Global Opportunities and Strategies for Addressing Landfill Methane

January 23, 2024

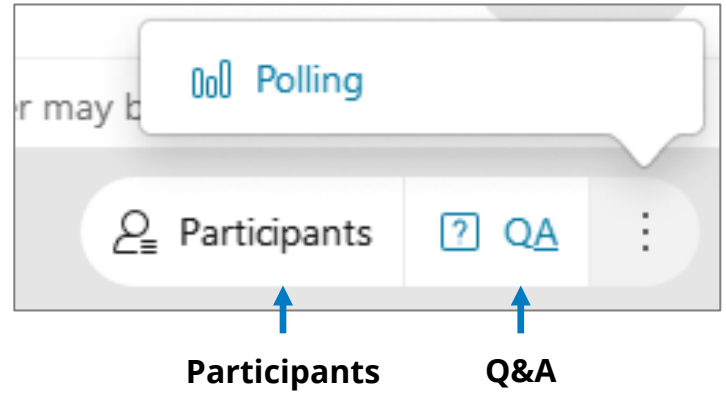
Call-in Details 1-415-655-0002 ID: 2431 611 4664

Global Methane Initiative

Webinar Panels

- We will use two panels
  - Participants and Question & Answer (Q&A)
  - Use the arrow to expand or collapse the panels

- Adding Panels
  - If some panels don't appear, select the desired panels in the lower right corner



Q&A

- Participants are muted
- Questions will be moderated at the end of the webinar
- To ask a question:
  - Select “All Panelists” from the drop-down menu
  - Enter your questions in the Q&A box
  - Hit “Send”

- Final materials will be posted to the GMI website: www.globalmethane.org

ISWA
International Solid Waste Association

Presenter: Aditi Ramola

Mobilizing methane action at open dumpsites and landfills

GMI-ISWA Webinar Series

23 January 2024
Online

ISWA

ISWA is the world's leading network promoting professional and sustainable waste- and resource management.

ISWA represents all aspects and stakeholders within the waste management sector: the public, the private and the academic.

With more than 1,300 Members in 109 countries, ISWA has a unique global network.

To Promote and Develop Sustainable and Professional Waste Management Worldwide and the transition to a Circular Economy

- Our mission

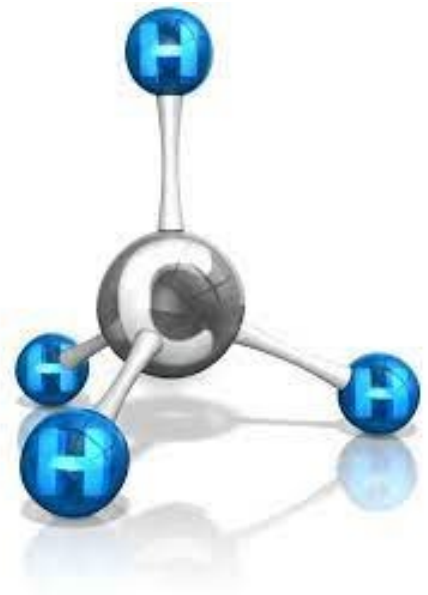
The (Solid) Waste Issue

- Almost 2.5 billion people lack access to basic waste services
- Between 30 and 40% of global waste is openly dumped and burned (or leaked into the environment)
- In a business as usual scenario waste generation is expected to grow in the coming decades
- Data plays a crucial role, but there is limited availability of good waste data globally

Impacts of open dumping and burning of waste

- Health impacts
- Release of dioxins and furans
- Release of benzopyrene and polyaromatic hydrocarbons
- Release of volatile organic chemicals
- Environmental and climate impacts
- Water and soil pollution
- Short-lived climate pollutants (SLCPs) and greenhouse gas (GHG) emissions

Methane



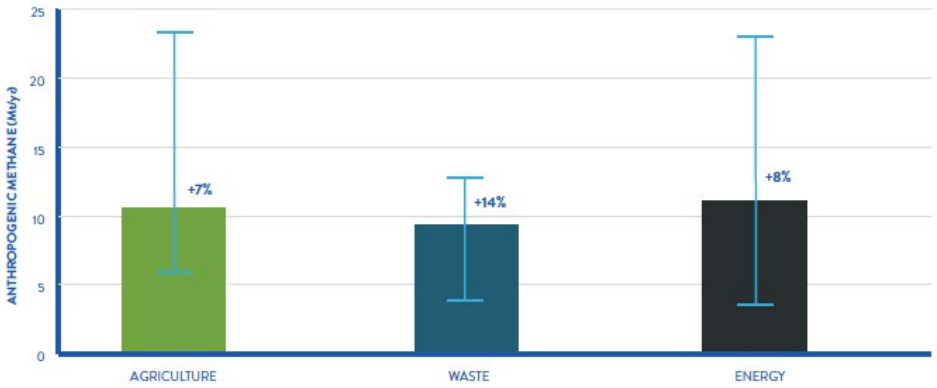
Some facts:

- Methane has an estimated mean half-life of 9.1 years in the atmosphere
- Therefore, it has a large effect for a relatively brief period
- Methane has a global warming potential (GWP) of up to 28 times greater than carbon dioxide (CO_2) for a 100-year time frame
- However, taken over a 20-year time frame the GWP is approximately 84 (values of 72 to 105 are reported) times greater than CO_2
- This implies that reducing methane emissions has a large and immediate impact on reducing global radiative forcing

Methane from the **solid** waste sector – context setting

SECTORS	AVERAGE
Agriculture	147
Livestock	114
Rice	30
Waste	73
Solid waste	43
Wastewater	30
Energy	134
Gas	35
Oil	43
Coal	41
Total (including 16 Mt/yr biomass burning)	372

Methane anthropogenic emissions in metric tons (Mt) per year across sources

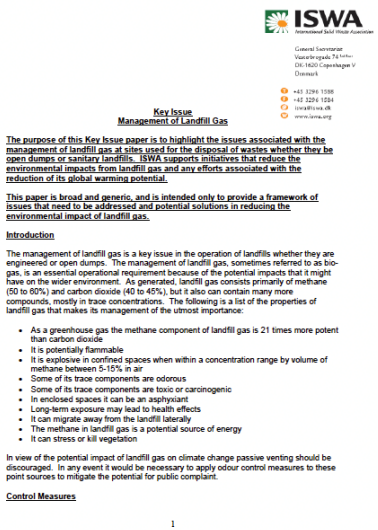


Global total projected increase in baseline anthropogenic methane emissions between 2020 and 2030 for the indicated sectors in Mt.

Source: United Nations Environment Programme/Climate and Clean Air Coalition (2022). Global Methane Assessment: 2030 Baseline Report. Nairobi.

