



# The CDM Solution for Municipal Solid Waste Management in Ranong, Thailand



Rayong CDM Seminar 07/07/2008



# **Presentation Outline**

- 1. Methane Gas sequestration in new Ranong landfill**
- 2. Process of CDM Project Development**



## **Background information: new Ranong landfill status**

- The construction of the new Ranong landfill is supported by the EC through the GAIN-IN-SafTI project (ref GAIN-IN-SafTI TH/Asia Pro Eco II –Post Tsunami/09 (120642)) and it is on the study and planning phase. The EC support will end in July 2009. At that time, the first landfill lot is expected to be in operation.
- Thai project local partners, Ranong Provincial Administration Organization and Municipality of Ranong, are on the process to buy the land and to issue the necessary authorizations to proceed with the field work.
- The CDM project is under study. It will greatly support the financial sustainability of WMs in Ranong and contribute to the global reduction of GHG.

# ***1. Methane gas sequestration in the new Ranong landfill***



Potential CDM Project

Location: Bang Non Lao, Ranong  
Province, Thailand



# Project Objectives

- Avoidance of present and future methane emission from new Ranong landfill;
  - 1. To further support the construction of Ranong sanitary landfill
  - 2. Methane gas capture and flaring (generation of electricity??)
- Closing the most dangerous old open dumping sites, protecting the local environment and preventing health impacts on the local community



# Additional Objectives

- Provision of an appropriate and sustainable solution to solid waste management problems through the implementation a new landfill management system,
- Improved solid waste collection service and disposal,
- Reduction of environmental, social and health impacts of solid waste disposal,

# Project Location

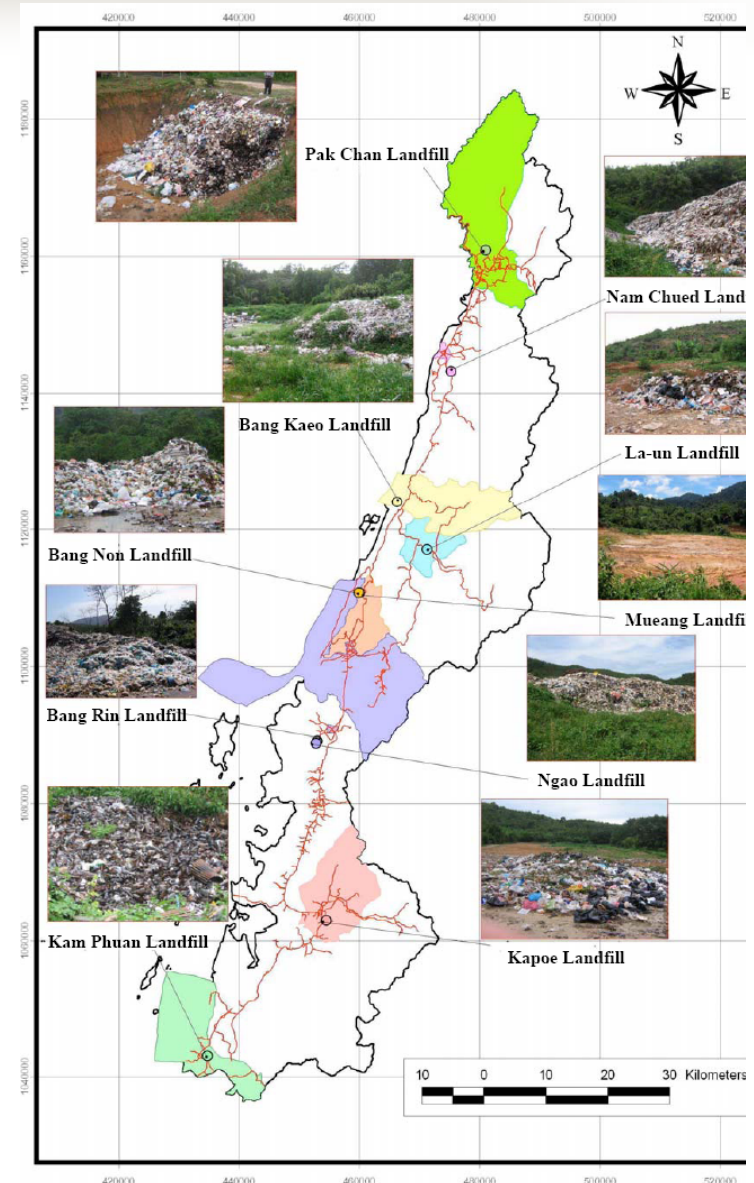


Figure 3-6 Location map of landfills in Ranong Province



# **Baseline data: population and waste**

- All the data on population do not refer to the illegal people living in Ranong whom represents a considerable share of the population.
- There is no systematic waste management structure and therefore data collection in Ranong.
- All the data concerning this structure (collection, transportation and disposal) have been obtained by personal interviews and observations during the field investigations occurred within the GAIN-IN-SafTI project frame.

