) LF (1,444,045)	RC (58,500) AC (102,592) RU (192,348) LFF (1,444,045)	RC (58,500) AC (102,592) RU (192,348) LFG-EL (1,444,045)	RC (43,875) AC (102,592) RU (189,716) LFF (1,461,302)	RC (43,875) AC (102,592) RU (189,716) LFG-EL (1,461,302)	RC (43,875) AC (102,592) RU (189,716) LFG-CHP (1,461,302)	RC (43,875) AC (102,592) RU (189,716) LFG-CHP (1,461,302)	RC (58,500) AC (102,592) RU (192,348) LFF (1,444,045)	RC (58,500) AC (102,592) RU (192,348) LFG-EL (1,444,045)	RC (58,500) AC (102,592) RU (192,348) LFG-CHP (1,444,045)	RC (58,500) AC (102,592) RU (192,348) LFG-CHP (1,444,045)	RC (43,875) AC (76,944) RU (185,099) LFG-EL (1,491,567)	RC (58,500) AC (102,592) RU (192,348) LFG-EL (1,444,045)	RC (43,875) AC (76,944) RU (185,099) LFG-EL (1,491,567)	RC (58,500) AC (102,592) RU (192,348) LFG-EL (1,444,045)	RC (58,500) AC (102,592) RU (192,348) LFG-EL (1,444,045)	RC (58,500) AC (164,992) RU (412,626) LFG-EL (1,161,367)	RC (58,500) AC (164,992) RU (235,238) LFG-EL (1,338,755)
2026																						
2027																						
2028																						
2029																						
2030	RC (73,125) AC (118,192) RU (207,913) LF (1,509,666)	RC (73,125) AC (118,192) RU (207,913) LFF (1,509,666)	RC (73,125) AC (118,192) RU (207,913) LFG-EL (1,509,666)	RC (73,125) AC (118,192) RU (207,913) LFG-CHP (1,509,666)	RC (97,500) AC (118,192) RU (212,301) LF (1,480,904)	RC (97,500) AC (118,192) RU (212,301) LFF (1,480,904)	RC (97,500) AC (118,192) RU (212,301) LFG-EL (1,480,904)	RC (73,125) AC (118,192) RU (207,913) LFF (1,509,666)	RC (73,125) AC (118,192) RU (207,913) LFG-EL (1,509,666)	RC (73,125) AC (118,192) RU (207,913) LFG-CHP (1,509,666)	RC (73,125) AC (118,192) RU (207,913) LFG-CHP (1,509,666)	RC (97,500) AC (118,192) RU (212,301) LFF (1,480,904)	RC (97,500) AC (118,192) RU (212,301) LFG-EL (1,480,904)	RC (97,500) AC (118,192) RU (212,301) LFG-CHP (1,480,904)	RC (97,500) AC (118,192) RU (212,301) LFG-CHP (1,480,904)	RC (73,125) AC (88,644) RU (202,595) LFG-EL (1,544,533)	RC (97,500) AC (118,192) RU (212,301) LFG-EL (1,480,904)	RC (73,125) AC+AD (178,344) RU (218,241) LFG-EL (1,438,687)	RC (97,500) AC+AD (237,792) RU (233,829) LFG-EL (1,339,776)	RC (97,500) AC+AD (372,992) RU (258,165) LFG-EL (1,180,240)	RC (253,500) AC+AD (359,992) RU (438,202) LFG-EL (857,203)	RC (97,500) AC+AD (414,592) IN (175,875) RU (297,310) LFG-EL (923,619)
2031																						
2032																						
2033																						
2034																						
2035	RC (73,125) AC (149,392) RU (224,282) LF (1,580,415)	RC (73,125) AC (149,392) RU (224,282) LFF (1,580,415)	RC (73,125) AC (149,392) RU (224,282) LFG-EL (1,580,415)	RC (73,125) AC (149,392) RU (224,282) LFG-CHP (1,580,415)	RC (97,500) AC (149,392) RU (228,669) LF (1,551,652)	RC (97,500) AC (149,392) RU (228,669) LFF (1,551,652)	RC (97,500) AC (149,392) RU (228,669) LFG-EL (1,551,652)	RC (73,125) AC (149,392) RU (224,282) LFF (1,580,415)	RC (73,125) AC (149,392) RU (224,282) LFG-EL (1,580,415)	RC (73,125) AC (149,392) IN (167,500) RU (254,432) LFG-CHP	RC (73,125) AC (149,392) IN (502,500) RU (314,732) LFG-CHP (987,465)	RC (97,500) AC (149,392) RU (228,669) LFF (1,551,652)	RC (97,500) AC (149,392) RU (228,669) LFG-EL (1,551,652)	RC (97,500) AC (149,392) IN (167,500) RU (258,819) LFG-CHP	RC (97,500) AC (149,392) IN (502,500) RU (319,119) LFG-CHP (958,702)	RC (73,125) AC+AD (135,444) RU (221,771) LFG-EL (1,596,874)	RC (97,500) AC+AD (180,592) PY (46,800) RU (242,709) LFG-EL (1,459,612)	RC (73,125) AC+AD (178,344) RU (229,493) LFG-EL (1,546,252)	RC (97,500) AC+AD (237,792) RU (244,581) LFG-EL (1,447,340)	RC (97,500) AC+AD (372,992) RU (268,917) LFG-EL (1,287,804)	RC (409,500) AC+AD (450,992) RU (465,362) LFG-EL (701,360)	RC (97,500) AC+AD (414,592) IN (402,000) RU (348,765) LFG-EL (764,356)
2036																						
2037																						
2038																						
2039																						
2040	RC (73,125) AC (149,392) RU (235,701) LF (1,694,647)	RC (73,125) AC (149,392) RU (235,701) LFF (1,694,647)	RC (73,125) AC (149,392) RU (235,701) LFG-EL (1,694,647)	RC (73,125) AC (149,392) RU (235,701) LFG-CHP (1,694,647)	RC (97,500) AC (149,392) RU (240,088) LF (1,665,884)	RC (97,500) AC (149,392) RU (240,088) LFF (1,665,884)	RC (97,500) AC (149,392) RU (240,088) LFG-EL (1,665,884)	RC (87,750) AC (149,392) RU (238,333) LFF (1,677,389)	RC (87,750) AC (149,392) RU (238,333) LFG-EL (1,677,389)	RC (87,750) AC (149,392) IN (167,500) RU (268,483) LFG-CHP	RC (87,750) AC (149,392) IN (502,500) RU (328,783) LFG-CHP	RC (117,000) AC (149,392) RU (243,598) LFF (1,642,874)	RC (117,000) AC (149,392) RU (243,598) LFG-EL (1,642,874)	RC (117,000) AC (149,392) IN (167,500) RU (273,748) LFG-CHP	RC (117,000) AC (149,392) IN (502,500) RU (334,048) LFG-CHP	RC (87,750) AC+AD (135,444) RU (235,823) LFG-EL (1,693,848)	RC (117,000) AC+AD (180,592) PY (46,800) RU (257,638) LFG-EL (1,550,834)	RC (87,750) AC+AD (178,344) RU (243,545) LFG-EL (1,643,226)	RC (117,000) AC+AD (237,792) RU (259,510) LFG-EL (1,538,562)	RC (117,000) AC+AD (372,992) RU (283,846) LFG-EL (1,379,026)	RC (409,500) AC+AD (450,992) RU (494,206) LFG-EL (798,166)	RC (97,500) AC+AD (414,592) IN (402,000) RU (360,184) LFG-EL (878,588)
2041																						
2042																						
2043																						
2044																						
2045	RC (73,125) AC (149,392) RU (247,827) LF (1,815,959)	RC (73,125) AC (149,392) RU (247,827) LFF (1,815,959)	RC (73,125) AC (149,392) RU (247,827) LFG-EL (1,815,959)	RC (73,125) AC (149,392) RU (247,827) LFG-CHP (1,815,959)	RC (97,500) AC (149,392) RU (252,215) LF (1,787,196)	RC (97,500) AC (149,392) RU (252,215) LFF (1,787,196)	RC (97,500) AC (149,392) RU (252,215) LFG-EL (1,787,196)	RC (87,750) AC (149,392) RU (250,460) LFF (1,798,701)	RC (87,750) AC (149,392) RU (250,460) LFG-EL (1,798,701)	RC (87,750) AC (149,392) IN (167,500) RU (280,610) LFG-CHP	RC (87,750) AC (149,392) IN (502,500) RU (340,410) LFG-CHP	RC (117,000) AC (149,392) RU (255,725) LFF (1,764,185)	RC (117,000) AC (149,392) RU (255,725) LFG-EL (1,764,185)	RC (117,000) AC (149,392) IN (167,500) RU (285,875) LFG-CHP	RC (117,000) AC (149,392) IN (502,500) RU (346,175) LFG-CHP	RC (87,750) AC+AD (135,444) RU (247,949) LFG-EL (1,815,160)	RC (117,000) AC+AD (180,592) PY (46,800) RU (269,765) LFG-EL (1,672,146)	RC (87,750) AC+AD (178,344) RU (255,671) LFG-EL (1,764,538)	RC (117,000) AC+AD (237,792) RU (271,637) LFG-EL (1,659,874)	RC (117,000) AC+AD (372,992) RU (295,973) LFG-EL (1,500,338)	RC (409,500) AC+AD (450,992) RU (524,838) LFG-EL (900,973)	RC (97,500) AC+AD (414,592) IN (402,000) RU (372,311) LFG-EL (999,900)
2046																						
2047																						
2048																						
2049																						
2050	RC (73,125) AC (149,392) RU (260,706) LF (1,944,790)	RC (73,125) AC (149,392) RU (260,706) LFF (1,944,790)	RC (73,125) AC (149,392) RU (260,706) LFG-EL (1,944,790)	RC (73,125) AC (149,392) RU (260,706) LFG-CHP (1,944,790)	RC (97,500) AC (149,392) RU (265,093) LF (1,916,027)	RC (97,500) AC (149,392) RU (265,093) LFF (1,916,027)	RC (97,500) AC (149,392) RU (265,093) LFG-EL (1,916,027)	RC (87,750) AC (149,392) RU (263,338) LFF (1,927,532)	RC (87,750) AC (149,392) RU (263,338) LFG-EL (1,927,532)	RC (87,750) AC (149,392) IN (167,500) RU (293,488) LFG-CHP (1,729,882)	RC (87,750) AC (149,392) IN (502,500) RU (353,788) LFG-CHP (1,334,582)	RC (117,000) AC (149,392) RU (268,603) LFF (1,893,017)	RC (117,000) AC (149,392) RU (268,603) LFG-EL (1,893,017)	RC (117,000) AC (149,392) IN (167,500) RU (298,753) LFG-CHP (1,695,367)	RC (117,000) AC (149,392) IN (502,500) RU (359,053) LFG-CHP (1,300,067)	RC (87,750) AC+AD (135,444) RU (260,827) LFG-EL (1,943,991)	RC (117,000) AC+AD (180,592) PY (46,800) RU (282,643) LFG-EL (1,800,977)	RC (87,750) AC+AD (178,344) RU (268,549) LFG-EL (1,893,369)	RC (117,000) AC+AD (237,792) RU (284,515) LFG-EL (1,788,705)	RC (117,000) AC+AD (372,992) RU (308,851) LFG-EL (1,629,169)	RC (409,500) AC+AD (450,992) RU (557,368) LFG-EL (1,010,152)	RC (97,500) AC+AD (414,592) IN (402,000) RU (385,189) LFG-EL (1,128,731)
Closest scenario	-	1A	1B	1C	1A	1B	1C	1B	3A	3B	3C	2B	4A	4B	4C	3B	5	5	7	8	9	10
Notes	-	LFF vs LF	LFG-EL vs LFF	LFG-CHP vs LFG-EL	100% vs 75% recycling	100% vs 75% recycling	100% vs 75% recycling	Helderberg MRF added in 2040	LFG-EL vs LFF	Incineration added in 2035, LFG-CHP vs LFG-EL	3x incineration capacity, +20% rubble recovery	Helderberg MRF added in 2040	LFG-EL vs LFF	Incineration added in 2035, LFG-CHP vs LFG-EL	3x incineration capacity, +20% rubble recovery	2035: AD plant 2040: MRF in Helderberg, composting at 75% capacity	100% vs 75% capacity; pyrolysis added in 2035	Composting plants have 2x size 2030: AD plant	100% vs 75% capacity	Composting and AD plants have 2x size	Helderberg, Swartklip & Bellville MRF, 100% rubble recovery	Lower recycling and rubble recovery, high incineration
Technologies																						
LF	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
LFF	✗	✓	✗	✗	✗	✓	✗	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
LFG-EL	✗	✗	✓	✗	✗	✗	✓	✗	✓	✗	✗	✗	✓	✗	✗	✓	✓	✓	✓	✓	✓	✓
LFG-CHP	✗	✗	✗	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗
RC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AD	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓
IN	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✓
PY	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
RU	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