- Bearing in mind uncertainties at the sectoral level, some observations:
  - Agriculture and Energy are comparable in magnitude and have roughly twice the emissions of the Waste sector
  - Within the waste sector, both emissions associated with solid waste and with wastewater are projected to grow, driven by growth in population and economic development, *with those from solid waste increasing more rapidly in both tonnes per year and in per cent of current emissions.*
  - Implication: there is substantial opportunity for methane emissions reduction from the solid waste sector

ISWA Working Group on Landfills through the decades



ISWA

Key Issue
Management of Landfill Gas

The purpose of this Key Issue paper is to highlight the issues associated with the management of landfill gas at sites used for the disposal of wastes whether they be open dumps or sanitary landfills. ISWA supports initiatives that reduce the environmental impacts from landfill gas and any efforts associated with the reduction of its global warming potential.

This paper is broad and generic, and is intended only to provide a framework of issues that need to be addressed and potential solutions in reducing the environmental impact of landfill gas.

Introduction

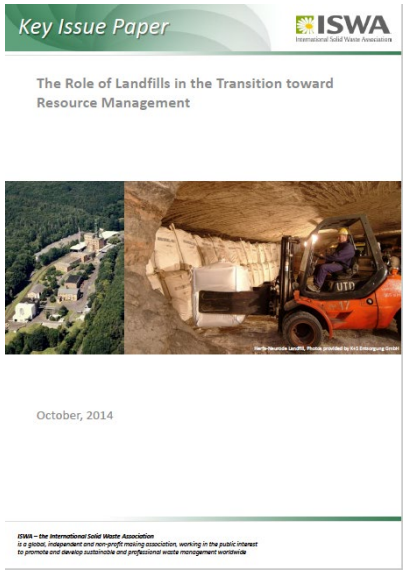
The management of landfill gas is a key issue in the operation of landfills whether they are engineered or open dumps. The management of landfill gas, sometimes referred to as bio-gas, is an essential operational requirement because of the potential impacts that it might have on the wider environment. As generated, landfill gas consists primarily of methane (50 to 60%) and carbon dioxide (40 to 45%), but it also can contain many more compounds, mostly in trace concentrations. The following is a list of the properties of landfill gas that makes its management of the utmost importance:

- As a greenhouse gas the methane component of landfill gas is 21 times more potent than carbon dioxide
- It is potentially flammable
- It is explosive in confined spaces when within a concentration range by volume of methane between 5-15% in air
- Some of its trace components are odorous
- Some of its trace components are toxic or carcinogenic
- In enclosed spaces it can be an asphyxiant
- Long-term exposure may lead to health effects
- It can migrate away from the landfill laterally
- The methane in landfill gas is a potential source of energy
- It can stress or kill vegetation

In view of the potential impact of landfill gas on climate change passive venting should be discouraged. In any event it would be necessary to apply odour control measures to these point sources to mitigate the potential for public complaint.

Control Measures

1



Key Issue Paper

ISWA

The Role of Landfills in the Transition toward Resource Management

October, 2014

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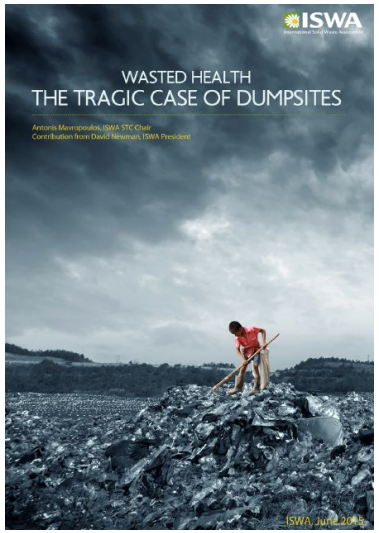
is a global, independent and non-profit making association, working in the public interest to promote and develop sustainable and professional waste management worldwide

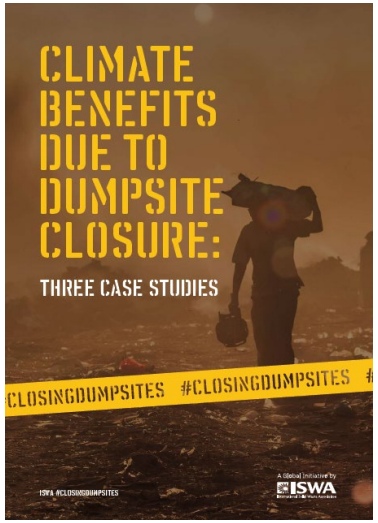


ISWA

WASTED HEALTH
THE TRAGIC CASE OF DUMPSITES

Antonis Mavropoulos, ISWA STC Chair
Contribution from David Newman, ISWA President

ISWA, June 2015



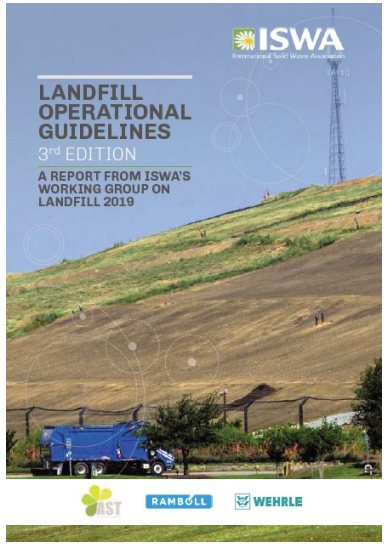
CLIMATE BENEFITS DUE TO DUMPSITE CLOSURE:

THREE CASE STUDIES

#CLOSINGDUMPSITES #CLOSINGDUMPSITES #

ISWA #CLOSINGDUMPSITES

A Global Initiative by ISWA



ISWA

LANDFILL OPERATIONAL GUIDELINES
3rd EDITION
A REPORT FROM ISWA'S WORKING GROUP ON LANDFILL 2019

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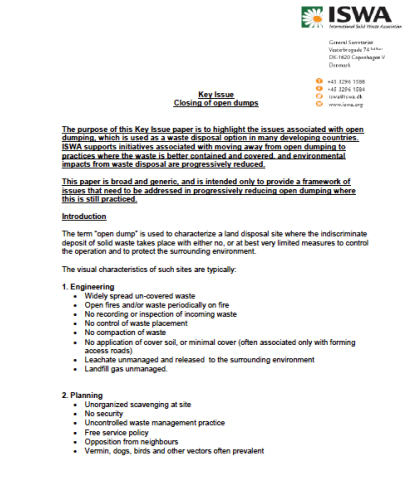

ISWA

Key Issue
Closing of open dumps

The purpose of this Key Issue paper is to highlight the issues associated with open dumping, which is used as a waste disposal option in many developing countries. ISWA supports initiatives associated with moving away from open dumping to practices where the waste is better contained and covered, and environmental impacts from waste disposal are progressively reduced.

This paper is broad and generic, and is intended only to provide a framework of issues that need to be addressed in progressively reducing open dumping where this is still practised.

Introduction

The term "open dump" is used to characterize a land disposal site where the indiscriminate deposit of solid waste takes place with either no, or at best very limited measures to control the operation and to protect the surrounding environment.