# Population and waste

District	Population	Waste Collected (Ton/day)	Waste production Ton/day (avarage 1 person=1Kg/day)	Collection efficinecy
Muang Ranong	91.390,00	64,60	91,39	71%
La-un	12.695,00	5,00	12,70	39%
Kraburi	44.951,00	5,43	44,95	12%
Kapoe	19.422,00	6,50	19,42	33%
Suk Samran	11.392,00	1,00	11,39	9%
<b>Total</b>	<b>179.850,00</b>	<b>82,53</b>	<b>179,85</b>	<b>46%</b>

# Baseline data: Ranong new landfill characteristics

- Area 22 Rais = 35.200m<sup>2</sup> (=approx. 3.5 Hectares)
- To be opened by: Nov- Dec 2008
- Capacity approx. : 137 ton/day, 330 days/year, for 12 years  
ton, capacity approx. 900.000 m<sup>3</sup>



Figure 3-15 Mueang (Bang Non) landfill at Mu 1, Ban Bang Non Nai, Mueang district (20.16 rai)



# **Scenario 1: New Ranong landfill biogas potential generation (at landfill max capacity)**

- **Quantity of waste disposed in the landfill: 137 ton/day**
- CDM project life time: **7+7 years**
- LFG theoretically generated during CDM project: **approx. 83.440.000 m<sup>3</sup>**;
- LFG theoretically sequestered during CDM project : **approx. 41.700.000 m<sup>3</sup>**
- tCO<sub>2</sub>eq. theoretically sequestered during CDM period: **377.631**
- tCO<sub>2</sub>eq. reduction per year in average during CDM period: **26.973**



# Continue

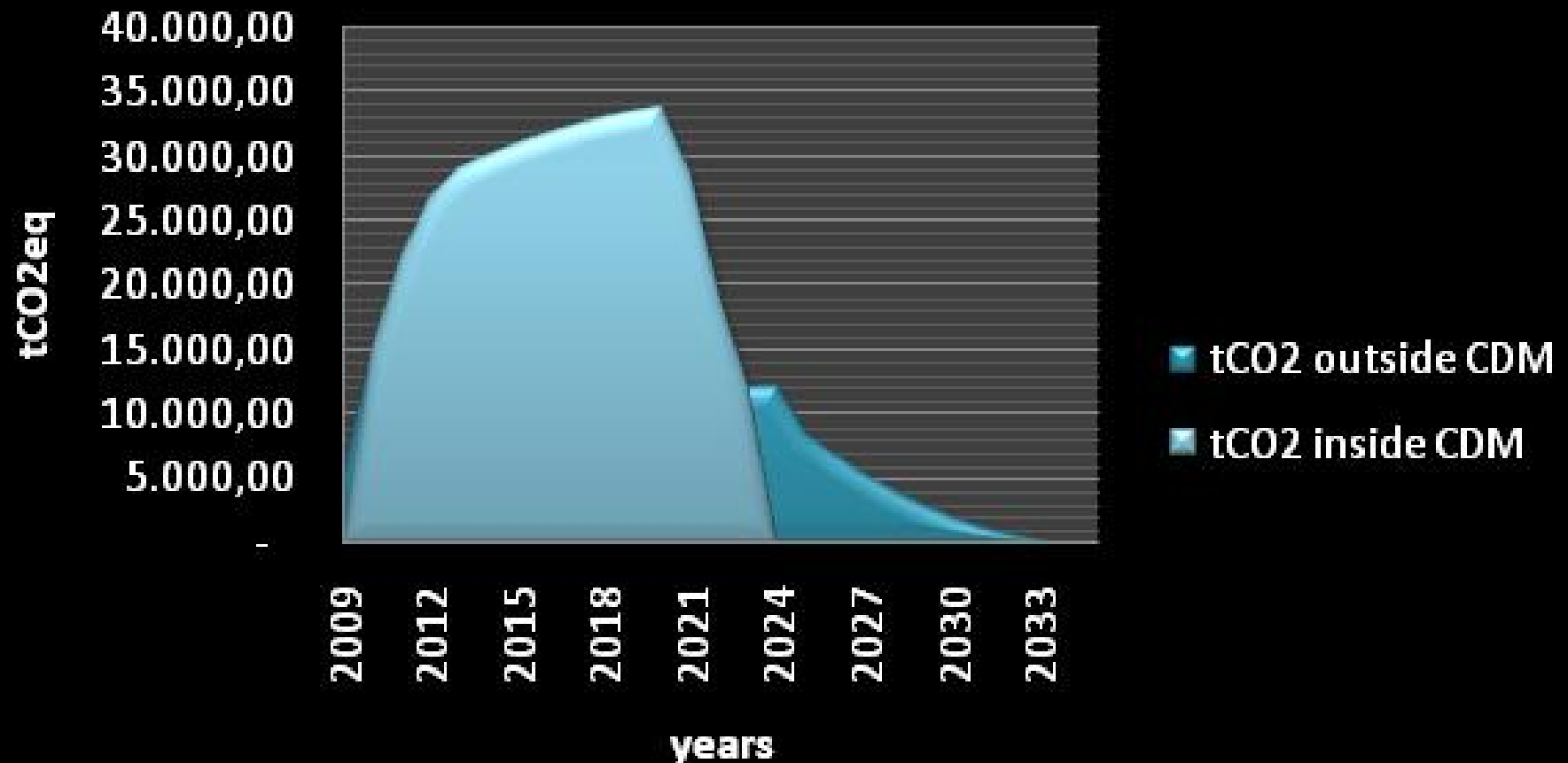
- Potential gross proceeds: approx. 269.730 euro/year on average for 14 years (1 tCO<sub>2</sub> eq = 10 euro).
- Total potential gross proceeds: approx. 3.776.220 euro