LF: landfilling (no gas recovery); LFF: landfilling with gas recovery and flaring; LFG-EL: landfilling with gas recovery and electricity generation; LFG-CHP: landfilling with gas recovery and combined heat and power generation; RC: recycling; AC: composting; AD: anaerobic digestion; IN: incineration; PY:pyrolysis; RU: builders rubble recovery

Empowering municipal strategy through data

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

WROSE model application and scenario analysis for the City of Cape Town regional waste management facility

wrose

Option 0 (baseline)

- MRF sorting
- Composting
- C&D waste diversion

Diversion potential: 40%

Landfill footprint: 285 ha

Estimated CAPEX: R3.5b

Option 1

- MRF sorting
- Composting
- C&D waste diversion
- Anaerobic Digestion
- Pyrolysis

Diversion potential: 46%

Landfill footprint: 272 ha

Estimated CAPEX: R4.3b

Option 2

- MRF sorting
- Composting
- C&D waste diversion
- Anaerobic Digestion
- Incineration

Diversion potential: 84%

Landfill footprint: 148 ha

Estimated CAPEX: R9.8b

Empowering municipal strategy through data

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

WROSE model application and scenario analysis for the City of Cape Town regional waste management facility

wrose

infrastructurenews

HOME | FEATURED | WATER & SANITATION | GREEN ECONOMY | GOVERNANCE & FINANCE | DIGIMAG

Cape Town's Waste Strategy Wins Global Award

May 18, 2026 | City of Cape Town | ReSource Sustainability Hero | Waste management

The City of Cape Town has secured global recognition after being named one of the winners of the Bloomberg Mayor's Challenge 2025, an international competition that rewards cities developing bold solutions to complex urban issues.

