



TCE CONSULTING ENGINEERS LIMITED

GORAI LANDFILL GAS PROJECT- A CASE STUDY

Waste Disposal in India

- Landfills account about 13% global methane emission
- About 300 millions urban population- 0.12 million tons of waste per day dumped in waste disposal sites which emit methane to atmosphere
- Other gases from landfill sites causes various kinds of diseases
- Unpleasant surroundings

Importance of Gorai Landfill Site

- TCE's voluntary initiative to develop a demonstration LFG project in India, as project network partner of M2M.
- Estimated to be about 6 million tons of waste in place.
- Expected closure shortly, thus urgent to cover and install LFG recovery system to minimize methane emission and maximize energy recovery.

Gorai Site Features

- Location: North West of Mumbai,
- Dumping started since 1975
- Expected closure year is 2006
- Total area = 25 ha, Effective dumping area = 10 ha
- Average dumping height more than 12 m
- Present dumping rate = 1700 tons/day



Waste Characteristics

Constituent	% by weight
<i>Paper and Cardboard</i>	11.8
Plastics	5
Metals	0.8
Glass	0.4
Sand and Earth Fill	30
<i>Compostable Matter</i>	42
Others	10
Total	100

Estimation of Methane Generation

- Landfill Gas Emissions Model (LandGEM) Version 3.02 developed by US EPA.
- LandGEM relies on several model parameters to estimate landfill emissions.
 - Methane generation rate (k)
 - Potential methane generation capacity (L_0)
 - Rate of waste disposal
 - Methane content

Equation used :

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 kL_0 \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Q_{CH_4} = annual methane generation in the year of the calculation (m³/year)

i = 1 year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1 year time increment

k = methane generation rate (year⁻¹)

L_0 = potential methane generation capacity (m³/Mg)

M_i = mass of waste accepted in the i th year (Mg)