# More data and graphics

Year	Landfill capacity	Biogas theoretically generated	Biogas theoretically captable	CH4 m3	CO2 m3	CO2eq tot	CO2eq Ton/year on average
	Ton/year	(Nm <sup>3</sup> )	(Nm <sup>3</sup> )	55% in LFG	44% in LFG	Ton	
2009	45.210,00	0	0			-	
2010	45.210,00	1.189.687,88	594.843,94	327.164,17	261.731,33	5.091,46	
2011	45.210,00	3.300.407,13	1.650.203,56	973.620,10	660.081,43	14.936,45	
2012	45.210,00	4.873.813,37	2.436.906,68	1.437.774,94	974.762,67	22.057,12	
2013	45.210,00	5.909.906,60	2.954.953,30	1.743.422,45	1.181.981,32	26.746,11	
2014	45.210,00	6.408.686,83	3.204.343,41	1.890.562,61	1.281.737,37	29.003,41	
2015	45.210,00	6.627.304,36	3.313.652,18	1.955.054,79	1.325.460,87	29.992,79	
2016	45.210,00	6.822.909,53	3.411.454,76	2.012.758,31	1.364.581,91	30.878,03	
2017	45.210,00	6.995.502,32	3.497.751,16	2.063.673,18	1.399.100,46	31.659,13	
2018	45.210,00	7.145.082,74	3.572.541,37	2.107.799,41	1.429.016,55	32.336,07	
2019	45.210,00	7.271.650,79	3.635.825,39	2.145.136,98	1.454.330,16	32.908,87	
2020	45.210,00	7.375.206,46	3.687.603,23	2.175.685,91	1.475.041,29	33.377,53	
2021		7.455.749,76	3.727.874,88	2.199.446,18	1.491.149,95	33.742,04	
2022		6.323.592,82	3.161.796,41	1.865.459,88	1.264.718,56	28.618,30	
2023		4.247.392,13	2.123.696,06	1.252.980,68	849.478,43	19.222,17	
2024		2.685.492,07	1.342.746,04	792.220,16	537.098,41	12.153,57	
2025		1.649.398,84	824.699,42	486.572,66	329.879,77	12.236,23	
2026		1.150.618,61	575.309,31	339.432,49	230.123,72	8.535,98	
2027		932.001,08	466.000,54	274.940,32	186.400,22	6.914,14	
2028		736.395,91	368.197,96	217.236,79	147.279,18	5.463,03	
2029		563.803,12	281.901,56	166.321,92	112.760,62	4.182,63	
2030		414.222,70	207.111,35	122.195,70	82.844,54	3.072,95	
2031		287.654,65	143.827,33	84.858,12	57.530,93	2.133,99	
2032		184.098,98	92.049,49	54.309,20	36.819,80	1.365,76	
2033		103.555,68	51.777,84	30.548,92	20.711,14	768,24	
2034		46.024,74	23.012,37	13.577,30	9.204,95	341,44	
2035		11.506,19	5.753,09	3.394,32	2.301,24	85,36	
2036		-	-	-	-	-	
<b>TOTAL CDM Period</b>	542.520,00	83.442.696,89	41.721.348,45			377.631,61	26.973,69

## More data and graphics

### tCO<sub>2</sub>eq at landfill maximum capacity





# **Scenario 2: new Ranong landfill biogas potential generation (at Muang Ranong current capacity)**

- **Quantity of waste disposed in the landfill: 64,60 ton/day**
- CDM project life time: **7+7+7 years**
- LFG theoretically generated during CDM project: **approx. 68.712.000 m<sup>3</sup>**;
- LFG theoretically sequestered during CDM project : **approx. 34.356.000 m<sup>3</sup>**
- tCO<sub>2</sub>eq. theoretically sequestered during CDM period: **approx. 266.659**
- tCO<sub>2</sub>eq. reduction per year in average during CDM period: **approx. 12.698**



