Landfill ER Revenues versus Landfill Costs

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Determining landfill cost recovery with ER revenues involves 3 steps:

- Estimating the range of common landfill costs.*
- Estimating the range of possible ER revenues.*
- Comparing total ER revenues to total landfill costs (both over a 21 year life).

All estimates by S. Cointreau, and do not represent official World Bank analyses. ER revenue estimates use the current World Bank model and factors recommended by the Carbon Finance Unit of the Bank.

Sanitary landfill costs are not the major part of total solid waste costs

- Sanitary Landfill ~ 5-20 $/tonne
- Collection ~ 20-80 $/tonne.
- Street sweeping ~ may add 10-40% to collection costs.
- Formal source segregated recycling ~ may add 30-100% to collection costs if door-to-door using separate vehicles.
- Transfer ~ 5-12 $/tonne, if needed, depending on truck sizes, traffic speeds, and hauling times
- Composting ~ 15-50 $/tonne
- Incineration to EU/US stds. ~ 150-200 $/tonne

Many factors influence landfill costs

- Waste quantity, affects economies-of-scale.
- Gently sloping base, reduces base and drainage costs.
- Valley within hills, affects depth potential.
- Topography, defines depth potential.
- Weather, affects leachate potential.
- Soil availability, affects cost of daily cover.
- Receiving water, affects leachate treatment.
- Length of new access road, a major investment.

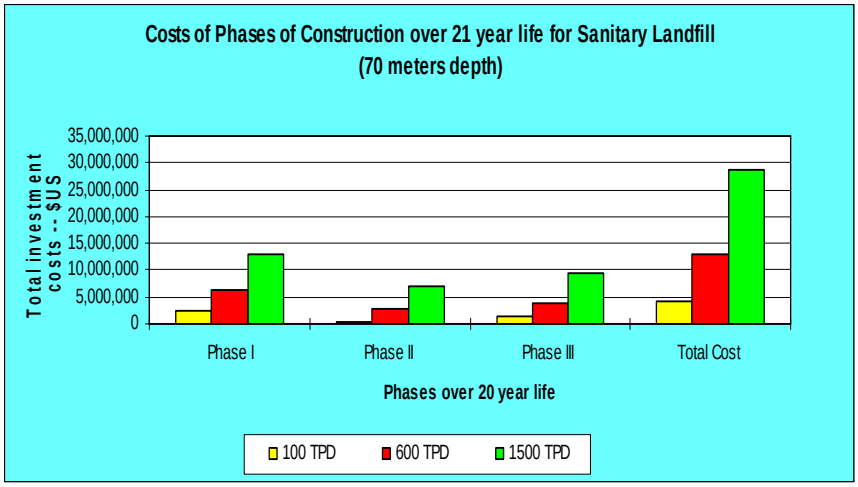
Common ranges of landfill cost

- Landfill costs in developing countries are not very different from those in high-income countries, as they are not labor intensive.
- 5 to 20 $US/tonne for lined modern SLF, at a good site, depending on size and depth. (Note: land prices not included)
- Level of lining and leachate management needed can affect costs by 20-30%.
- Poor site selection can drive up costs by a factor of 2 or more.
- Long access roads to a remote site can be costly.

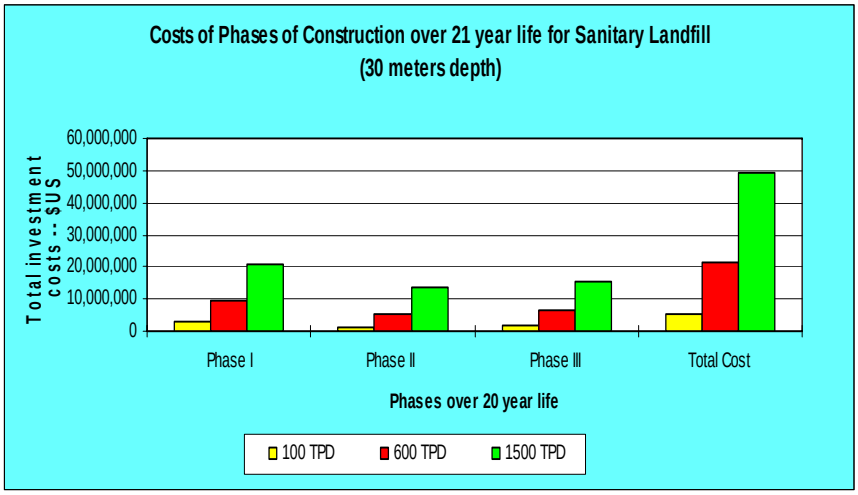
A landfill is not a one-time civil works activity.