t_{ij} = age of the j th section of waste mass M_i accepted in the i th year

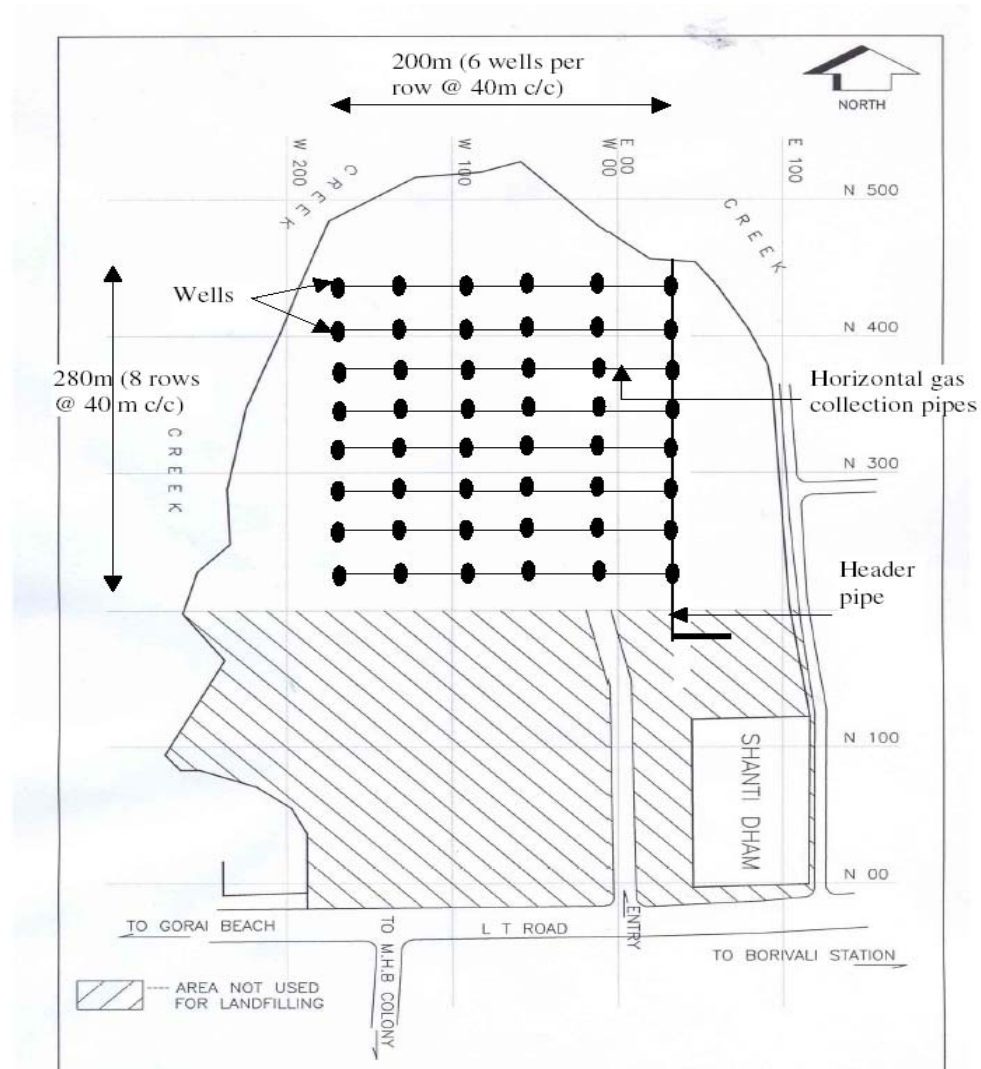
Estimation of parameters

- ▶ $k : 0.5 \text{ year}^{-1}$
- ▶ $L_o : 170 \text{ m}^3/\text{Mg}$
- ▶ Rate of waste disposal : 424 tons/day in 1993 to 1700 tons/day in 2005
- ▶ Methane content : 50% by volume of LFG
- ▶ Project => 2008 – 2027
- ▶ Volume of CH_4 recovered = 50% of estimated volume of CH_4 evolved