## Continue 2.

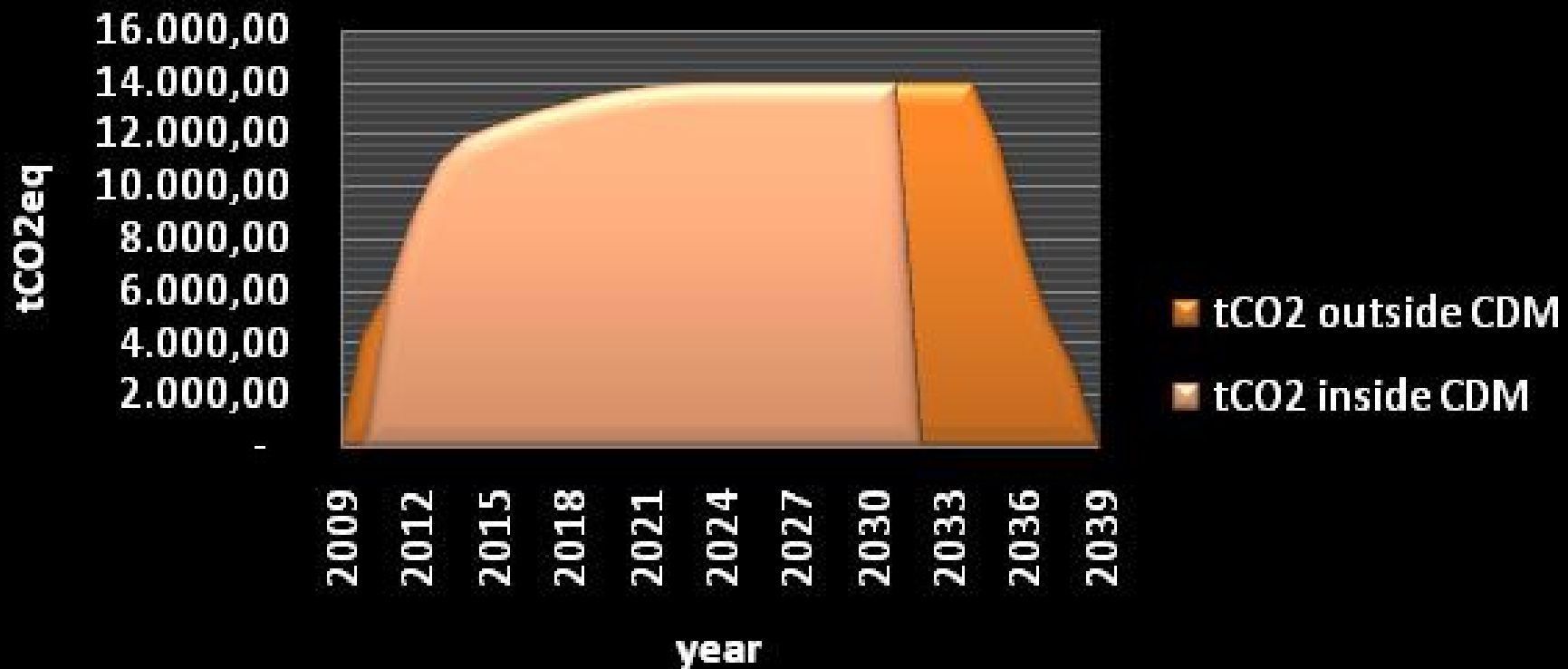
- Potential gross proceeds: approx. 126.980 euro/year on average for 21 years (1 tCO<sub>2</sub> eq = 10 euro).
- Total potential proceeds: approx 2.666.580 euro.

# More data and graphics

Year	Landfill capacity	Biogas theoretically generated	Biogas theoretically captable	CH4 m3	CO2 m3	CO2eq	CO2eq Ton/year on average
	Ton/year	(Nm <sup>3</sup> )	(Nm <sup>3</sup> )	55% LFG	44% LFG	Ton	
2009	21.318	0	0			-	
2010	21.318	560.977	280.488	154.269	123.415	4.354,08	
2011	21.318	1.556.250	778.125	427.969	342.375	6.039,50	
2012	21.318	2.298.163	1.149.082	631.995	505.596	8.918,71	
2013	21.318	2.786.715	1.393.358	766.347	613.077	10.814,68	
2014	21.318	3.021.906	1.510.953	831.024	664.819	11.727,41	
2015	21.318	3.124.992	1.562.496	859.373	687.498	12.127,47	
2016	21.318	3.217.226	1.608.613	884.737	707.790	12.485,41	
2017	21.318	3.298.609	1.649.305	907.118	725.694	12.801,24	
2018	21.318	3.369.141	1.684.571	926.514	741.211	13.074,96	
2019	21.318	3.428.822	1.714.411	942.926	754.341	13.306,57	
2020	21.318	3.477.652	1.738.826	956.354	765.083	13.496,07	
2021	21.318	3.515.631	1.757.815	966.799	773.439	13.643,46	
2022	21.318	3.542.759	1.771.379	974.259	779.407	13.748,74	
2023	21.318	3.559.035	1.779.518	978.735	782.988	13.811,90	
2024	21.318	3.564.461	1.782.230	980.227	784.181	13.832,96	
2025	21.318	3.564.461	1.782.230	980.227	784.181	13.832,96	
2026	21.318	3.564.461	1.782.230	980.227	784.181	13.832,96	
2027	21.318	3.564.461	1.782.230	980.227	784.181	13.832,96	
2028	21.318	3.564.461	1.782.230	980.227	784.181	13.832,96	
2029	21.318	3.564.461	1.782.230	980.227	784.181	13.832,96	
2030	21.318	3.564.461	1.782.230	980.227	784.181	13.832,96	
2031	21.318	3.564.461	1.782.230	980.227	784.181	13.832,96	
2032	21.318	3.564.461	1.782.230	980.227	784.181	13.832,96	
2033	21.318	3.564.461	1.782.230	980.227	784.181	13.832,96	
2034		3.564.461	1.782.230	980.227	784.181	13.832,96	
2035		3.003.484	1.501.742	825.958	660.766	11.655,92	
2036		2.008.210	1.004.105	552.258	441.806	7.793,46	
2037		1.266.298	633.149	348.232	278.585	4.914,25	
2038		777.746	388.873	213.880	171.104	3.018,28	
2039		0	0	0	0	-	
<b>TOTAL CDM Period</b>	532.950,00	68.712.588,46	34.356.294,23			266.659,81	12.698,09