The visual characteristics of such sites are typically:

1. Engineering
   - Widely spread un-covered waste
   - Open fires and/or waste periodically on fire
   - No recording or inspection of incoming waste
   - No control of waste placement
   - No compaction of waste
   - No application of cover soil, or minimal cover (often associated only with forming access roads)
   - Leachate unmanaged and released to the surrounding environment
   - Landfill gas unmanaged.

2. Planning
   - Unorganized scavenging at site
   - No security
   - Uncontrolled waste management practice
   - Free service policy
   - Opposition from neighbours
   - Vermin, dogs, birds and other vectors often prevalent

1

KEY ISSUE PAPER

ISWA

Landfill Aftercare

July, 2013

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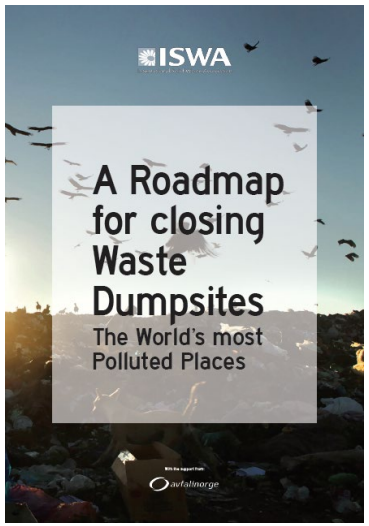


ISWA

A Roadmap for closing Waste Dumpsites
The World's most Polluted Places

ESTIMATION OF WASTE SECTOR GREENHOUSE GAS EMISSIONS IN TYRE CAZA, LEBANON, USING THE SOLID WASTE EMISSIONS ESTIMATION TOOL (SWEET)

ISWA SCS ENGINEERS

ISWA

THE IMPACT OF MANAGEMENT CHOICES ON LANDFILL METHANE EMISSIONS

SCS ENGINEERS
Environmental Consultants and Contractors
sølvi
DSWA

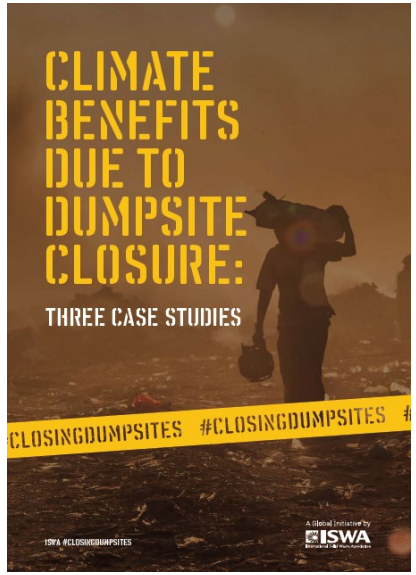
ISWA's Task Force on Closing Dumpsites (TFCD)

- Formally set up in 2018
- The ISWA TFCD is an international partnership that is led and facilitated by ISWA, aiming to close dumpsites throughout the world
- The goal of the initiative is to enable jurisdictions (cities/towns/municipalities), with the support of their regional and national governments, to move along the waste hierarchy in a coordinated and cohesive manner in order to mitigate methane and black carbon emissions.
- ISWA's goal is not only to play an active part in the closure of dumpsites, but also to ensure that the final closure of a dumpsite is supported by a system of infrastructure, by putting more sustainable alternatives in place, together with an integrated waste management plan, institutional and administrative capacity, financial resources and social support for the people living on the dumpsites.

SWEET Application

- Can’t manage what you don’t measure
- Solid Waste Emissions Estimation Tool (SWEET)
- Past applications:
  - Estrutural dumpsite, Brasilia, Brazil
  - Rautenweg-landfill, Vienna, Austria
  - Hiriya landfill, Tel Aviv, Israel
  - Ras Al Ain, Tyre, Lebanon

- Future applications:
  - Banyuwangi, East Java, Indonesia
  - Tabanan, Bali, Indonesia
  - Chengalpattu, Tamil Nadu, India



Time to rename the Task Force?

- #ClosingDumpsites

to

- #ClosingDumpsitesAndMovingUpTheWasteHierarchy

to

- #ClosingDumpsitesAndMovingToIntegratedSustainableWasteManagement

Considerations for dumpsite closure

There are many benefits of closing dumpsites: environmental, public health, and financial/economic.

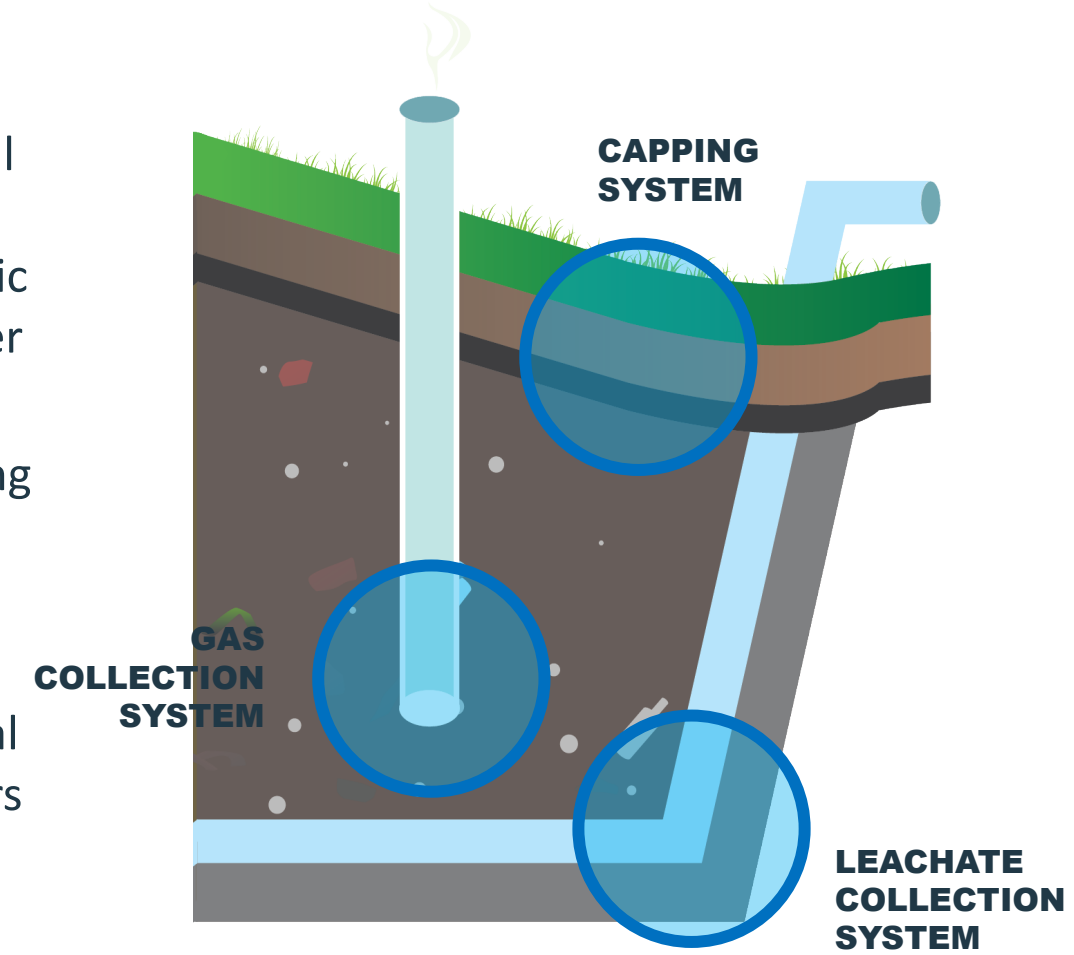
BUT

Several factors need to be taken into consideration for the closure of a dumpsite:

- It’s ultimately about people, not waste
- Technical considerations
- Financial and economic considerations
- Governance structures
- Social aspects

Landfill Gas (LFG) Capture and Use

- The 2019 Refinement to the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC, 2019) include a higher fraction of Degradable Organic Carbon (DOC) for easily degradable carbon and lower DOC for less degradable carbon.
- The IPCC made this amendment in response to strong indications that methane generation is higher (than previously assumed) shortly after landfilling and lower (than previously assumed) in later years.
- This implies that a large methane reduction potential can be expected, even more than before, in the years immediately following disposal, if LFG extraction systems are in place.



Organic waste management strategies

Long term solutions must include comprehensive and robust organic waste management strategies including diverting organics from landfills

Combination of decentralized and centralized systems for treatment of the organic waste fraction

Encourage source separation, collection and transportation to appropriate treatment facilities (composting, anaerobic digestion (AD) etc.)

Develop appropriate policies and regulations to support organic waste diversion

Create markets for materials from the processes to ensure economic viability

Better MRV processes to ensure that the strategy is working

Final remarks

Methane from the waste sector is intricately tied to development – gross domestic product (GDP) and population growth

Without concerted action the emissions from the sector are set to rise in the coming decades

Mitigating methane emissions from the solid waste sector provides opportunities for action and addressing climate change

Waste segregation, implementing strategies for managing organic waste, landfill management with gas capture, etc.

References and further reading

- GMI - https://www.globalmethane.org/methane/index.aspx
- US EPA - https://www.epa.gov/lmop
- ISWA - https://www.iswa.org/landfill/?v=c86ee0d9d7ed
- UNEP - https://www.ccacoalition.org/short-lived-climate-pollutants/methane
- WB - https://www.worldbank.org/en/news/factsheet/2023/12/04/world-bank-steps-up-efforts-to-address-methane-emissions
- CCAC - https://www.ccacoalition.org/resources/solid-waste-emissions-estimation-tool-sweet

Thank You!

aramola@iswa.org

ISWA
International Solid Waste Association

January 23, 2024

Presenter: James Law, Chair of WGL/TFCD

Practical Dimensions of Mitigating Methane at Dumpsites and Landfills

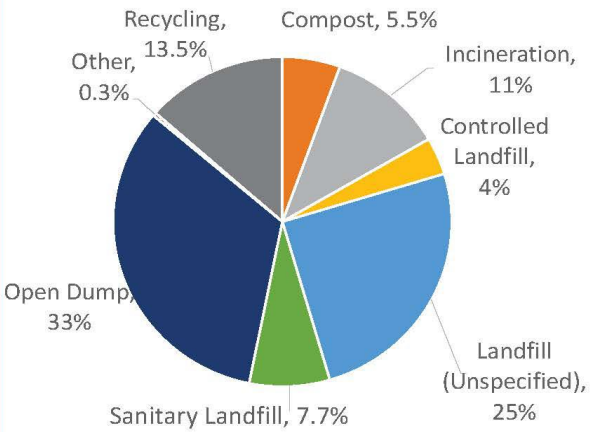
SCS ENGINEERS

Outline Addressing Landfill Methane

- Closing Dumpsites – A Global Priority and Emergency!
- Key Phases for Successful Projects
- Site Enhancement Strategies for Methane Mitigation
- Insights into Long-Term Solutions
- Case Studies

Why Closing Dumpsites A Global Priority?

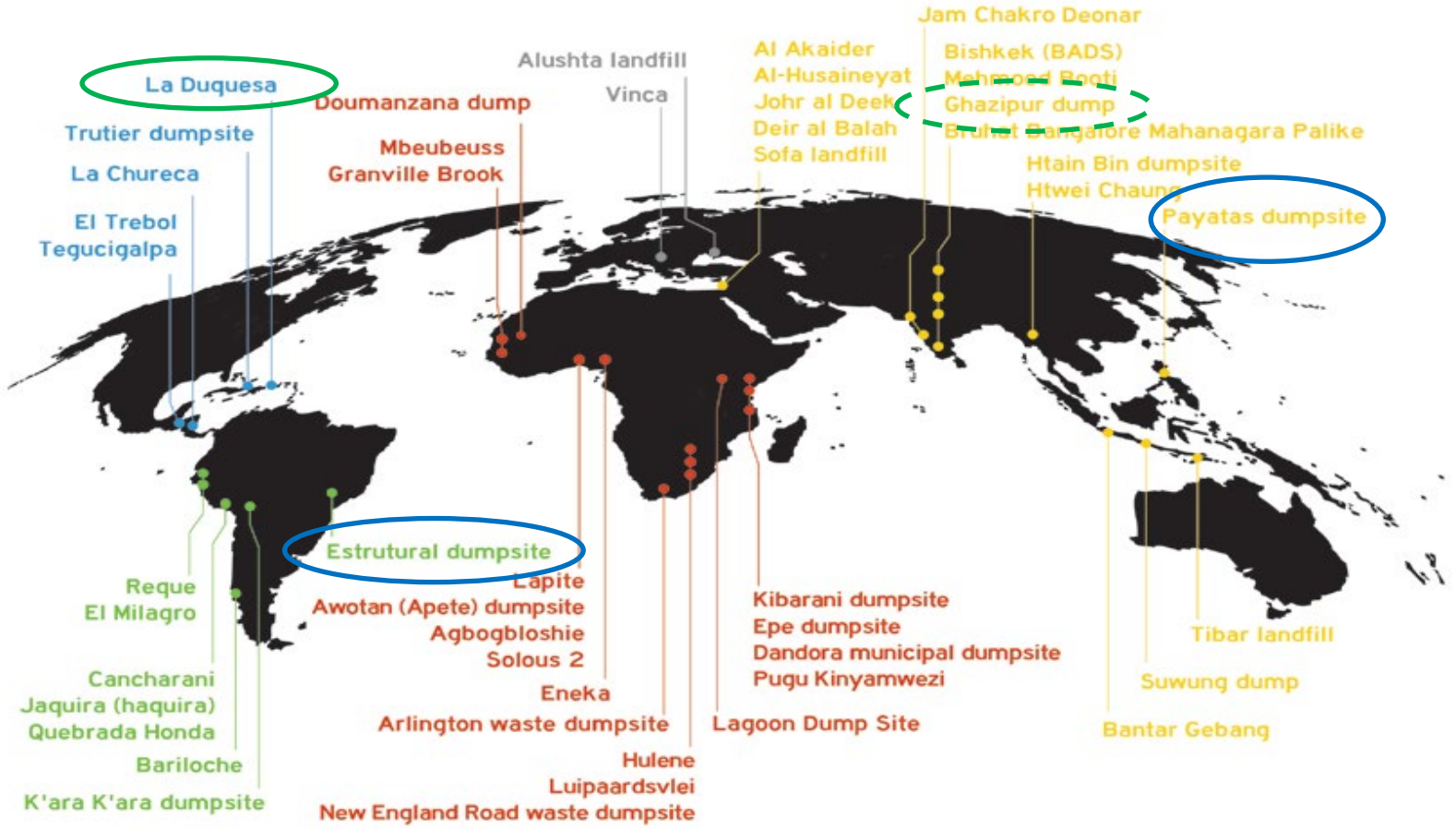
- 70% of global waste goes to dumpsites, controlled or sanitary landfills
- 33% (per TWB) or 40% (per ISWA) is to open dumps in 90% of low-income countries in Global South



