Climate MRV for Africa – Phase 2
MRV of Mitigation Actions
Landfill Gas Capture and Flaring/ Utilization Case Study

Lead partner

Project of the European Commission DG Clima Action

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Amr Osama Abdel-Aziz, Assen Gasharov, Mike Bess and Laura Lahti
Team Leader and Key Experts
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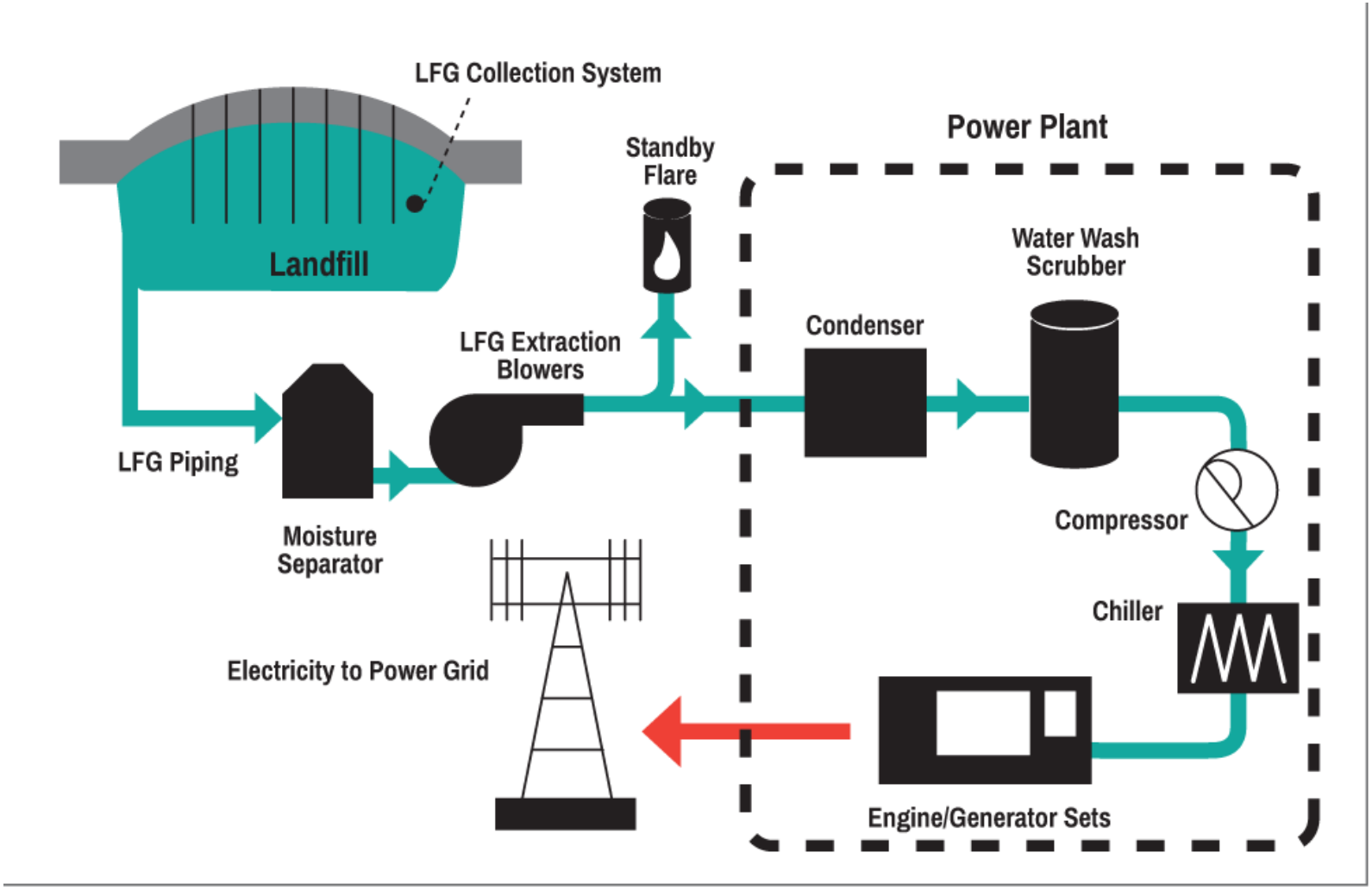
Agenda

- Define Mitigation Action
- Co-Benefits of Mitigation Action
- Define the GHG Assessment Boundary
- Baseline Emissions
- Mitigation Action Emissions
- Monitoring Performance over Time

Define Mitigation Action



Define Policy/Action

Information	Example
The title of the policy/action	Required landfill gas collection and control
Type of policy or action	Regulations requiring the installation of LFG capturing and flaring or utilization for electricity systems in new and existing SWDS
Geographical coverage	Nationwide coverage
The status of the policy or action	Proposed
Targeted GHG	CH4 and CO2
Key performance indicators	• Tons of waste landfilled • Energy (electricity) generated from energy recovery