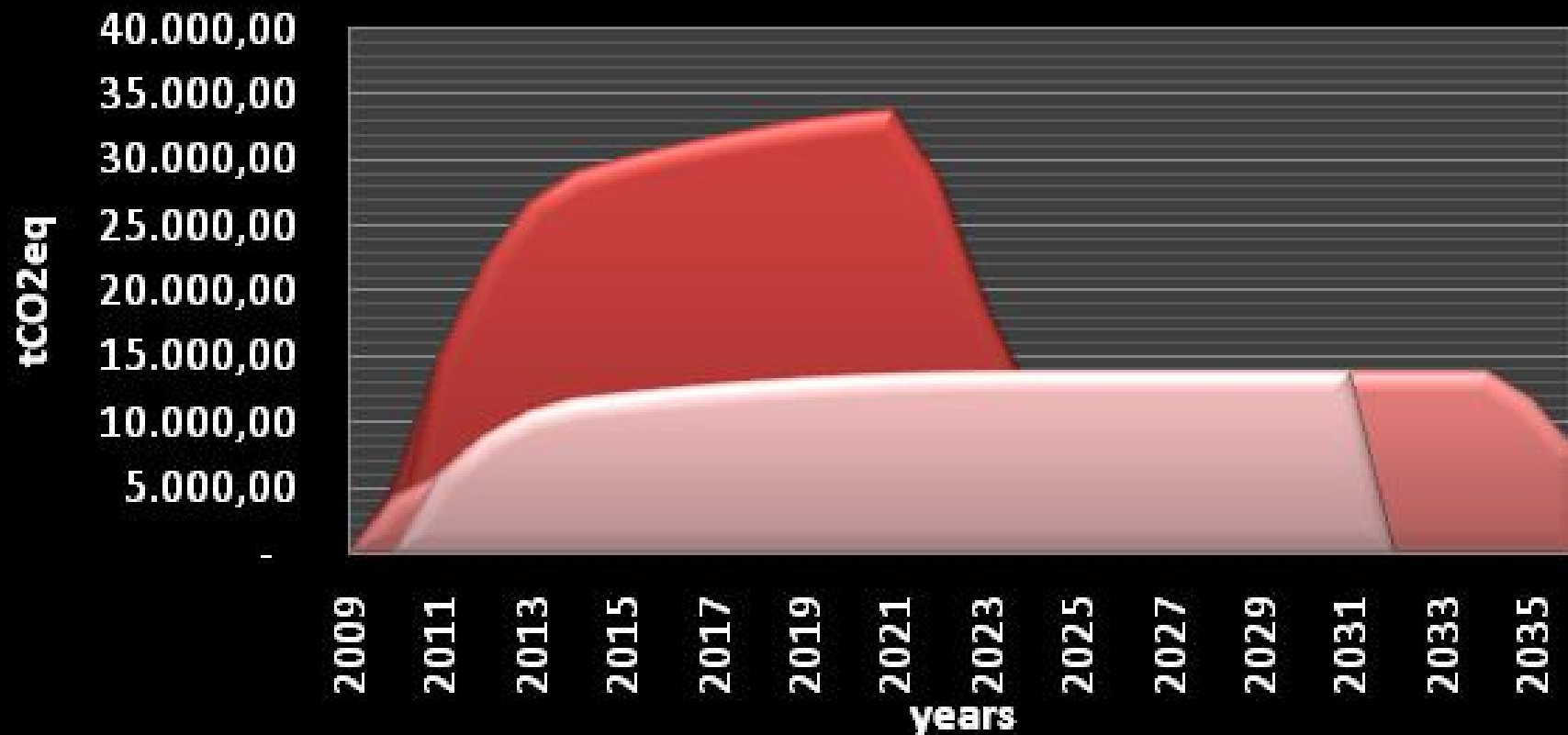
# More data and graphics

## tCO<sub>2</sub>eq at Muang Ranong current waste collection capacity



# More data and graphics

## tCO2eq compared



# Estimated initial Investments for LFG captation and flaring

	Total cost for GAIN-IN-SafTI (First landfill lot) Euro	Total cost Landfill (average 12-21 years)	Total cost after EC Founding (average 12-21 years)	Total cost Landfill/year (12 years)	Total cost after EC Founding/year (12 years)	Total cost Landfill/year (21 years)
<b>Flaring facility</b>						
LFG aspiration and flaring equipment	60.000,00	120.000,00	60.000,00	10.000,00	5.000,00	5.714,29
Spare parts	-	-	-	-	-	-
Shipping from EU to thailand (1X40ft)	20.000,00	30.000,00	10.000,00	2.500,00	833,33	1.428,57
Local transportation (included 1.03)	-	-	-	-	-	-
Import and other taxes and charges (50% of the equipment costs)	-	-	-	-	-	-
Installation and commissioning	10.000,00	20.000,00	10.000,00	1.666,67	833,33	952,38
Maintenance agreement	10.000,00	140.000,00	130.000,00	11.666,67	10.833,33	6.666,67
Insurance (2.5% of Equipment costs) (included 1.03)	-	-	-	-	-	-
<b>Sub-TOTAL 1.</b>	<b>100.000,00</b>	<b>310.000,00</b>	<b>210.000,00</b>	<b>25.833,33</b>	<b>17.500,00</b>	<b>14.761,90</b>
	-	-	-	-	-	-
<b>Emission monitoring</b>	-	-	-	-	-	-
Monitoring equipment (equipment installation, monitoring)	7.000,00	7.000,00	-	583,33	-	333,33
External Monitoring, reporting,	-	350.000,00	350.000,00	23.333,00	23.333,00	20.000,00
<b>Sub-TOTAL 2.</b>	<b>7.000,00</b>	<b>357.000,00</b>	<b>350.000,00</b>	<b>23.916,33</b>	<b>23.333,00</b>	<b>20.333,33</b>
	-	-	-	-	-	-
<b>Landfill Gas Extraction Civil works and equipments</b>	-	-	-	-	-	-
Gas well filed (including drilling and material) 16 wells/ha X 2 ha)	-	-	-	-	-	-
drill hole	18.000,00	126.000,00	108.000,00	10.500,00	9.000,00	6.000,00
drainage for filling the hole drilled	172,98	1.210,83	1.037,85	100,90	86,49	57,66
concrete bed and concrete well	2.200,00	15.400,00	13.200,00	1.283,33	1.100,00	733,33
pipe HDPE for biogas captation	-	-	-	-	-	-
well head (7)	400,00	2.800,00	2.400,00	233,33	200,00	133,33
Pipe from well head to flaring facility	-	-	-	-	-	-
Collect station for differnt pipes comming from different wells (3)	1.870,00	5.610,00	3.740,00	467,50	311,67	267,14