- Full design, civil works, equipment, and operating costs are determined over the full life of the facility.
- Certain parts of the landfill are built at the start (e.g., access road, fence, weighbridge, office, worker facilities, equipment maintenance facilities, parking, leachate treatment works, perimeter drains, and initial cells).
- Other parts are built every 3-5 years (e.g., more cells with their leachate and gas collection systems, incremental additional leachate treatment and gas recovery units.)
- Other parts are done at the end (e.g., final cover and seeding, post closure monitoring systems).
- The following charts indicate the sequencing of expenditures over a typical 20 year life of a landfill.

Typical Landfill Costs Over Time – 70 meters depth



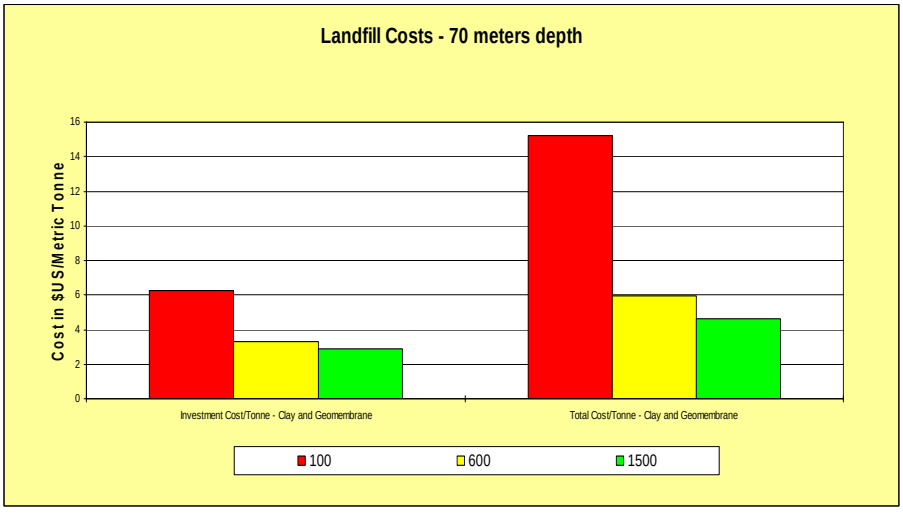
Typical Landfill Costs Over Time – 30 meters depth



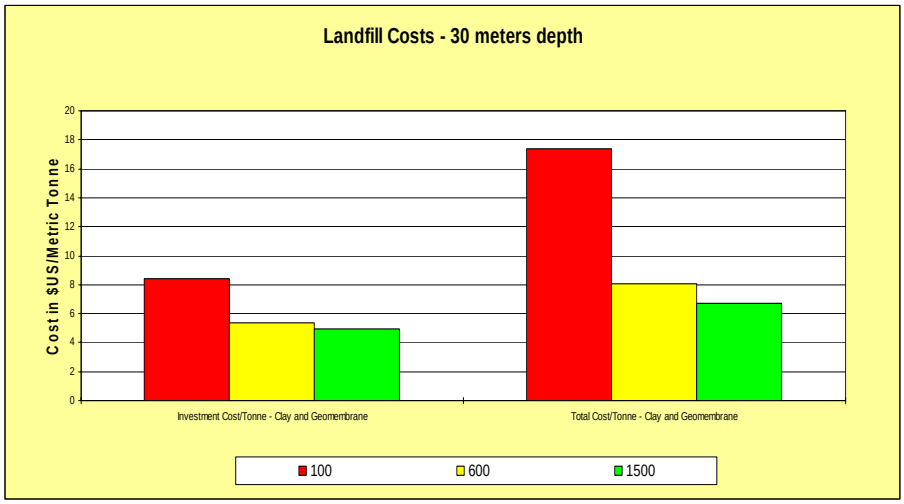
Landfills have huge economies-of-scale.