50 Largest and Dangerous Dumpsites per ISWA

Dumpsite Statistics

- Globally, >50,000 dumpsites, over 2 million people working on dumpsites
- 750 people killed in first half of 2016
- Less than 10% identified large dumpsites were closed
- A global emergency in health and climate change



Why Closing Dumpsites A Global Priority?

- COP28 in Dubai - at the first ISWA Waste & Resources Pavilion, dumpsites have been reported as the third largest GHG generator
- It is a low-hanging fruit for methane emissions reduction
- Other issues addressed are dumpsite slope instability, fires, odors etc… which may cause health issues and loss of lives!

Dumpsite Slope Failures & Fires

What prices we pay if no actions to current practice?

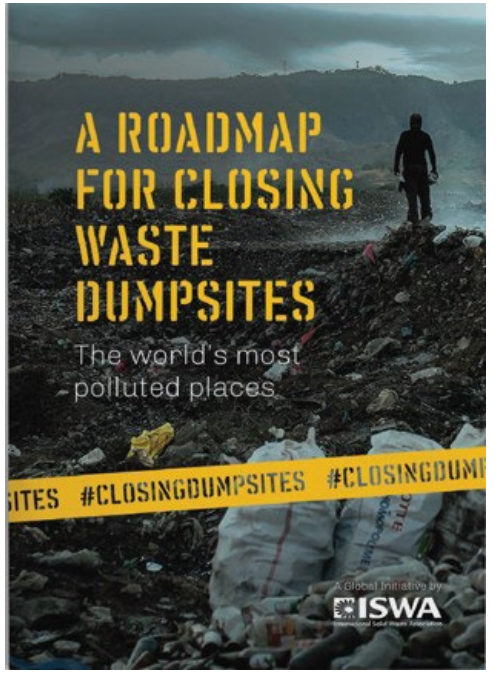
- A global health and environmental emergency of people living around and on dumpsites, including waste pickers
- Issues with air & plastic pollution, and marine litter

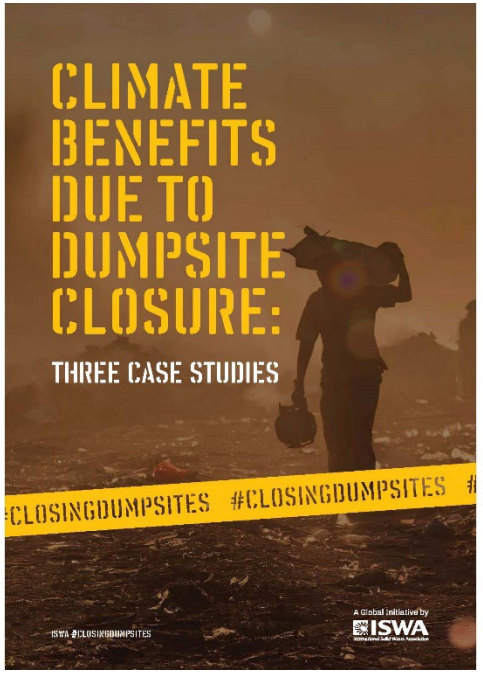
What prices we pay if no actions to current practice?

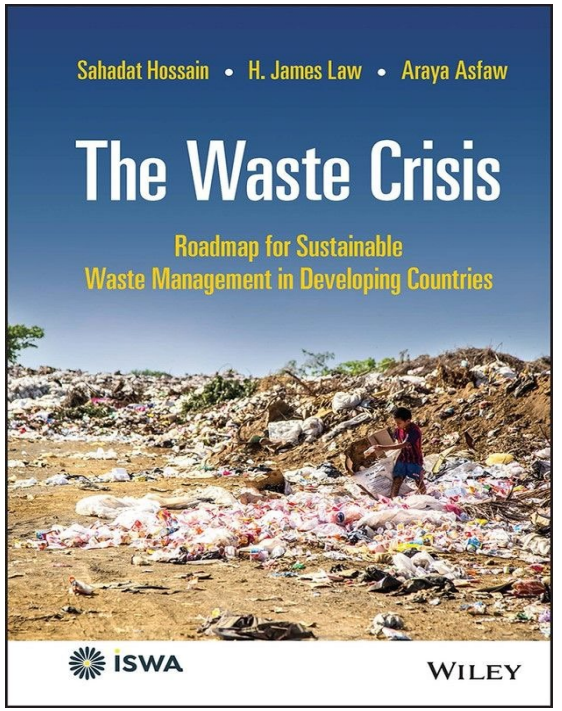
- Waste is about people
- Waste issue is a basic human right!
- Climate change – without action, dumpsites account for 8-10% of GHG emissions by 2025 and much greater by 2050

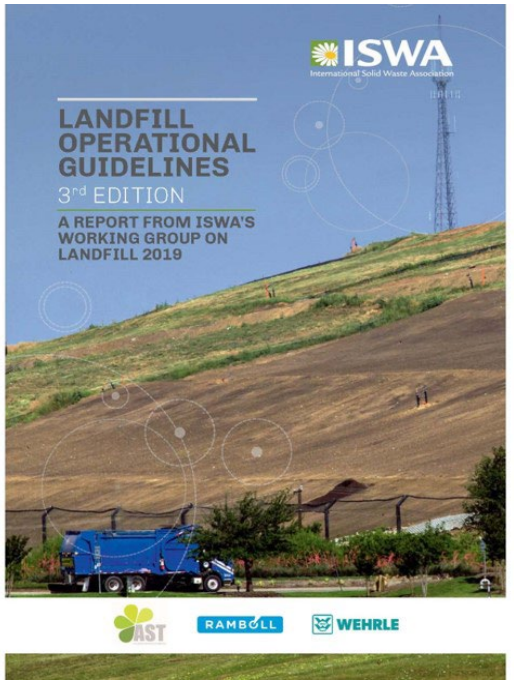
Recent ISWA Publications

1. A Roadmap for Closing Waste Dumpsites, 2016
2. Climate Benefits Due to Dumpsite Closure, 2019
3. Landfill Operational Guidelines 3rd Edition, 2019
4. The Waste crisis – Roadmap for Sustainable Waste Management in Developing Countries, 2022