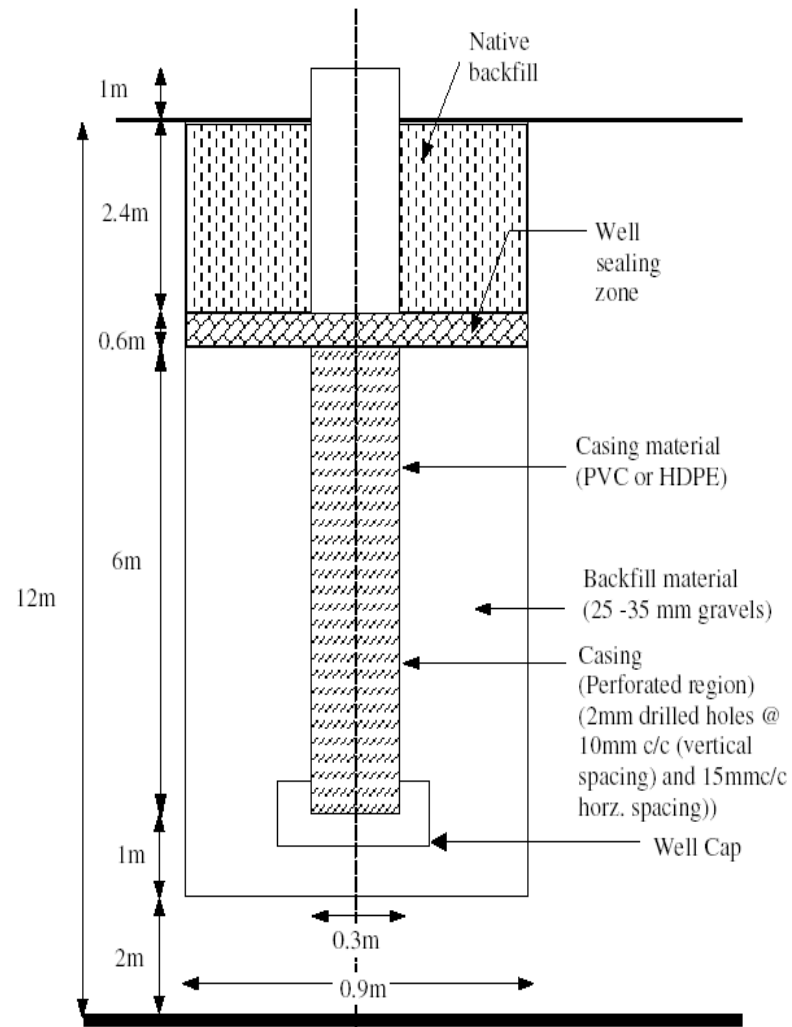
Features of the LFG Collection System

- ✱ 2.4m top lining system
- ✱ 48 vertical wells (8 rows with 6 wells/row)
- ✱ 300mm dia. PVC or HDPE pipes
- ✱ 300mm thick gravel layer surrounding pipes
- ✱ Depth of wells = 10m
- ✱ Perforations in PVC pipes = 2mm dia @ (10-15)mm c/c
- ✱ Pipes extract the LFG and are collected in the gas collection system after purification