<b>Sub-TOTAL 3.</b>	<b>22.642,98</b>	<b>151.020,83</b>	<b>128.377,85</b>	<b>12.585,07</b>	<b>10.698,15</b>	<b>7.191,47</b>

# Estimated initial investments for landfill

	Total cost for GAIN-IN-SaftI (First landfill lot) Euro	Total cost Landfill (average 12-21 years)	Total cost after EC Founding (average 12-21 years)	Total cost Landfill/year (12 years)	Total cost after EC Founding/year (12 years)	Total cost Landfill/year (21 years)	Total cost after EC Founding/year (21 years)
yearly operation for landfill construction							
Road connection							
external road		14.850,00	14.850,00	1.237,50	1.237,50	707,14	707,14
internal road	5.500,00	21.807,50	16.307,50	1.817,29	1.358,96	1.038,45	776,55
Sub total 4.01	5.500,00	36.657,50	31.157,50	3.054,79	2.596,46	1.745,60	1.483,69
Landfill setting and waterproofing							
bottom setting and waterproofing	23.370,91	155.641,78	132.270,87	12.970,15	11.022,57	7.411,51	6.298,61
banks construction and water proofing	15.213,33	142.382,22	127.168,89	11.865,19	10.597,41	6.780,11	6.055,66
white water collection							
Sub total 4.02	38.584,24	298.024,00	259.439,76	24.835,33	21.619,98	14.191,62	12.354,27
service area							
service area setting	14.850,00	14.850,00	-	1.237,50	-	707,14	-
boxes	147,19	147,19	-	12,27	-	7,01	-
tanks	5.242,58	5.242,58	-	436,88	-	249,65	-
office	9.770,91	9.770,91	-	814,24	-	465,28	-
Sub total 4.03	30.010,68	30.010,68	-	2.500,89	-	1.429,08	-
Infrastructures							
Electricity provision	16.454,67	16.454,67	-	1.371,22	-	783,56	-
Fire prevention		-	-	-	-	-	-
Subtotal 4.04	16.454,67	16.454,67	-	1.371,22	-	783,56	-
Landfill closing							
Surface proofing	22.106,67	138.746,67	116.640,00	11.562,22	9.720,00	6.606,98	5.554,29
Final covering	10.900,00	76.300,00	65.400,00	6.358,33	5.450,00	3.633,33	3.114,29
Subtotal 4.05	33.006,67	215.046,67	182.040,00	17.920,56	15.170,00	10.240,32	8.668,57
Landfill equipment							
Pumps	10.836,00	10.836,00	-	903,00	-	516,00	-
Machinaries							
External Consulting		927.500,00	927.500,00	75.000,00	75.000,00	65.000,00	65.000,00
Sub-Total 4.06	10.836,00	938.336,00	927.500,00	75.903,00	75.000,00	65.516,00	65.000,00
Subtotal 4	134.392,25	1.534.529,51	1.400.137,26	125.585,79	114.386,44	93.906,17	87.506,54