Empowering municipal strategy through data

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

eThekwini Integrated Energy Complex (EIEC) Feasibility Study

UK PACT

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

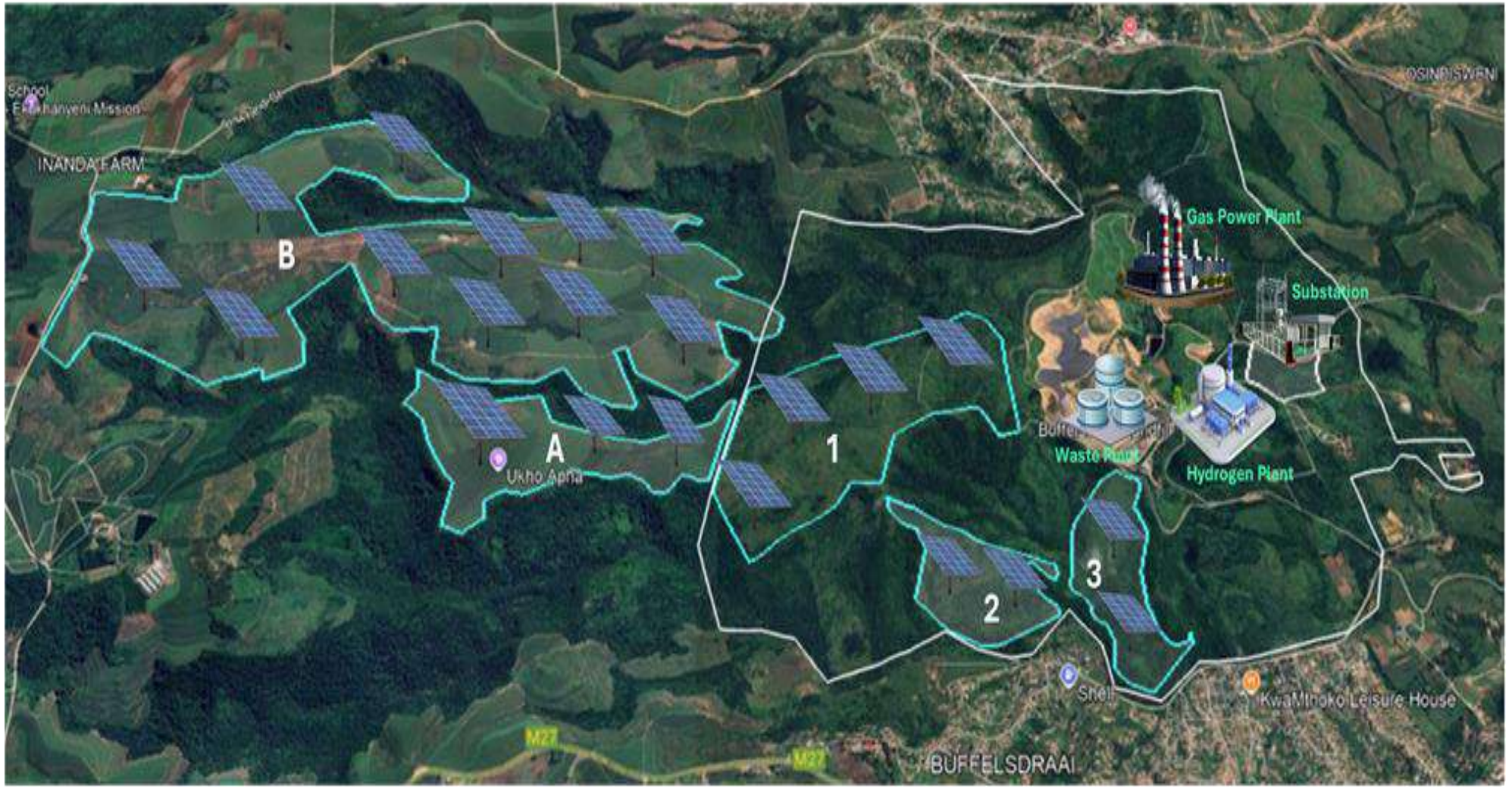
Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Anaergia
Fueling a Sustainable World

ZWELAMANZI

Rampox Energy
Smart Energy Solutions

ETHEKWINI MUNICIPALITY



Empowering municipal strategy through data

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

eThekwini Integrated Energy Complex (EIEC) Feasibility Study

UK PACT

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

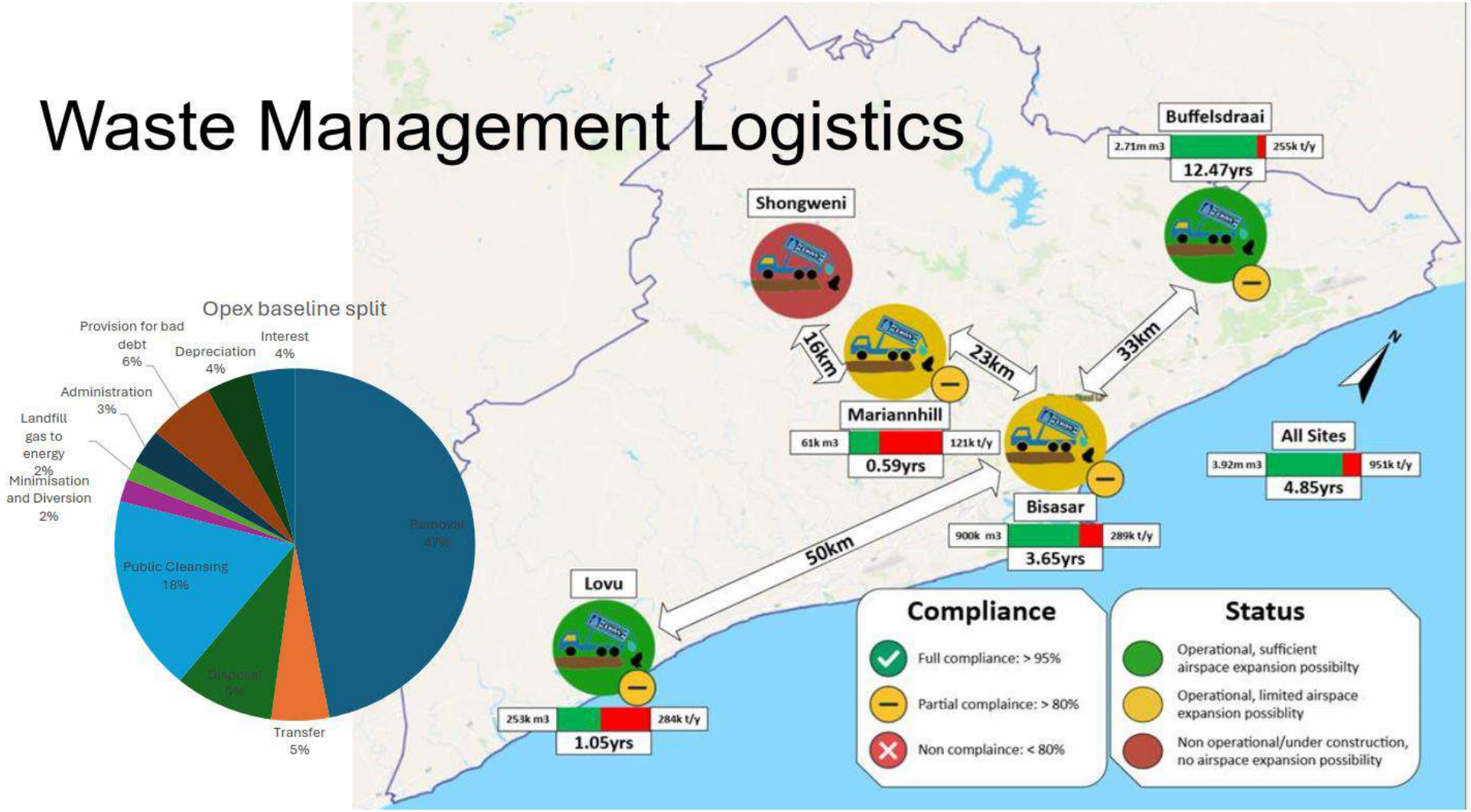
Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Anaergia
Fueling a Sustainable World

ZWELAMANZI

Rampox Energy
Smart Energy Solutions

ETHEKWINI MUNICIPALITY



Empowering municipal strategy through data

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

eThekwini Integrated Energy Complex (EIEC) Feasibility Study

UK PACT

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Anaergia
Fueling a Sustainable World