Co-benefits of Mitigation Action

- Improved local air quality ➔ Energy from renewable source
- Reduction of fossil fuel subsidy;
- Reduced odor emissions from landfills;
- Reduced risk of explosion;
- Improved groundwater quality, ➔leachate collection which prevents contamination of groundwater;
- Creation of new job opportunities;

Define the GHG Assessment Boundary

Assess the significance of potential GHG effects

GHG effect	Likelihood	Relative magnitude	Included?
Reduced emissions from landfills (diversion to composting, AD, and energy recovery)			
CO_2	Very likely	Minor	Excluded
CH_4	Very likely	Major	**Included**
N_2O	Very likely	Minor	Excluded

List GHG to be included in Assessment Boundary

	GHG effect	GHG sources	GHG sinks	Greenhouse gases
1	Reduced emissions from landfills (diversion to composting, AD, and energy recovery)	Landfills	N/A	CH_4
4	GHG reductions from displaced fossil grid electricity	Fossil fuel combustion for Grid electricity generation	N/A	CO_2

Baseline Emissions

Baseline Scenario
Landfill gas from the landfill site is released to the atmosphere

Baseline Emissions

$$BE_y = BE_{CH4,y} + BE_{EC,y}$$

Where:

$BE_{CH4,y}$: Baseline emissions from the SWDS in year *y* (t CO2e/yr)

BE_{Elec} : Baseline emissions from displaced electricity in year y (t CO2e/yr)

Source	GHG
Emissions from decomposition of waste at the SWDS site	CH4
Emissions from electricity displaced by mitigation action in the baseline	CO2

Baseline Emissions from SWDS – Ex-Post

$$BE_{CH4,y} = (1-OX_{top\_layer})* F_{CH4,PJ,y} * GWP_{CH4}$$

Parameter	Definition
$BE_{CH4,y}$	Baseline emissions of methane from the SWDS in year y (t CO2e/yr)
OX_{top_layer}	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH4,PJ,y}$	Amount of methane in the LFG which is flared and/or utilized for energy (electricity) in the project activity in year y (t CH4/yr)
GWP_{CH4}	Global warming potential of CH4 (t CO2e/t CH4)

Baseline Emissions from SWDS – Ex-Ante

$$F_{CH4,PJ,y} = \eta_{PJ} \cdot BE_{CH4,SWDS,y}$$

Where:

Parameter	Definition
$BE_{CH4,SWDS,y}$	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (t CH4/yr)
η_{PJ}	Efficiency of the LFG capture system that will be installed in the project activity

$$BE_{CH4,SWDS,y} = f.(1-f).(1-OX).\ 16/12.\ F.DOC_f.MCF.$$
$$\sum_{x=1}^{y} \sum_{j} W_{j,x}.DOC_j.e^{-k_j(y-x)}.(1-e^{-k_j})$$

Baseline Emissions from SWDS – Ex-Ante

Parameter	Definition	Value (Specific to Egypt)
F	Fraction of methane in LFG	0.527
DOC_f	Fraction of degradable organic carbon that decomposes under the specific conditions occurring in the SWDS	0.517
OX	Oxidation factor	0.1
K	Methane generation rate	IPCC default values for wet conditions
MCF	Methane Correction Factor	Between 0.4 - 1
f	Fraction of methane captured at the SWDS and flared	0
W	Amount of solid waste type disposed in SWDS	Waste in tons
Φ	Default value for Model Correction factor to account for model uncertainties	0.75 for wet conditions
GWP	Methane Global Warming Potential	25