# TOTAL estimated initial investments

	Total cost for GAIN-IN-SafTI (First landfill lot) Euro	Total cost Landfill (average 12-21 years)	Total cost after EC Founding (average 12-21 years)	Total cost Landfill/year (12 years)	Total cost after EC Founding/year (12 years)	Total cost Landfill/year (21 years)	Total cost after EC Founding/year (21 years)
<b>Flaring facility</b>							
LFG aspiration and flaring equipment	60.000,00	120.000,00	60.000,00	10.000,00	5.000,00	5.714,29	2.857,14
Spare parts	-	-	-	-	-	-	-
Shipping from EU to thailand (1X40ft)	20.000,00	30.000,00	10.000,00	2.500,00	833,33	1.428,57	476,19
Local transportation (included 1.03)	-	-	-	-	-	-	-
Import and other taxes and charges (50% of the equipment costs)	-	-	-	-	-	-	-
Installation and commissioning	10.000,00	20.000,00	10.000,00	1.666,67	833,33	952,38	476,19
Maintenance agreement	10.000,00	140.000,00	130.000,00	11.666,67	10.833,33	6.666,67	6.190,48
Insurance (2.5% of Equipment costs) (included 1.03)	-	-	-	-	-	-	-
<b>Sub-TOTAL 1.</b>	<b>100.000,00</b>	<b>310.000,00</b>	<b>210.000,00</b>	<b>25.833,33</b>	<b>17.500,00</b>	<b>14.761,90</b>	<b>10.000,00</b>
<b>Emission monitoring</b>							
Monitoring equipment (equipment installation, monitoring)	7.000,00	7.000,00	-	583,33	-	333,33	-
External Monitoring, reporting,	-	350.000,00	350.000,00	23.333,00	23.333,00	20.000,00	20.000,00
<b>Sub-TOTAL 2.</b>	<b>7.000,00</b>	<b>357.000,00</b>	<b>350.000,00</b>	<b>23.916,33</b>	<b>23.333,00</b>	<b>20.333,33</b>	<b>20.000,00</b>
<b>Landfill Gas Extraction Civil works and equipments</b>							
Gas well filed (including drilling and material) 16 wells/ha X 2 ha)							
drill hole	18.000,00	126.000,00	108.000,00	10.500,00	9.000,00	6.000,00	5.142,86
drainage for filling the hole drilled	172,98	1.210,83	1.037,85	100,90	86,49	57,66	49,42
concrete bed and concrete well	2.200,00	15.400,00	13.200,00	1.283,33	1.100,00	733,33	628,57
pipe HDPE for biogas captation	-	-	-	-	-	-	-
well head (7)	400,00	2.800,00	2.400,00	233,33	200,00	133,33	114,29
Pipe from well head to flaring facility	-	-	-	-	-	-	-
Collect station for different pipes coming from different wells (3)	1.870,00	5.610,00	3.740,00	467,50	311,67	267,14	178,10
<b>Sub-TOTAL 3.</b>	<b>22.642,98</b>	<b>151.020,83</b>	<b>128.377,85</b>	<b>12.585,07</b>	<b>10.698,15</b>	<b>7.191,47</b>	<b>6.113,23</b>
<b>yearly operation for landfill construction</b>							
<b>Road connection</b>							
external road	-	14.850,00	14.850,00	1.237,50	1.237,50	707,14	707,14
internal road	5.500,00	21.807,50	16.307,50	1.817,29	1.358,96	1.038,45	776,55
<b>Sub total 4.01</b>	<b>5.500,00</b>	<b>36.657,50</b>	<b>31.157,50</b>	<b>3.054,79</b>	<b>2.596,46</b>	<b>1.745,60</b>	<b>1.483,69</b>
<b>Landfill setting and waterproofing</b>							
bottom setting and waterproofing	23.370,91	155.641,78	132.270,87	12.970,15	11.022,57	7.411,51	6.298,61
banks construction and water proofing	15.213,33	142.382,22	127.168,89	11.865,19	10.597,41	6.780,11	6.055,66
<b>white water collection</b>							
<b>Sub total 4.02</b>	<b>38.584,24</b>	<b>298.024,00</b>	<b>259.439,76</b>	<b>24.835,33</b>	<b>21.619,98</b>	<b>14.191,62</b>	<b>12.354,27</b>
<b>service area</b>							
service area setting	14.850,00	14.850,00	-	1.237,50	-	707,14	-
boxes	147,19	147,19	-	12,27	-	7,01	-
tanks	5.242,58	5.242,58	-	436,88	-	249,65	-
office	9.770,91	9.770,91	-	814,24	-	465,28	-
<b>Sub total 4.03</b>	<b>30.010,68</b>	<b>30.010,68</b>	<b>-</b>	<b>2.500,89</b>	<b>-</b>	<b>1.429,08</b>	<b>-</b>
<b>Infrastructures</b>							
Electricity provision	16.454,67	16.454,67	-	1.371,22	-	783,56	-
<b>Fire prevention</b>							
<b>Subtotal 4.04</b>	<b>16.454,67</b>	<b>16.454,67</b>	<b>-</b>	<b>1.371,22</b>	<b>-</b>	<b>783,56</b>	<b>-</b>
<b>Landfill closing</b>							
Surface proofing	22.106,67	138.746,67	116.640,00	11.562,22	9.720,00	6.806,98	5.554,29
Final covering	10.900,00	76.300,00	65.400,00	6.358,33	5.450,00	3.833,33	3.114,29
<b>Subtotal 4.05</b>	<b>33.006,67</b>	<b>215.046,67</b>	<b>182.040,00</b>	<b>17.920,56</b>	<b>15.170,00</b>	<b>10.240,32</b>	<b>8.668,57</b>
<b>Landfill equipment</b>							
Pumps	10.836,00	10.836,00	-	903,00	-	516,00	-
Machinaries	-	-	-	-	-	-	-
<b>External Consulting</b>							
	-	927.500,00	927.500,00	75.000,00	75.000,00	65.000,00	65.000,00
<b>Sub-Total 4.06</b>	<b>10.836,00</b>	<b>938.336,00</b>	<b>927.500,00</b>	<b>75.903,00</b>	<b>75.000,00</b>	<b>65.516,00</b>	<b>65.000,00</b>
<b>Subtotal 4</b>	<b>134.392,25</b>	<b>1.534.529,51</b>	<b>1.400.137,26</b>	<b>125.585,79</b>	<b>114.386,44</b>	<b>93.906,17</b>	<b>87.506,54</b>
<b>GRAN TOTAL</b>	<b>264.035,23</b>	<b>2.352.550,34</b>	<b>2.088.515,11</b>	<b>187.920,53</b>	<b>165.917,59</b>	<b>136.192,87</b>	<b>123.619,77</b>

