



# Developing Landfill Gas to Energy and CDM Projects Internationally

Methane to Markets Expo  
Beijing, October, 2007

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 **VEOLIA**  
ENVIRONMENTAL SERVICES



# Presentation Topics

- Introduction - Veolia Environmental Services
- Landfill gas capture and utilisation technologies
- A CDM project example
- CDM project development - Observations / recommendations
- Conclusions

# Veolia Environmental Services

## Key Figures - 2006



### *Waste Management Division of Veolia Environnement*

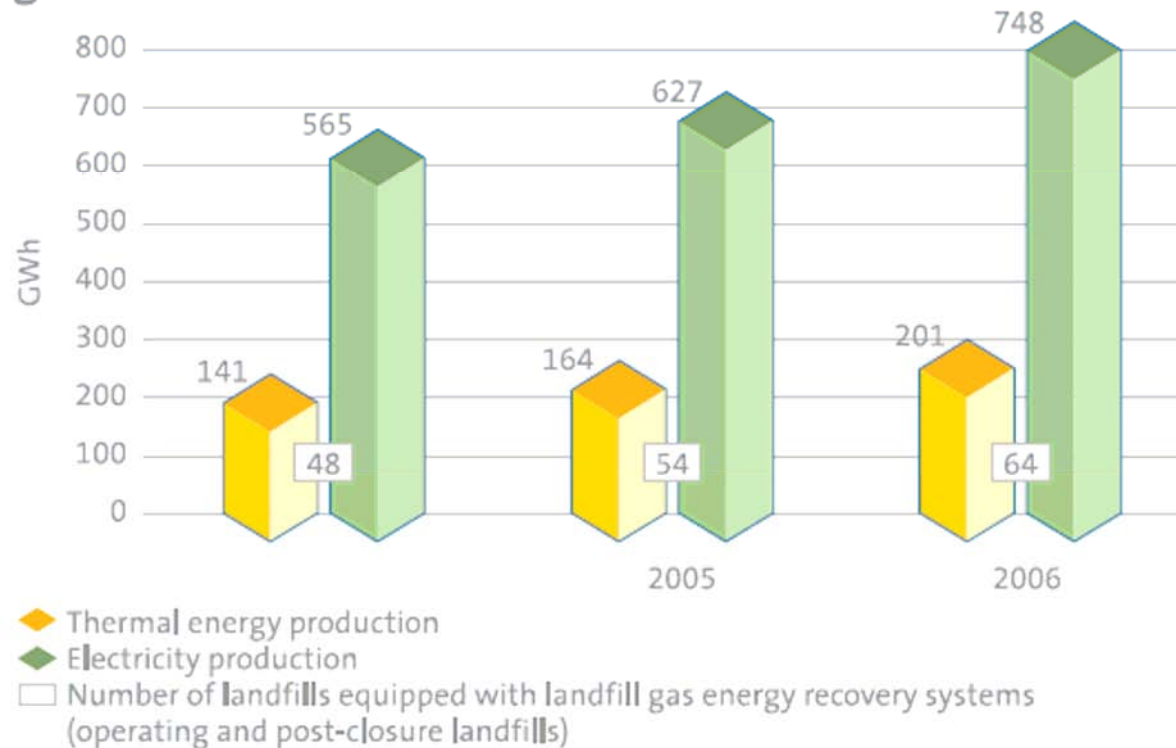
- Annual Revenue : **€ 7.5 Billion**
- Operating in **33** Countries
- **82,700** employees worldwide
- Collected **35** million tonnes of waste
- Treated **58** million tonnes of waste in **698** treatment facilities
- Recovered **7** million tonnes of waste
- **4.2** Million MWh of electricity and **2.5** Million MWh of thermal energy sold
- **2** registered **CDM projects**; others in the « pipeline »