Baseline Emissions from Electricity – Ex-Post

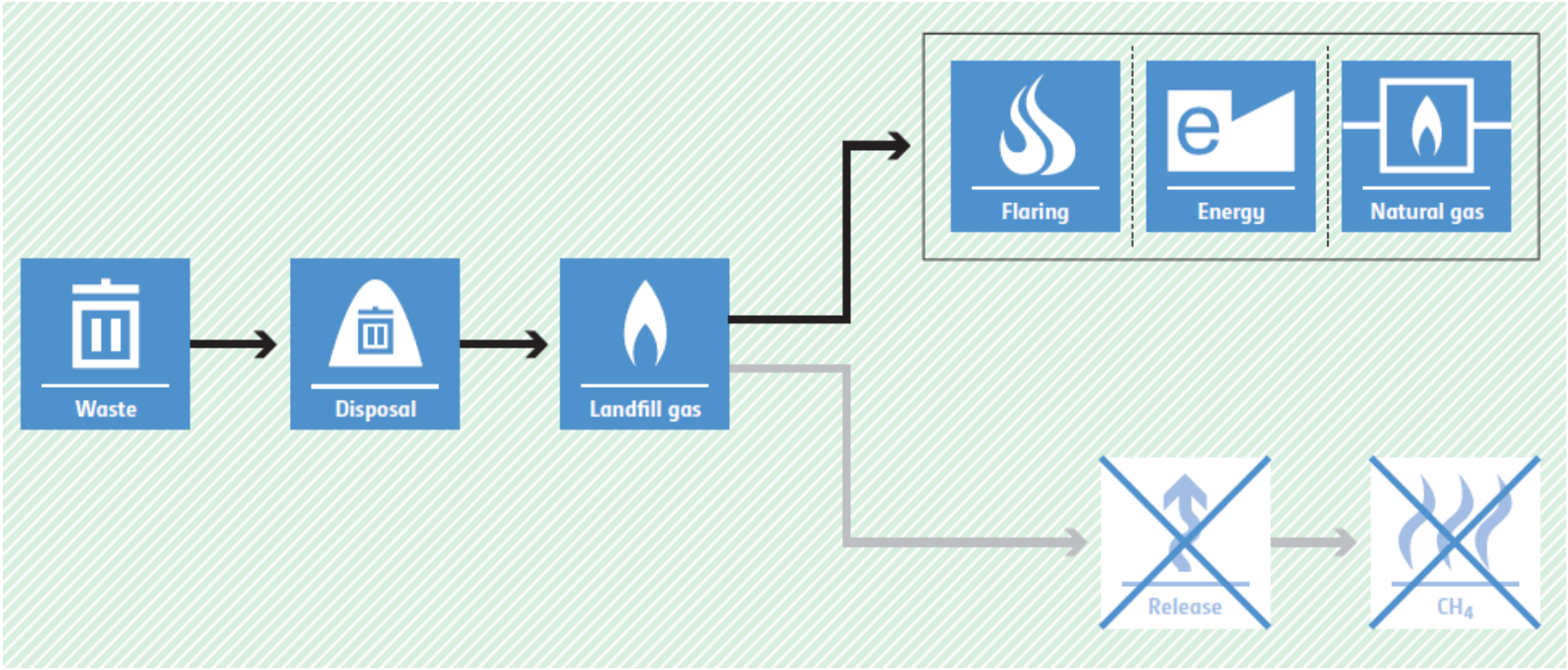
$$BE_{EC,y} = EC_{BL} * EF_{EL} * (1 + TDL)$$

Parameter	Definition
$BE_{EC,y}$	Baseline emissions associated with electricity generation in year y (t CO2e/yr)
EC_{BL}	Quantity of electricity generated by the landfill gas in year y (MWh/yr)
EF_{EL}	Egypt's National Grid Emission factor for electricity generation (0.399 t CO2/MWh)
TDL	Average technical transmission and distribution losses for providing electricity to source (20% Default value)

Mitigation Action Emissions

Mitigation Action Scenario

LFG from the landfill site is captured and flared; and/or used to produce energy (electricity)



Source: CDM Methodology Booklet , Eighth Edition, November 2016

Mitigation Action Emissions

$$PEy = PEEC,y + PEFC,y + PEflare,y$$

Source	GHG
PEECy: Emissions from electricity consumption due to the project activity	CO2
PEFCy: Emissions from fossil fuel consumption in the project activity (If any)	CO2
PEflare,y: Emissions from flaring	CH4

Mitigation Action Emissions

$$PE_{EC,y} = EC_{PJ,y} * EF_{grid,y} * (1+ TDL_y)$$

Parameter	Definition	Value (Specific to Egypt)
EC	Quantity of electricity consumed during the project activity	MWh
EF	Egypt's National Grid Emission factor	0.399 t CO2/MWh
TDL	Average technical transmission and distribution losses for providing electricity to source	20% (Default value)

Mitigation Action Emissions

$$PE_{FC,j} = FC_{i,j} * COEF_i$$

Parameter	Definition	Unit
$FC_{i,j}$	the quantity of fuel type i combusted in process j during the year y	mass or volume unit / yr
$COEF_i$	CO2 emission coefficient of fuel type i in year y	tCO2 / mass or volume unit

Mitigation Action Emissions

$$PE_{Flare,y} = F_{CH4,F}.(1-\eta_{flare,}).10^{-3}$$

Parameter	Definition	Unit
$F_{CH4,F}$	Amount of methane in the LFG which is flared in the project activity in year y	(t CH4/yr)
$\eta_{flare,}$	Flare efficiency	80% (Default value)

GHG Emission Reductions

$$ER_y = BE_y - PE_y$$

Monitoring Over Time

- Following parameters for each landfill during the Mitigation Action lifetime for accurate estimation of GHG emission reductions

Parameter
Amount of waste disposed in the landfill
Volumetric flow of **LFG sent to the flare** on a dry basis
Volumetric flow of LFG **used for electricity generation** on a dry basis
Percent methane in the LFG which is flared and/or utilized for energy (electricity)
Amount of **electricity generated using LFG** by the project activity
Update the **electricity grid emission factor** (t CO2/MWh) of Egypt on a regular basis
Flare Efficiency
Amount of **Electricity used by flaring equipment**
Amount of Fossil fuel used by flaring equipment (if any)

Monitoring Over Time

- Using Defaults

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Flare Efficiency
Amount of **Electricity used by flaring equipment**
Amount of Fossil fuel used by flaring equipment (if any)

Monitoring Over Time

Simplified Option

- Develop and implied emission factor from sample landfills (tCO2e /t waste)
- Apply implied EF only to amount of waste to other landfills assuming that waste composition and other variables are similar in Egypt

Thank you!

Amr Osama Abdel-Aziz, Assen Gasharov, Mike Bess and Laura Lahti