# Indicative final figures

Bigas extraction and compustion	Landfill/year (12 -14 years)	<i>After EC Founding/year (12 -14 years)</i>	Total cost Landfill/year (21 years)	<i>Total cost after EC Founding/year (21 years)</i>
<b>GRAN TOTAL Costs</b>	<b>187.920,53</b>	<b>165.917,59</b>	<b>136.192,87</b>	<b>123.619,77</b>
<b>Gran Total Revenue</b>	<b>269.730,00</b>	<b>269.730,00</b>	<b>126.980,00</b>	<b>126.980,00</b>
<b>Profit/year</b>	<b>81.809,47</b>	<b>103.812,41</b>	<b>- 9.212,87</b>	<b>3.360,23</b>

# Landfill Tentative schedule

	08					09					10					11					12																	
	a	m	g	l	a	s	o	n	d	g	f	m	a	m	g	l	a	s	o	n	d	g	f	m	a	m	g	l	a	s	o	n	d	g	f	m	a	m
Final decision on land by local partner																																						
Adm procedures																																						
Field work																																						
Waste in place estimat										21318t				21318t				21318t				21318t																
Lot						1st Full										2nd Full																						
ECfounds																																						
Extension										?	?	?	?																									
ODM revenue																																						
Lot with EC founds																																						
Lot with CF or other found																																						

## **2. Process of CDM Project Development for Local Governments: general view**





# Relevant issues of CDM

- The CDM mechanism of Kyoto Protocol is a **COMMERCIAL** approach to combat global Climate Change and assist in improving local environmental impacts.
- CDM projects generate a tradable commodity, Certified Emissions Reductions (CER's).
- Without strict monitoring and verification CDM projects will not produce CER's

# Typical CDM Project Cycle