Key Phases for Successful Projects

- Reliable and accurate waste data, record-keeping
- Comprehensive integrated waste management plan
- Stakeholders' involvement
- Political consensus
- Social aspects and waste pickers management
- Existing dumpsite layout, slope geometry, operational conditions
- Key Issues for managing technical challenges
- Site allocation for a new sanitary landfill
- Basic steps of construction & operation of a new facility

Open Dumpsite – Usual Technical Problems & Challenges

- Widely dispersed uncovered waste and no control of waste placement
- No application of cover soil or compaction of waste
- Open fires and/or waste periodically on fire
- No recording or inspection of incoming waste
- Scavenging at site
- No security fence or check points
- Presence of vermin, dogs, birds and other vectors
- No leachate management or treatment system in-place
- No odor control or landfill gas management system

It is also typical that there are no planning or engineering measures at open dumpsite.

Site Enhancement Strategies

- The need for immediate site improvements
- Reliable modeling of methane emissions estimation
- Landfill gas collection system that can capture 60-90% of methane
- Biocover to reduce methane emissions by up to 80%
- Waste diversion and composting to significantly reduce methane emissions
- Landfill mining to reduce waste volume, recover resources, future methane emissions reduction, and to reclaim land
- Innovative Technologies: Biofiltration, gasification, and the use of drones for landfill monitoring. These technologies offer new ways to reduce and utilize methane emissions
- Long-term solutions to collect methane using effective final cover system and gas collection system

Dumpsite Closure LFG System - Objectives

Active or Passive LFG Control System:

- Reduces fugitive LFG Emissions
- Reduces methane (GHG) emissions
- Controls potential subsurface LFG migration
- Reduces pressure accumulating below final cover system
- Recovers LFG for beneficial utilization (LFG-to-energy)

Insights into Long-Term Solutions

Three methods of closing an open dumpsite and each considered being a long-term solution:

1. Closure by Upgrading into a Controlled Sanitary Landfill
2. In-Place Closure by Covering the Waste
3. Closure by Removing Waste from the Dump

Closure by Upgrading

- Close with a low permeability cap and a topsoil layer over the existing waste mass
- Install a basic landfill gas collection system, which can either be passive or active gas collection system
- Stormwater Management and Re-grading to reduce the leachate generation potential
- There is available space adjacent to the existing open dump
- New waste can be deposited in properly engineered and lined cells with leachate collection system
- The key consideration is to keep things simple and sustainable in a local context (local construction method and local available construction materials), while maximizing the environmental improvement and performance

In-Place Closure Method – Most Commonly Used

- Waste is left in-place, covered with a layer of local soil, and re-vegetated
- A basic landfill gas collection system, which can be passive or active, can be installed, depending on the gas generation volume estimated, the waste composition, and the age of the waste
- This method will:
  - ✓ Reduce waste exposure to wind and vectors
  - ✓ Minimize the risk of fires
  - ✓ Prevent people and animals from scavenging
  - ✓ Control infiltration of surface water and thus reducing leachate generation
  - ✓ Control odor and gas migration

The in-place closure cap system will support suitable post-closure passive end-use activities such as ball-fields and park.

Removal of Waste Method

- Removal of the waste mass and disposal of it off-site
- Sorting the waste for recyclable material recovery and separation of some hazardous waste
- Potential odor problems that need to be managed
- After the removal and clean-up, the land can be treated as a brownfield redevelopment site or as a passive recreation park
- In high-priced real estate district, the land and real estate end-use values can be significantly higher than costs of waste removal and disposal costs

Case Study:
ISWA-Climate and Clean Air Coalition (CCAC) Lebanon Project Gas Emission Reduction Estimation July 2019-June 2021

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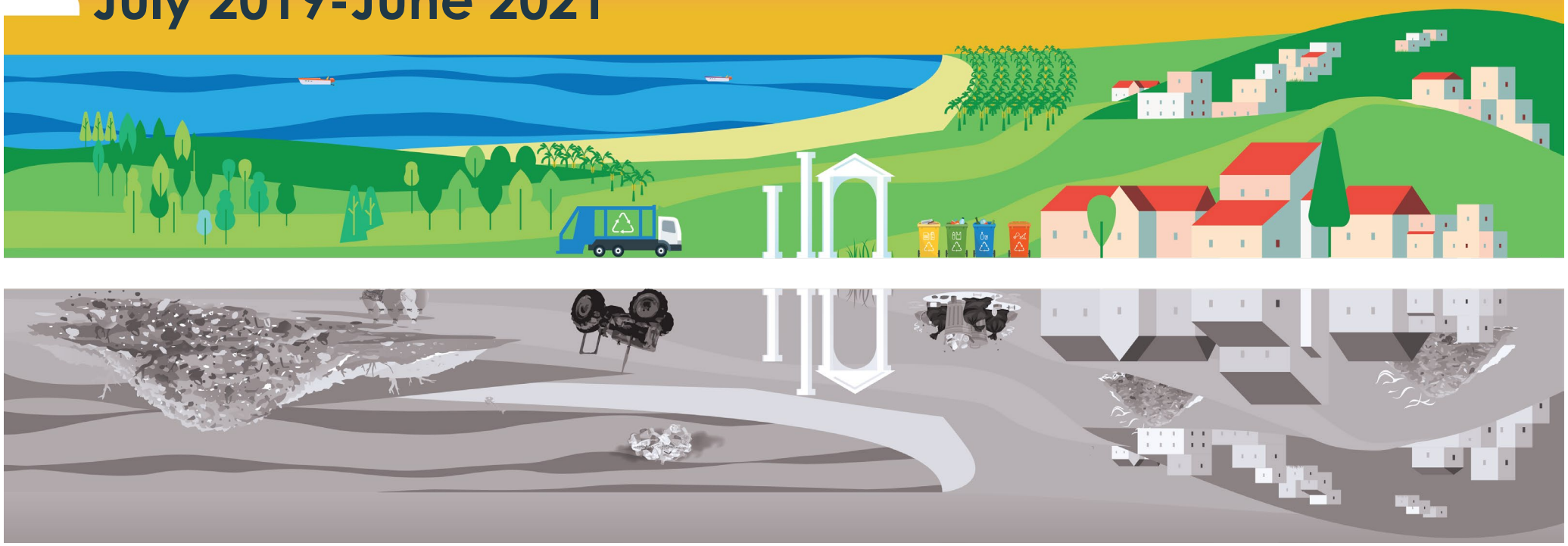


Task Force on Closing Dumpsites (2019-2022)