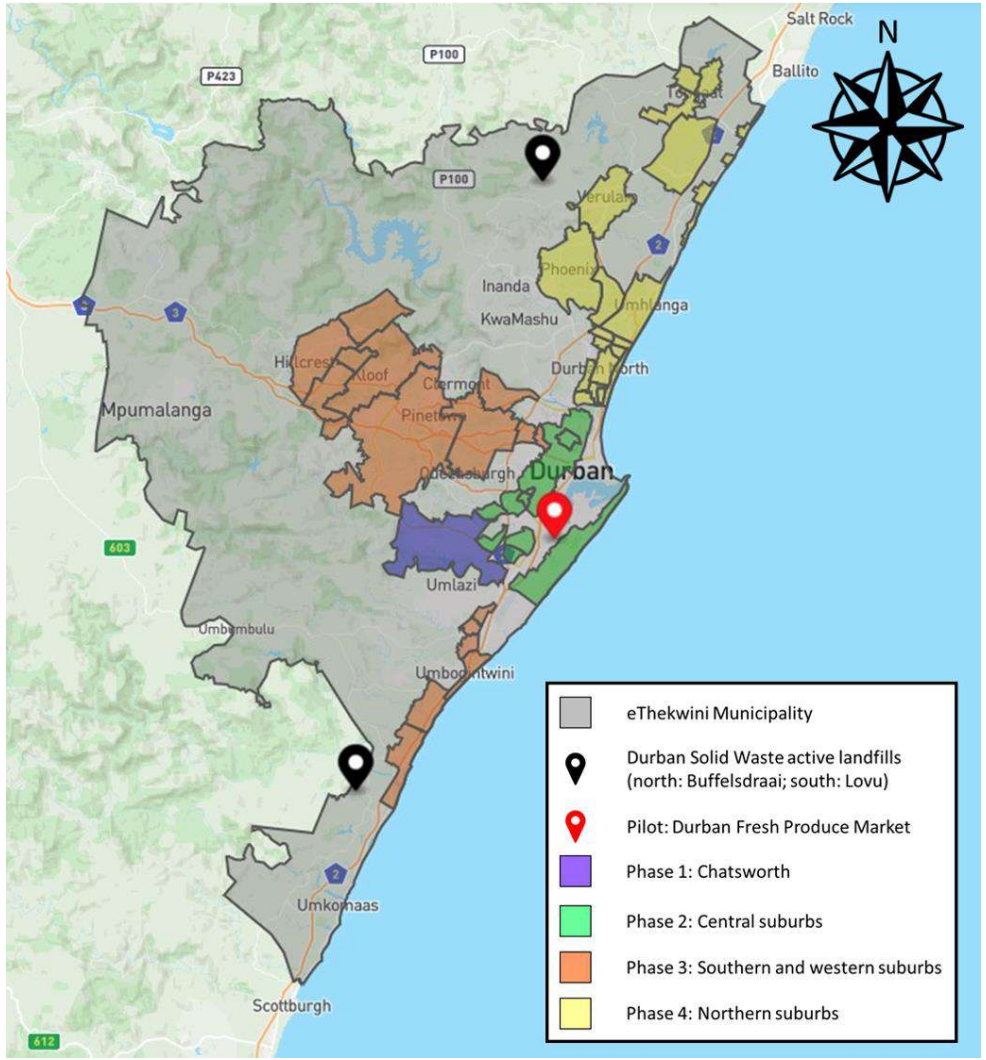
ZWELAMANZI

Rampox Energy
Smart Energy Solutions

ETHEKWINI MUNICIPALITY

Definition of a source-separation scheme for organic waste

- **Pilot phase (2027-2028)**
  - 5,831 t/y (2.1% of OFMSW production)
- **Phase 1 (2029-2030)**
  - 11,549 t/y (4.0% of OFMSW production)
- **Phase 2 (2031-2032)**
  - 18,454 t/y (6.3% of OFMSW production)
- **Phase 3 (2033-2034)**
  - 28,397 t/y (9.6% of OFMSW production)
- **Phase 4 (2035-2050)**
  - 39,030 t/y (13.1% of OFMSW production)



Empowering municipal strategy through data

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

eThekwini Integrated Energy Complex (EIEC) Feasibility Study

UK PACT

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

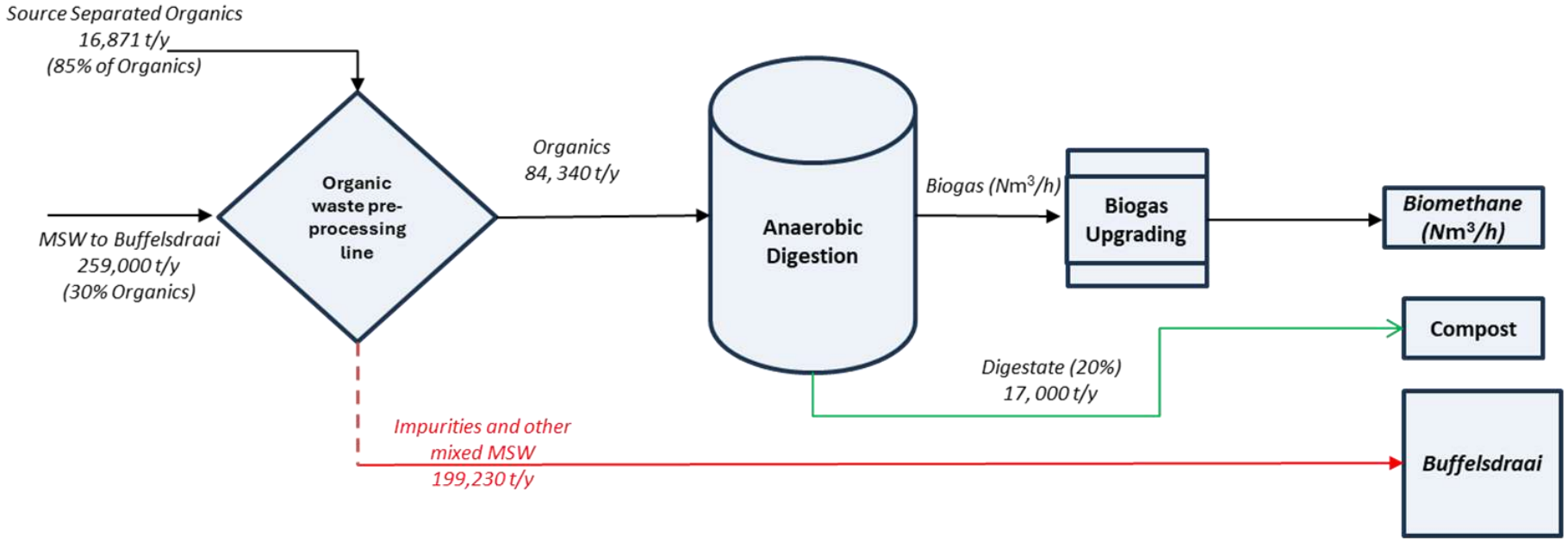
Anaergia Fueling a Sustainable World

ZWELAMANZI

Rampox Energy Smart Energy Solutions

ETHEKWINI MUNICIPALITY

Scenario AD–Biomethane: (Source Segregation Organic + MSW at Buffelsdraai AD Plant)



Mixed MSW entering landfill	SSO feedstock	Organic feedstock	Total Energy Consumption	Potential CH4 production	Potential diesel replacement	GHG emission reduction	Landfill space savings	Waste diversion rate
[t/y]	[t/y]	[t/y]	[MWh/y]	[Nm3/y]	[L/y]	[tCO2eq/y]	[m3/y]	[%]
259,000	16,871	84,340		7,008,000	7,000,000	122,307	99,224	31.2

Empowering municipal strategy through data

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

eThekwini Integrated Energy Complex (EIEC) Feasibility Study

1 COSTS – CAPEX and OPEX ESTIMATION*

TOTAL CAPEX

R 645 880 000

Organic Waste Pre-Processing Line
R 215 690 000 (33.4%)