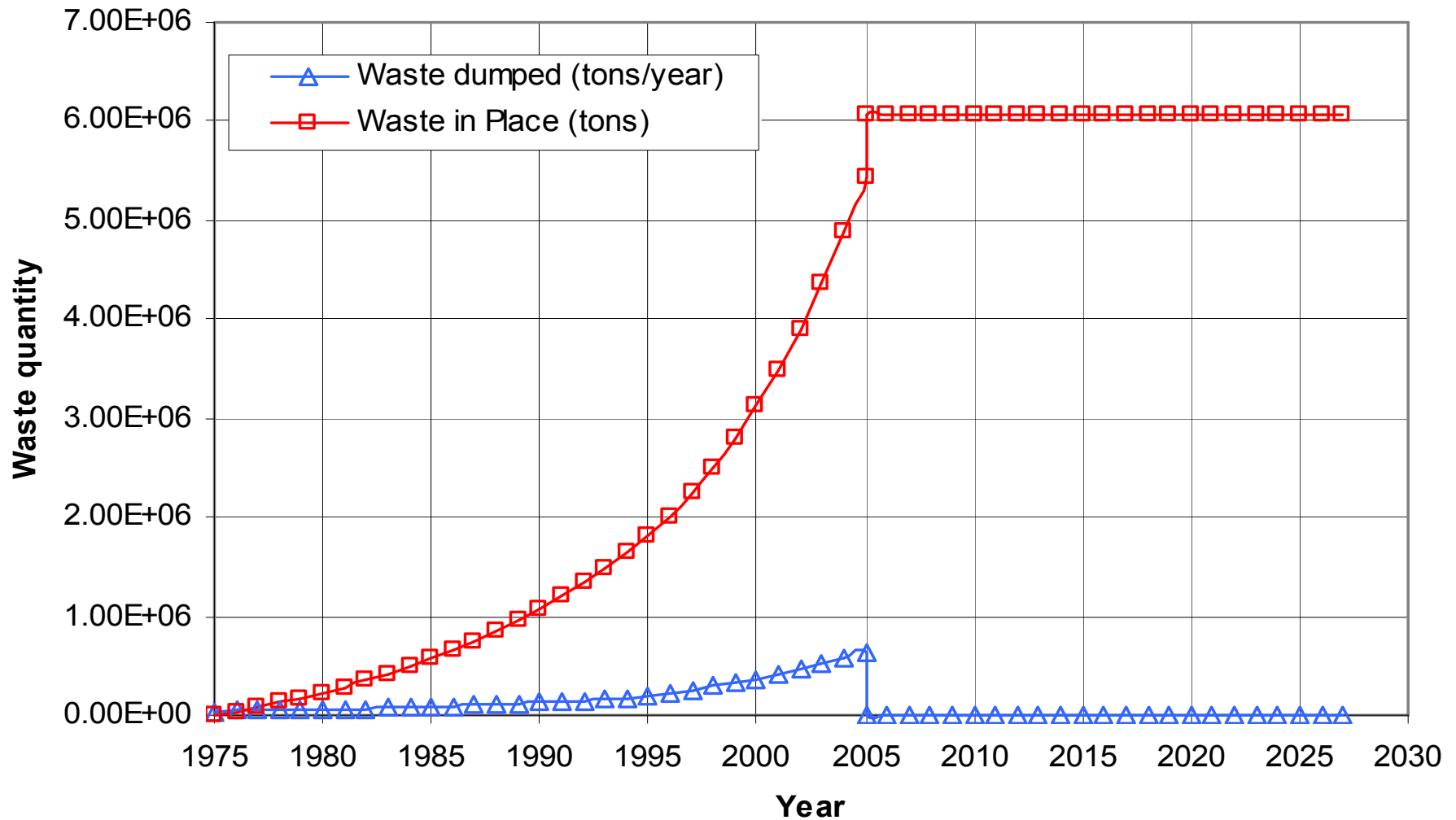
Plan of the Site with Well Network



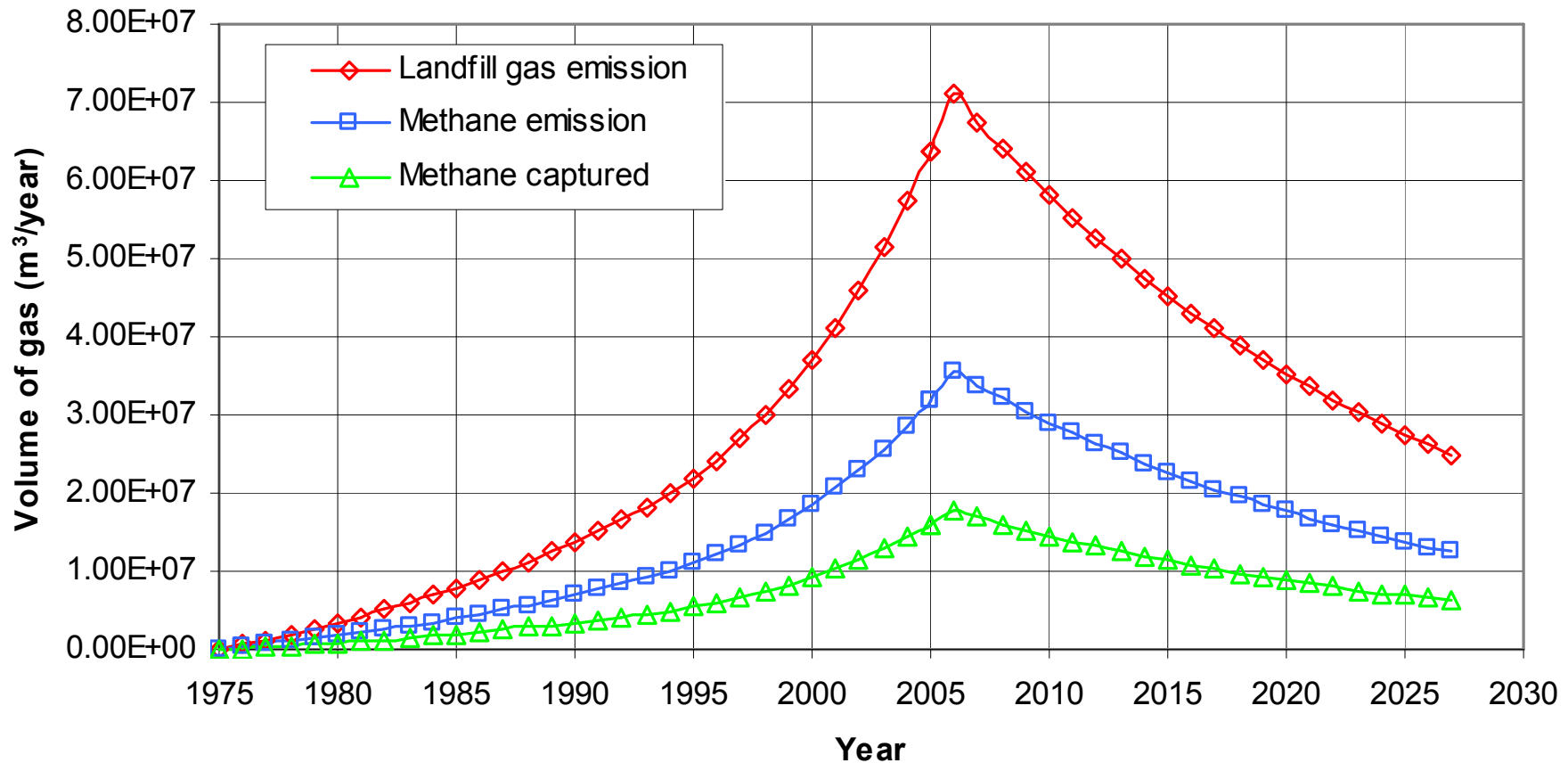
Cross Section of the Vertical Well



Waste Landfilled and Waste in Place



Emission & Capture of LFG & Methane

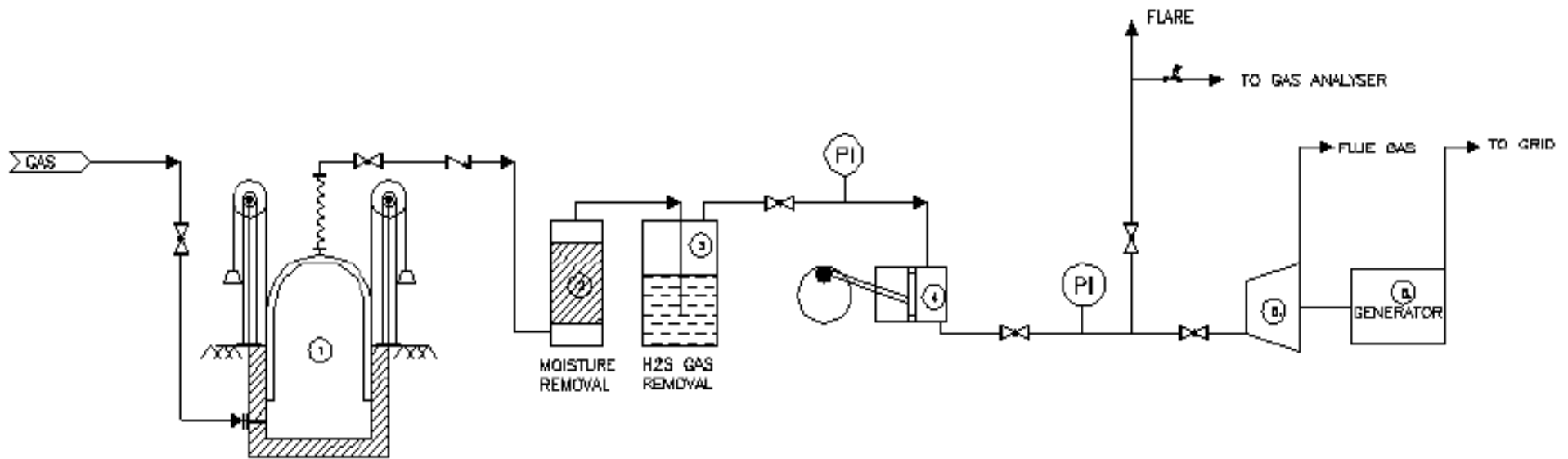








LFG Utilization at Gorai Site

- No direct user of gas nearby so option is power generation
- Methane recovery 1840 m³/hr. to 710m³/hr from year 2008 to 2027 respectively.
- Power generation from 6MW to 2MW on continuous basis from year 2008 to 2027 respectively.
- 3 nos. each of 2 MW capacity could be an economical option
- Generated power can be utilized by BMC at some other location by wheeling.