Overview of the 1st ISWA-CCAC Project of this kind on climate benefits of closing dumpsites:

- Use of a US-EPA modeling spreadsheet called Solid Waste Emissions Estimation Tool (SWEET) on a project in Tyre Caza, Lebanon
- Kick-off meeting took place on December 8, 2020 (online)
- A 3-day training workshop held in June 2021 (online mode)
- Final report and video deliverables - Nov 2021
- A webinar for the launch of final report - Jan 2022
- Key factors to success - Reliable site-specific data on waste composition and volume/tonnage, and a detailed integrated waste management system plan available

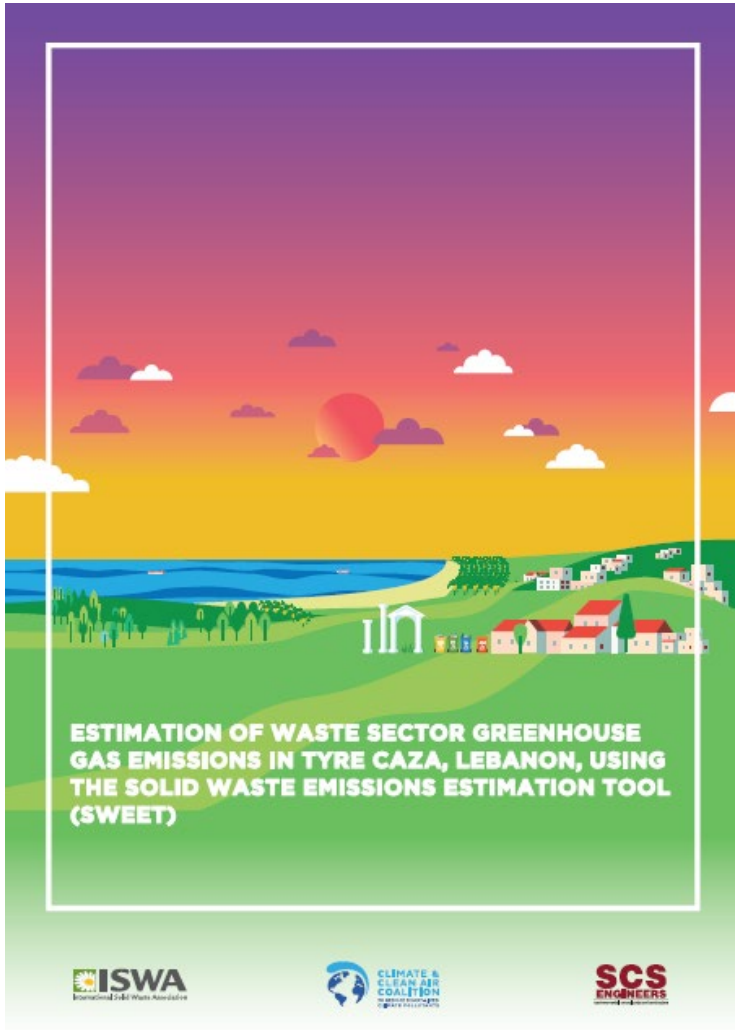
Closed Ras El-Ain Dumpsite near Tyre, Lebanon

Photo: Karim Hashash, Office of the Minister of State for Administrative Reform (OMSAR) in Lebanon

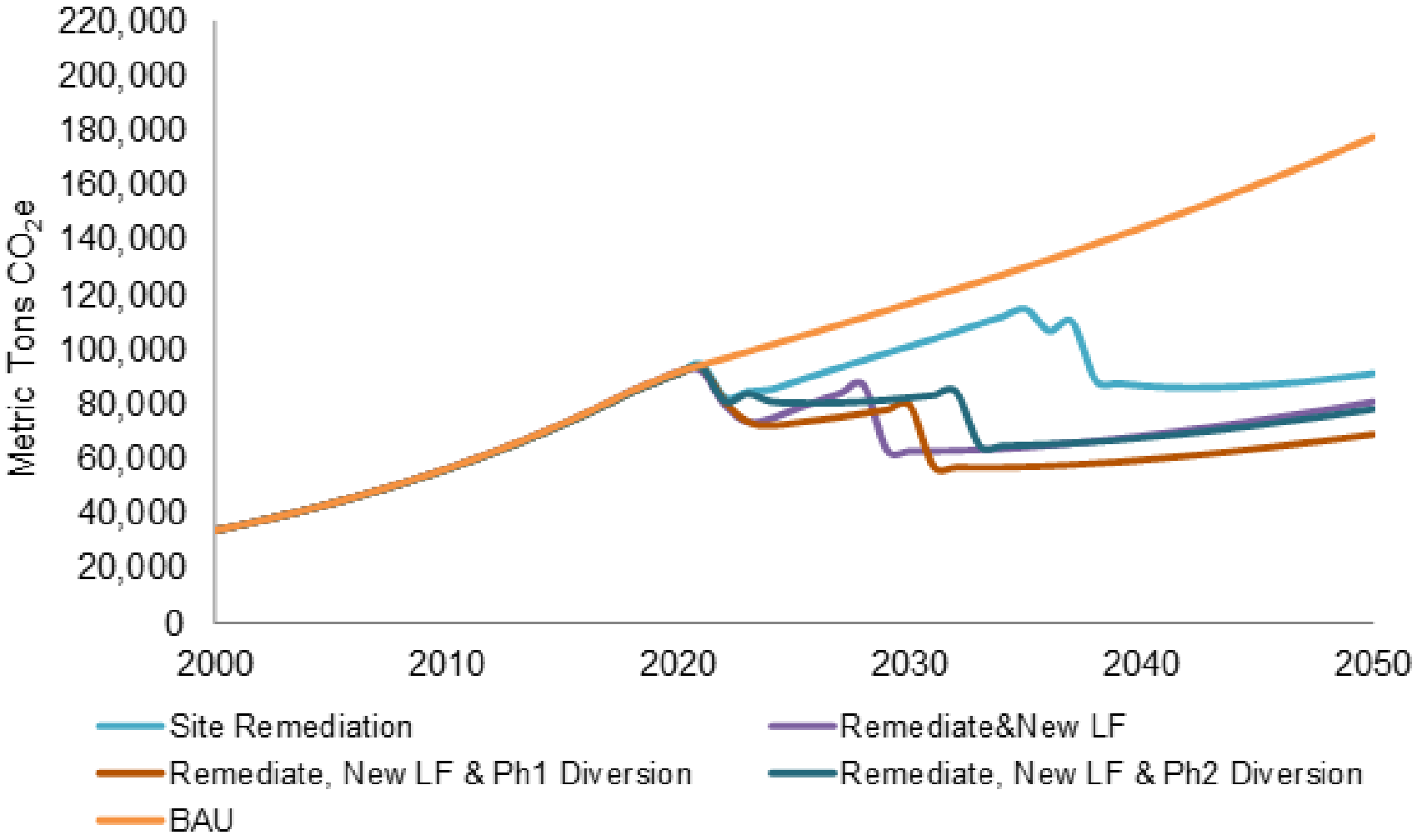
Task Force on Closing Dumpsite Project

Five Scenarios in Gas Emissions Estimation:

1. BAU: Baseline Scenario, Business as Usual
2. Alt S1: Remediate Dumpsite (2022-2025) - capping
3. Alt S2: Remediate Dumpsite and Develop new Landfill (2023)
4. Alt S3: Remediate Dumpsite, Develop new Landfill, and Implement Phase 1 Diversion to 40%, involving local government actions & policies to revise and improve current collection, recycling, & operation systems (2023-2025)
5. Alt S4: Remediate Dumpsite, Develop new Landfill, and Implement Phase 2 Diversion to 52%, involving national policies on utilization of refuse derived fuel (RDF) (2023-2025)



Total GHG and Black Carbon (SLCPs) Emissions



Total Emissions Reduction in Percent, %

(% of Baseline Scenario Emissions)

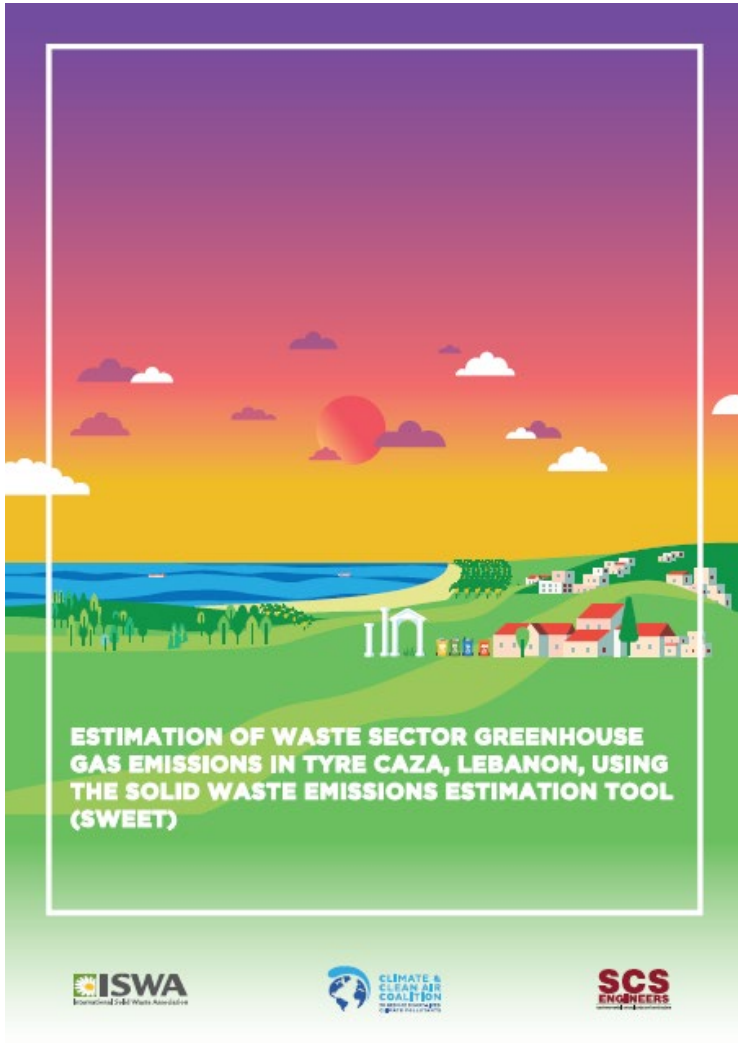
Year	Alternative Scenario 1	Alternative Scenario 2	Alternative Scenario 3	Alternative Scenario 4
2025	15%	25%	30%	22%
2030	13%	46%	32%	29%
2035	11%	51%	56%	50%
2040	40%	53%	59%	53%
2045	46%	54%	60%	55%
2050	48%	55%	61%	56%

Alt. S3 diversion scenario yields most emissions reduction, from 30% in 2025 to 61% in 2050

Climatic Benefits at Lebanon Site

In addition to a cleaner environment and better health, a large GHG emissions reduction (up to 61% by 2050) is achievable and would realize significant climate change benefits by:

- closing the dumpsite
- building a new sanitary landfill
- diverting 40% of waste for composting and recycling, and mitigating methane emissions with landfill gas collection system

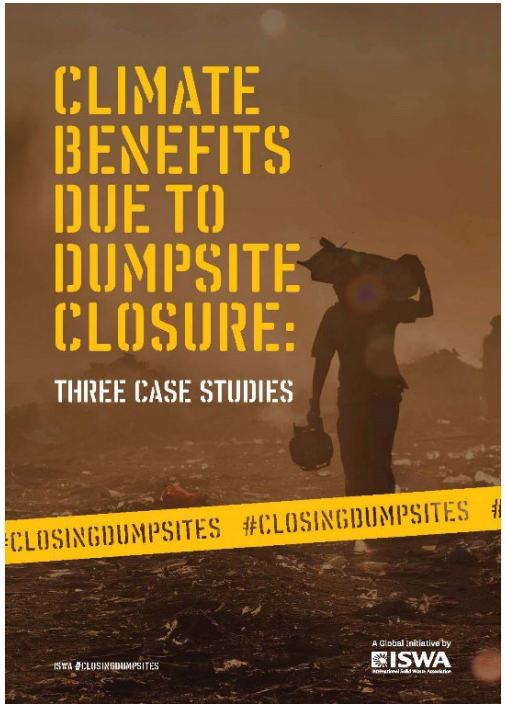


Other Case Studies

Estrutural Dump closure, Brazil – A success story by Rodrigo Rollemberg, the Governor

- Showcase successful closures of dumpsites and a strong message these cities have already saved hundreds of thousand tonnes of carbon dioxide emissions (tCO2-e)

1. Estrutural Dump closure in Brasilia, Brazil - Will have saved about 1,000,000 tCO2-e (70.6% reduction) by 2050
2. Rautenweg Landfill, Vienna, Austria - About 950,000 tCO2-e (80% reduction)
3. Hiriya LF, Tel Aviv, Israel - About 2,300,000 tCO2-e (75% reduction)



Conclusions

- Closing of dumpsites requires an alternative waste management system with adequate planning, institutional and administrative capacity, financial resources, social support, involvement of relevant stakeholders and political consensus
- The technical, financial and social elements for closing a dumpsite are proven and available
- The most advanced technical solution may not necessarily be the right solution but the simple and sustainable one would, when analyzed by the site performance and environmental impacts.

Thank You

ISWA
International Solid Waste Association

SCS ENGINEERS

Thank you!

Upcoming Webinar

Methane mitigation project phases, practical solutions, and GHG emission quantification – second virtual workshop in the Mobilizing Methane Action at Open Dumpsites and Landfills series

Registration opening soon!

Final materials will be posted to:
www.globalmethane.org

Questions?
secretariat@globalmethane.org