- Landfill equipment has to be big enough to push the waste and enable the compaction needed.
- You can't buy half a bulldozer or landfill compactor. Machinery that is underutilized wastes money.
- Landfills under 400 tonnes/day will either have undersized or underutilized equipment.
- The following chart shows typical economies-of-scale.

Typical New Landfill Investment and Total Costs – 70 meters depth



Typical New Landfill Investment and Total Costs – 30 meters depth



How much ER carbon finance does a LF gas capture system generate?

- Depends on:
  - Landfill design (depth of fill, types of gas collection and extraction, ease of containment by natural barriers).
  - Landfill operations (permeable refuse and soil layers allowing gas movement to gas pipes, open gas pipes that are free of water, containment that minimizes gas leakage from the top and sides of the landfill, extraction systems that minimize gas leakage).
  - Speed of waste decomposition (waste putrescibility, ambient temperature, rainfall/evaporation).
  - ER price paid per equivalent carbon unit.

Current ER carbon finance revenue potential for LFG capture and flaring

(assuming $14/t of C02eq)*

- Scenario's examined:
  - Food content of 40% and 65%
  - Yard waste content of 10%
  - Wet and dry conditions
  - Tropical and temperate conditions
  - 100 and 600 tonnes/day landfills
  - Landfill depths of 30 and 70 meters
  - Model automatically calculates LFG recovery and composting ER's as well.

*March 2008 price by World Bank (9.5 Euros), Commodities market in EU up to 200% for ready low-risk projects, Commodities market in US about 30%.

Total LFG capture and flaring ER revenues over 21 years in $MM (at 14/tC02eq).*, **

Note the High and Low ranges in the yellow boxes.

ER Model Scenarios	Wet Climate Tropical	Wet Climate Temperate	Dry Climate Tropical	Dry Climate Temperate	Total Landfill Cost ***
40% food					
100 tonnes/day	**3.3**	**2.8**	**2.0**	**1.6**	**11.7-13.3**
600 tonnes/day	**19.6**	**16.5**	**12.1**	**9.9**	**27.5-37.1**
65% food					
100 tonnes/day	**4.9**	**4.1**	**3.0**	**2.4**	**11.7-13.3**
600 tonnes/day	**29.3**	**24.7**	**18.0**	**14.7**	**27.5-37.1**

*Cointreau estimate using Nov. 2007 World Bank model, which assumes 70% of DOC decomposes, 50% of landfill gas is methane, and 50% gas collection frequency.

**Estimated ER revenues assume cost-effective designs and operations.

***Based on Cointreau cost estimates of two scenarios: a 30 meter deep landfill and a 70 meter deep landfill, with lower total costs for the deeper 70 meter depth landfills.

What portion of landfill costs could CF cover?

- Landfill cost recovery potential from 8% to 106% of total sanitary landfill costs (including the gas system), if all revenues go only to landfill cost recovery.
- However, usually some revenue needs to cover private developer profit and some is allocated to community development funding to the host municipality and surrounding neighborhood or waste picking community.
- No funds are likely to be leftover for the rest of the solid waste system.
- When systems are small and poorly operated, cost recovery potential can be half of the above estimates.

Footnote comment:

How does ER revenue cost recovery compare for Composting?

May cover 20-60% of total cost over 21 year period, if compost costs kept low.

Composting ER revenues over 21 years in $MM (at 14/tC02eq).*, **

Note the high and low ranges in the yellow boxes.

ER Model Scenarios	Wet Climate Tropical	Wet Climate Temperate	Dry Climate Tropical	Dry Climate Temperate	Total Compost Cost ***
40% food					
100 tonnes/day	**4.7**	**3.9**	**2.9**	**2.3**	**11.5 – 38.3**
65% food					
100 tonnes/day	**7.0**	**5.9**	**4.3**	**3.5**	**11.5 – 38.3**

*Cointreau estimate using Nov. 2007 World Bank model, which assumes 70% of DOC decomposes, 50% of landfill gas is methane, and 50% gas collection frequency.
**Estimated ER revenues assume cost-effective designs and operations.
***No significant economies-of-scale in composting, so 600 tonnes/day scenario not done as it was for landfill.

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