LFG Collection, Purification and Utilization System



- 1.GAS HOLDER
- 2.MOISTURE REMOVER
- 3.H2S GAS REMOVER
- 4.COMPRESSOR
- 5.GAS ENGINE
- 6.GENERATOR

-  NEEDLE VALVE
-  GLOBE VALVE
-  PRESSURE INDICATOR
-  CHECK VALVE

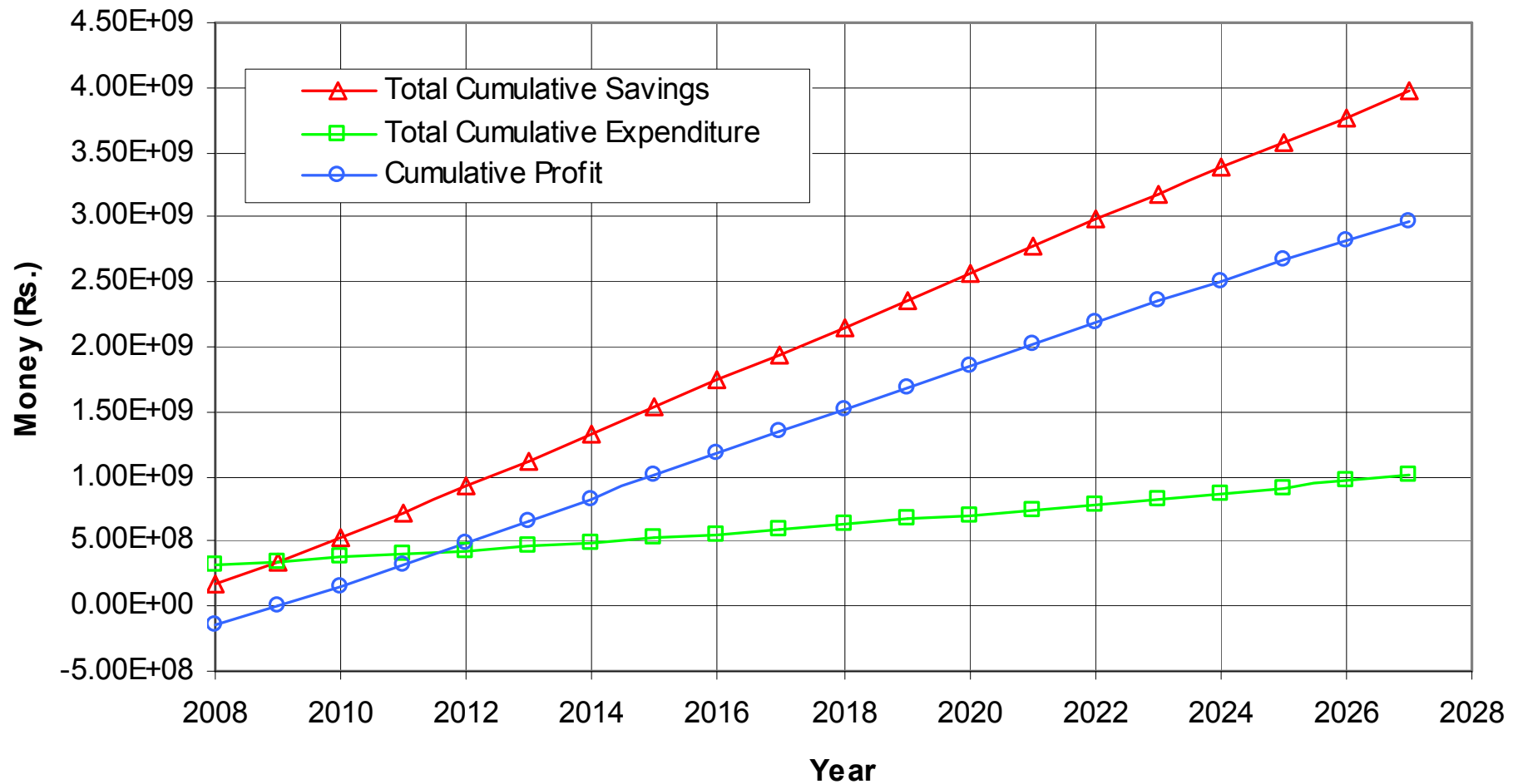


Cost Analysis

- Expected project cost in the range of Rs.25-30 Crores. (\$ 5-6 millions)
- Assuming saving due to grid power purchase considering present tariff of Rs.2.80/kwh and 10% cost escalation per year, the payback period is about 2years.
- For 20 years of plant operation the net benefit would be in the tune of Rs.290 Crores.(\$ 64 millions)



Revenue, Expenditure and Profit





Conclusions

- Study shows economic viability of LFG projects in India.
- The project has potential to reduce 415 million m³ of methane emission to atmosphere during 20 years of plant operation.
- The project shall be developed as a demonstration project supported by funding agencies.
- Potential to generated 960 mw and reduce 2530 million m³ per year methane emission to atmosphere by development of LFG projects in India.