Anaerobic Digestion
R 118 950 000 (18.4%)

Biogas Upgrading
R 102 520 000 (15.9%)

Civil works
R 208 720 000 (32.3%)

OPTION CO_2 Liquefaction R 54 400 000 (8.4%)

OPEX:
R 30 000 000 /y

2 REVENUE ESTIMATION (20 YEARS)

Gate fee	Biomethane – at current price	Carbon Credits	CO_2 Stream
R 168 680 700	R 1 074 282 000	R 636 583 000	R –
9.0%	57.1%	33.9%	0%
of total revenue	of total revenue	of total revenue	of total revenue

TOTAL REVENUE (20 YEARS): R 1 879 545 700

3 KEY ECONOMIC INDICATORS

Total CAPEX	Annual OPEX	Total Revenue (20 years)
R 645 880 000	R 30 000 000 /y	R 1 879 545 700

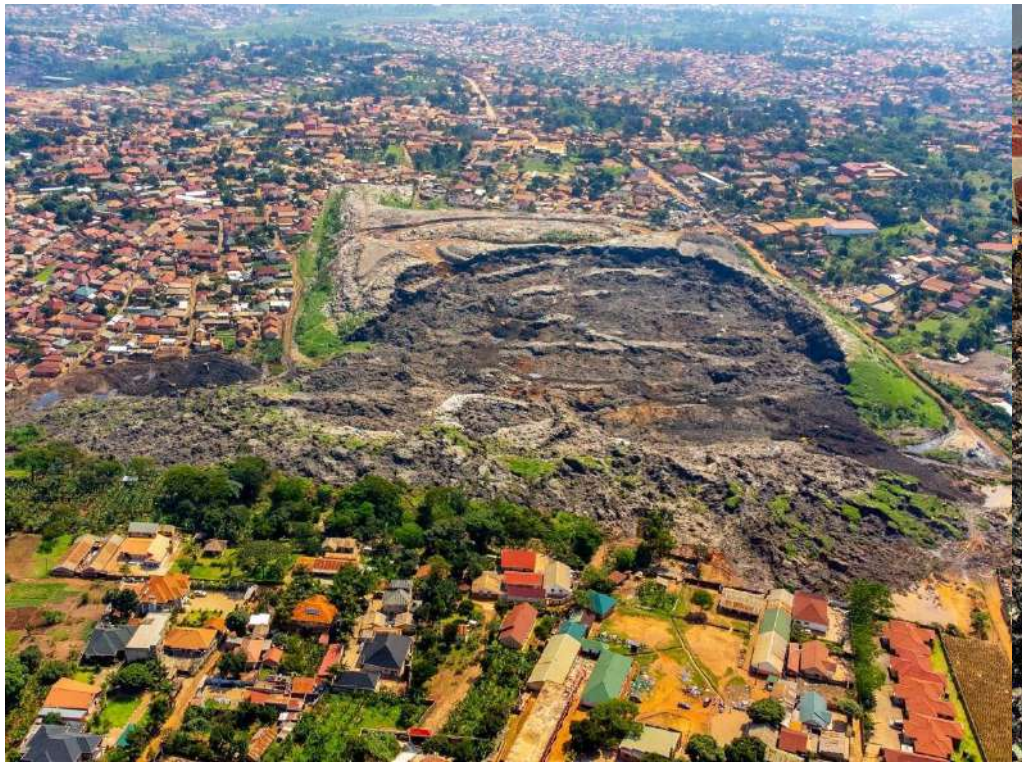
International policy and crisis response

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

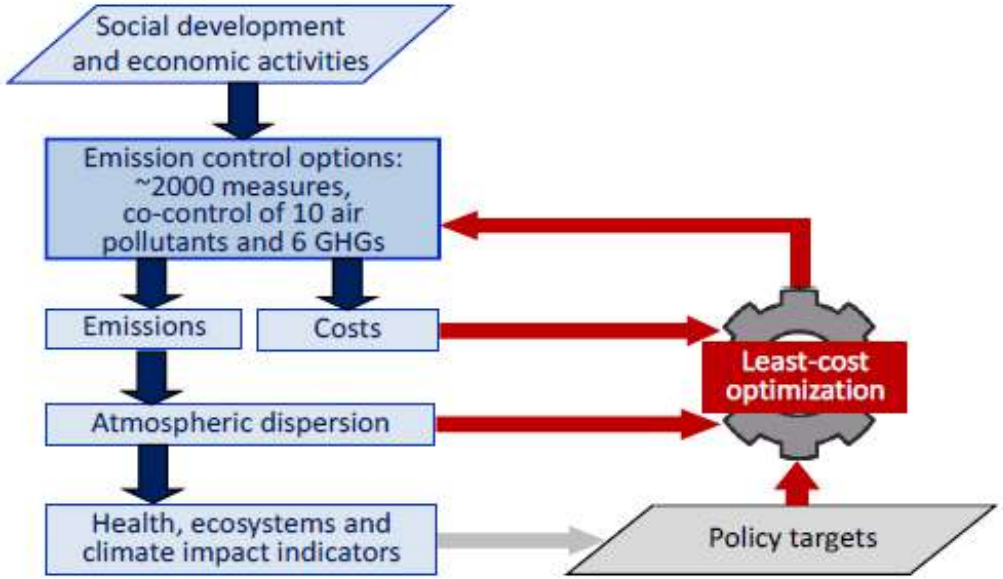
Strategy for Organic Waste Management Uganda (SOWU)

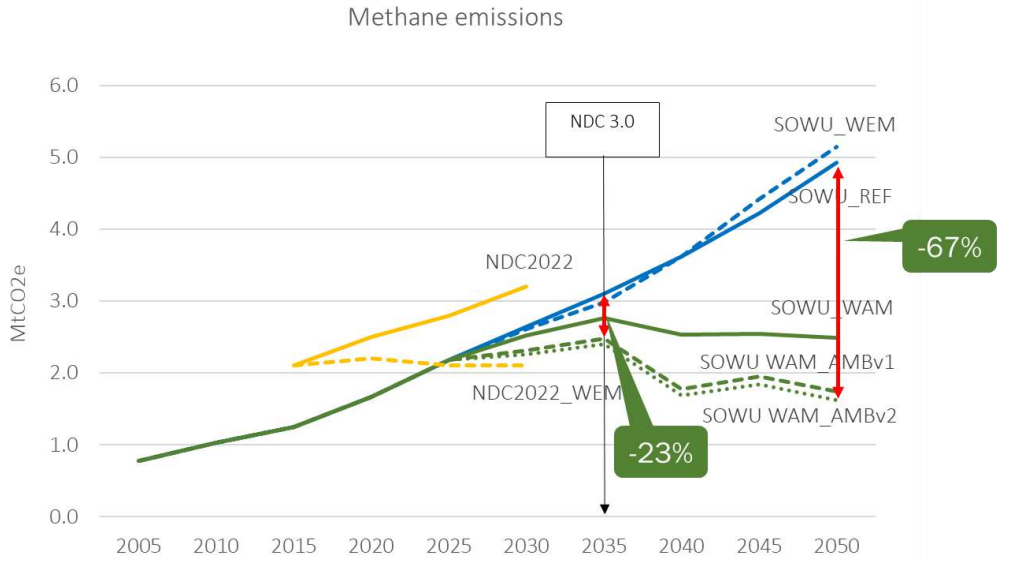
- **Kiteezi landfill, 10 August 2024** – over 30 casualties, 200 people lost their homes, thousands still survive off scavenging



International policy and crisis response

Strategy for Organic Waste Management Uganda (SOWU)





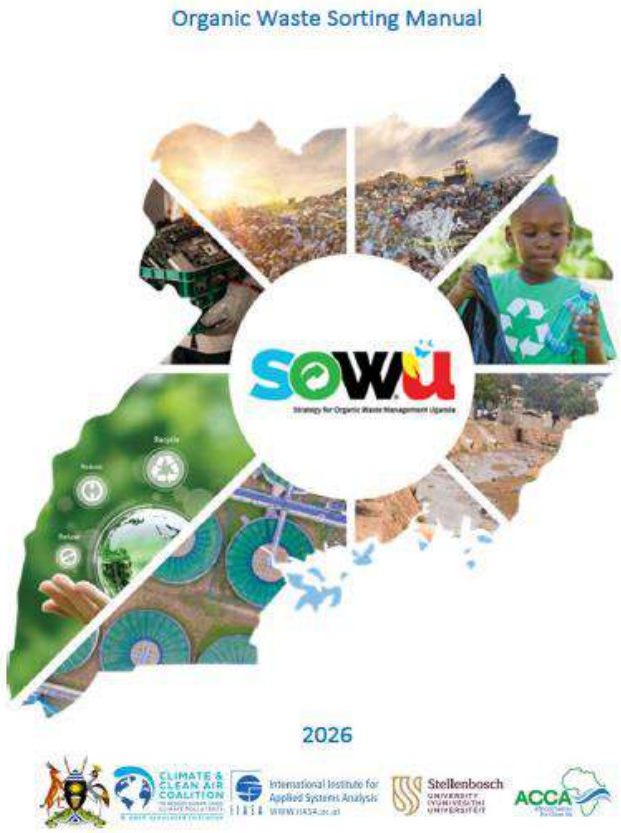
Strategy for Organic Waste Management Uganda

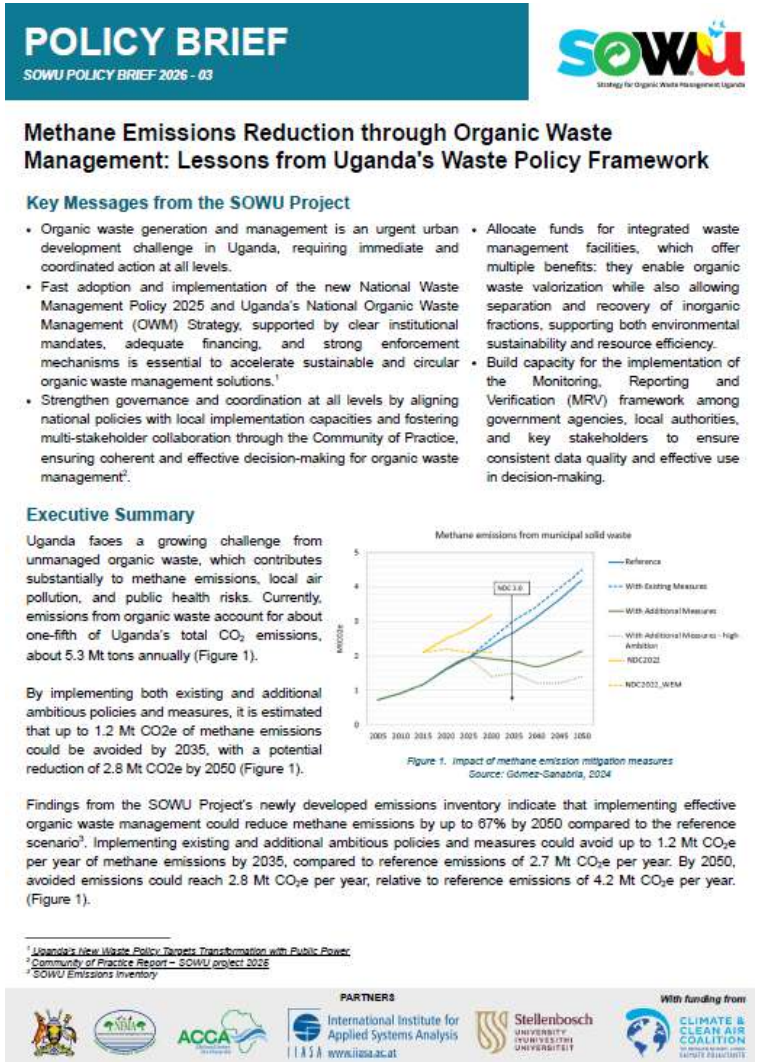
International policy and crisis response

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Strategy for Organic Waste Management Uganda (SOWU)





POLICY BRIEF

SOWU POLICY BRIEF 2026 - 03

SOWU Strategy for Organic Waste Management Uganda

Methane Emissions Reduction through Organic Waste Management: Lessons from Uganda's Waste Policy Framework

Key Messages from the SOWU Project

- Organic waste generation and management is an urgent urban development challenge in Uganda, requiring immediate and coordinated action at all levels.
- Fast adoption and implementation of the new National Waste Management Policy 2025 and Uganda's National Organic Waste Management (OWM) Strategy, supported by clear institutional mandates, adequate financing, and strong enforcement mechanisms is essential to accelerate sustainable and circular organic waste management solutions.[1]
- Strengthen governance and coordination at all levels by aligning national policies with local implementation capacities and fostering multi-stakeholder collaboration through the Community of Practice, ensuring coherent and effective decision-making for organic waste management[2].
- Allocate funds for integrated waste management facilities, which offer multiple benefits: they enable organic waste valorization while also allowing separation and recovery of inorganic fractions, supporting both environmental sustainability and resource efficiency.
- Build capacity for the implementation of the Monitoring, Reporting and Verification (MRV) framework among government agencies, local authorities, and key stakeholders to ensure consistent data quality and effective use in decision-making.

Executive Summary

Uganda faces a growing challenge from unmanaged organic waste, which contributes substantially to methane emissions, local air pollution, and public health risks. Currently, emissions from organic waste account for about one-fifth of Uganda's total CO_2 emissions, about 5.3 Mt tons annually (Figure 1).

By implementing both existing and additional ambitious policies and measures, it is estimated that up to 1.2 Mt CO2e of methane emissions could be avoided by 2035, with a potential reduction of 2.8 Mt CO2e by 2050 (Figure 1).

Methane emissions from municipal solid waste

Figure 1. Impact of methane emission mitigation measures
Source: Gómez-Sanabria, 2024

Findings from the SOWU Project's newly developed emissions inventory indicate that implementing effective organic waste management could reduce methane emissions by up to 67% by 2050 compared to the reference scenario[3]. Implementing existing and additional ambitious policies and measures could avoid up to 1.2 Mt CO_2e per year of methane emissions by 2035, compared to reference emissions of 2.7 Mt CO_2e per year. By 2050, avoided emissions could reach 2.8 Mt CO_2e per year, relative to reference emissions of 4.2 Mt CO_2e per year. (Figure 1).

[1] Uganda's New Waste Policy Targets Transformation with Public Power
[2] Community of Practice Report – SOWU project 2026
[3] SOWU Emissions Inventory

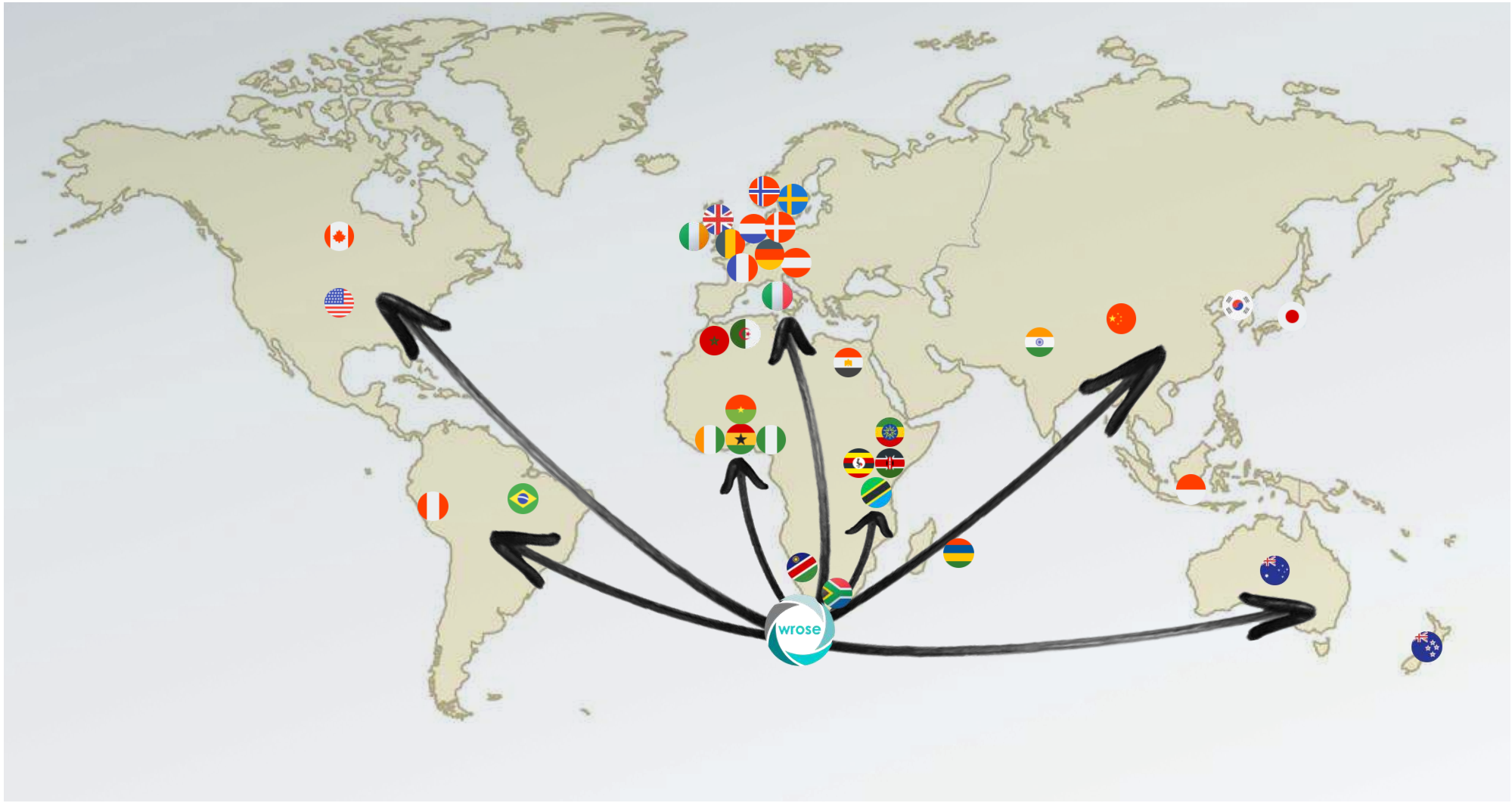
PARTNERS

With funding from

Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT



Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

- BIOTHEREP: Hybrid Biochemical and Thermochemical conversion of Slaughterhouse biowaste for Renewable Energy production

BIOTHEREP

LEAP-RE
Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

science, technology & innovation
Department:
Science, Technology and Innovation
REPUBLIC OF SOUTH AFRICA

sonedi
South African National Energy Development Institute

Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

- BIOTHEREP: Hybrid Biochemical and Thermochemical conversion of Slaughterhouse biowaste for Renewable Energy production

BIOTHEREP

LEAP-RE
Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

science, technology & innovation
Department:
Science, Technology and Innovation
REPUBLIC OF SOUTH AFRICA

sonedi
South African National Energy Development Institute

- TUM SEED Center

TUM

S.E.E.D CENTER

Federal Ministry for Economic Cooperation and Development

DAAD Deutscher Akademischer Austauschdienst
German Academic Exchange Service

Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

- BIOTHEREP: Hybrid Biochemical and Thermochemical conversion of Slaughterhouse biowaste for Renewable Energy production

BIOTHEREP

LEAP-RE
Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

science, technology & innovation
Department: Science, Technology and Innovation
REPUBLIC OF SOUTH AFRICA

sonedi
South African National Energy Development Institute

- TUM SEED Center

S.E.E.D CENTER

Federal Ministry for Economic Cooperation and Development

DAAD Deutscher Akademischer Austauschdienst
German Academic Exchange Service

- HyREC²A: Hybrid Renewable Energy Collaborative Climate Action

HyREC²A
HYBRID RENEWABLE ENERGY COLLABORATIVE CLIMATE ACTION

Bayerische Staatskanzlei

DEGGENDORF INSTITUTE OF TECHNOLOGY DIT

Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Vines4Future: Living Heritage, Climate Change and Sustainability in South African Agriculture

The British Academy

THE UNIVERSITY OF EDINBURGH

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

OLD VINE PROJECT

Cultiver

AQUILA ENVIRONMENTAL

Western Cape Government

Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Vines4Future: Living Heritage, Climate Change and Sustainability in South African Agriculture

Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Vines4Future: Living Heritage, Climate Change and Sustainability in South African Agriculture

Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Vines4Future: Living Heritage, Climate Change and Sustainability in South African Agriculture

Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Vines4Future: Living Heritage, Climate Change and Sustainability in South African Agriculture

Unlocking Circular Value from Vine Waste using the WROSE Model:

Insights for Sustainable Wine Industry

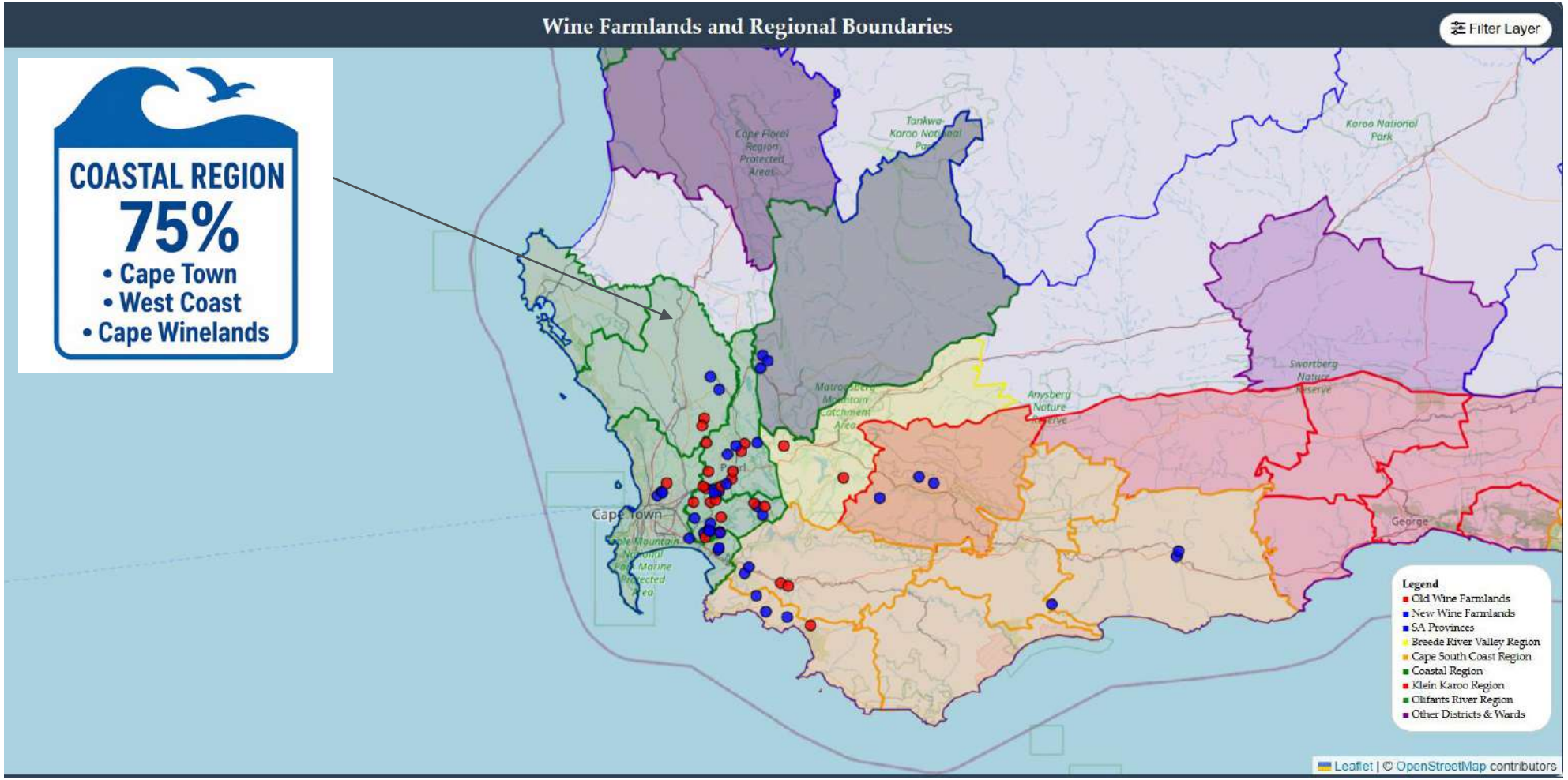
Prof. Cristina Trois
Dr Yared Abera
Dr Andrea Dell'Orto
Miss Martina Mariani

Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

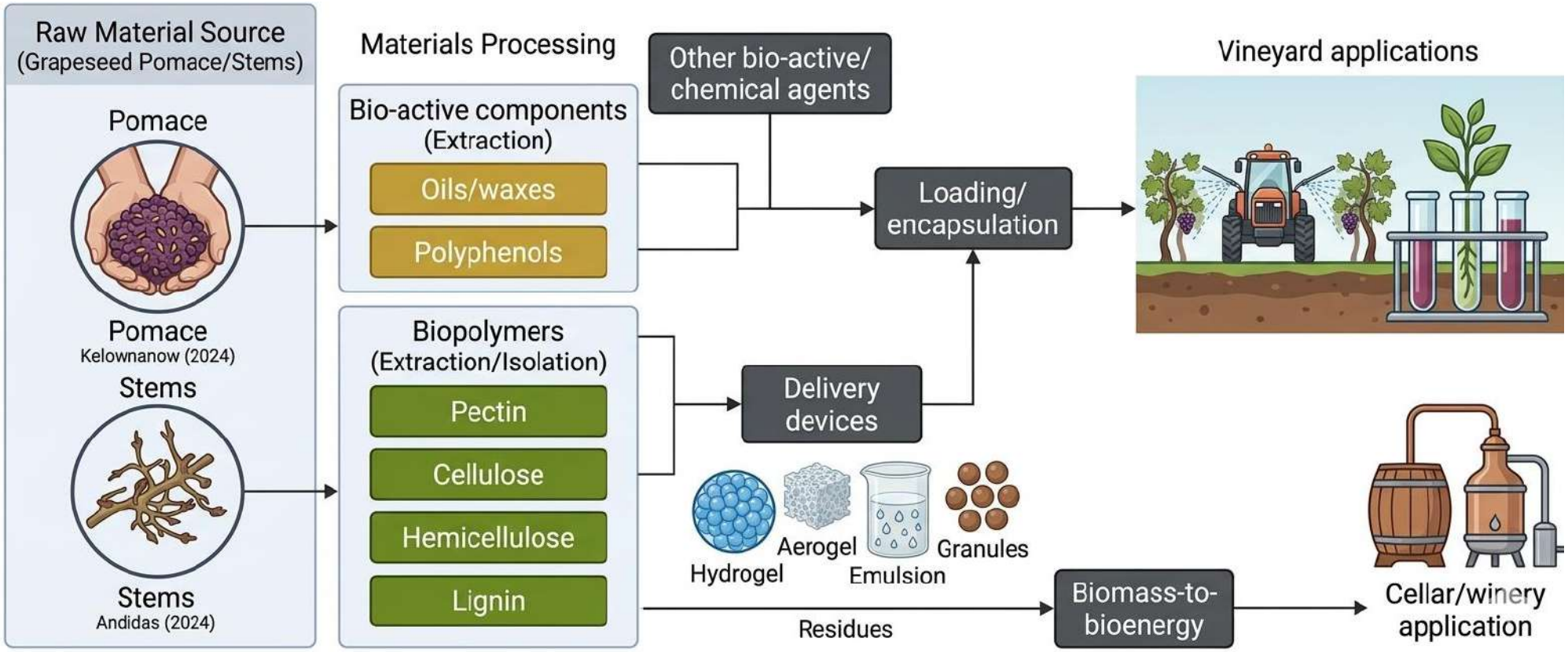
Vines4Future: Living Heritage, Climate Change and Sustainability in South African Agriculture



Addressing W²EF challenges with multinational cooperation

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT



6 - 192 GWh/yr
Electricity generation potential

6 - 178 kt CO_2eq
GHG emissions avoided annually

106.7M L
Bioethanol production potential

17.7 kt
Biochar for soil carbon sequestration

24,04 Kt
Bio-oil production Potential

15,1 Kt
Syngas production Potential

National and international leadership: CoPs, ARUA CoE and ARUA-Guild CoRE-RE

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

- **Community of Practice** *"Waste to Value: Transitioning South Africa towards a Waste-to-Resource Circular Economy"*

- **Community of Practice** *"Climate Research in Collaboration with Society"*

- **ARUA Centre of Excellence in Energy**

- **ARUA-Guild Cluster of Research Excellence in Renewable Energy**

Internal support for a strengthened CRSES

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Faculty of Engineering

Electrical & Electronic Engineering Department

- Wind Energy Spoke
- Scatec Chair in PV systems
- NRF SARChI Chair in Power Systems Simulation
- Power Systems Research Group (PSRG)
- ESKOM Chair and EPEP Programme

Mechanical & Mechatronic Engineering Department

- Solar Thermal Energy Research Group (STERG) STE Spoke
- ACWA Power Chair in Concentrated Solar Power

Industrial Engineering Department

- E-mobility Research Group

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

- Tech Development and Commercialisation
- Green Hydrogen
- CRSES-Next
- Training, Awareness and Collaboration

Civil Engineering Department

Chemical Engineering Department

- Sasol NRF SARChI chair in Green Hydrogen
- NRF SARChI chair in Biofuels and Bioenergy

Partner with us to build the future!

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Researchers & Academic Consultants	**Policy Makers & National Authorities**	**Municipalities & Local Government**	**Industry & Private Companies**
Lack of localised multi-disciplinary baseline data in Africa	National strategy planning lacks quantified emission forecasting	Critical climate risks and rapidly shrinking landfill airspace	Rising corporate carbon taxes and organic waste penalties
Access an advanced, TIA-funded mathematical optimisation engine	Run macro-level strategic scenario planning tailored to South Africa	Simulate short-, medium- and long-term tech scenarios before spend	Model techno-economic feasibility for complex biowaste streams
Fast-track research validation and high-impact co-authorship	Vetted, evidence-based data approved by the World Bank	De-risked public infrastructure and successful civic strategy	High financial returns on bioenergy and off-grid security

Partner with us to build the future!

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

Prof Cristina Trois
Director: CRSES and ARUA CoE

email: cristinatrois@sun.ac.za

W: +27 21 808 4251
C: +27 82 346 2644

www.crses.sun.ac.za

Photo by Stefan Els