# Veolia Environmental Services' landfills

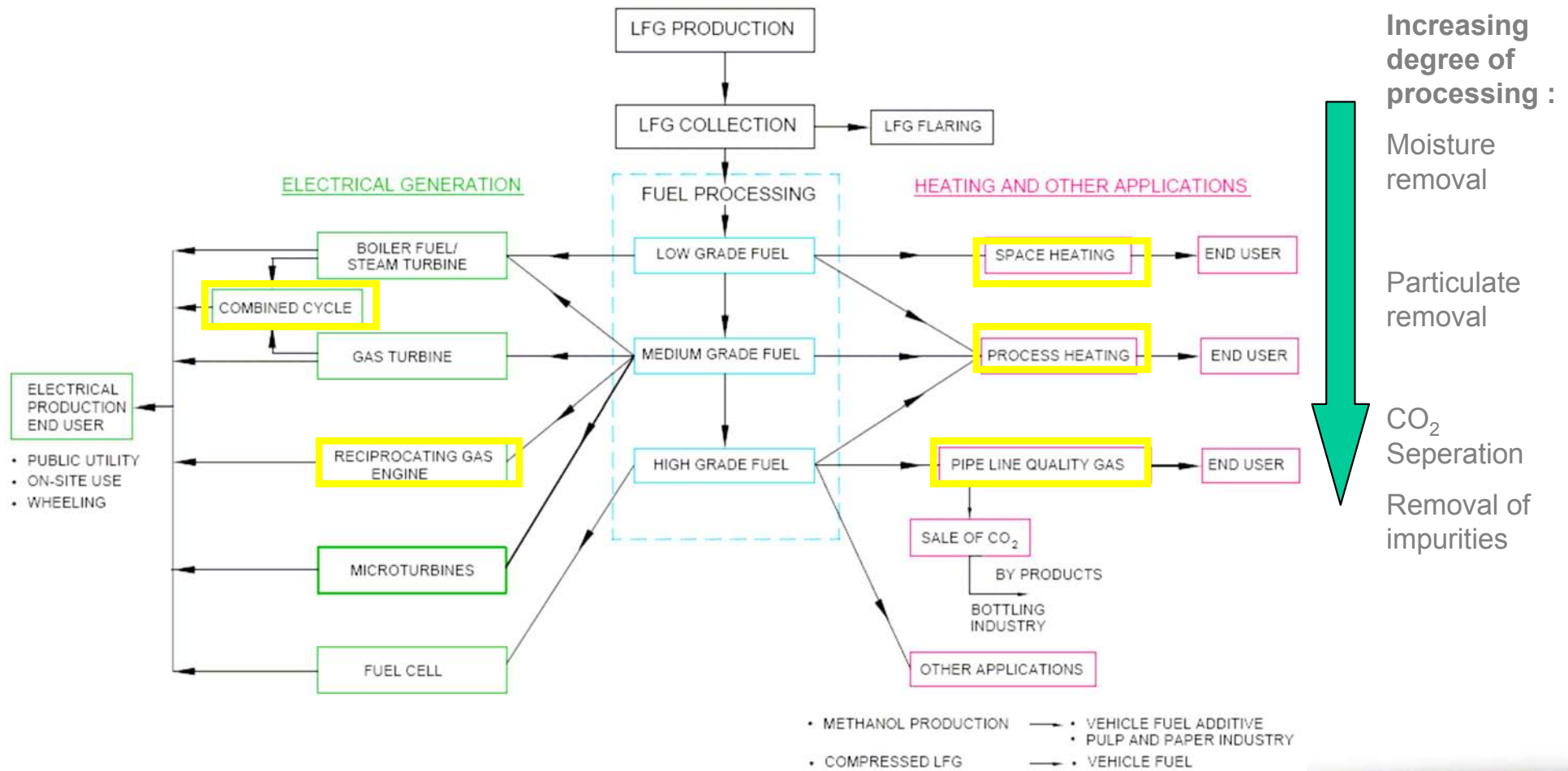
Veolia Environmental Services manages 146 non-hazardous waste landfills world-wide

## Thermal energy and electricity generated from landfills



# Landfill Gas Utilisation Technologies

The figure presents the various applications for the three grades of fuel that can be produced from raw LFG. It also illustrates the increasing degree of processing that is required to transform the LFG from a low-grade fuel into a more refined fuel source.





# Landfill Gas Utilisation projects

## *VES Examples :*

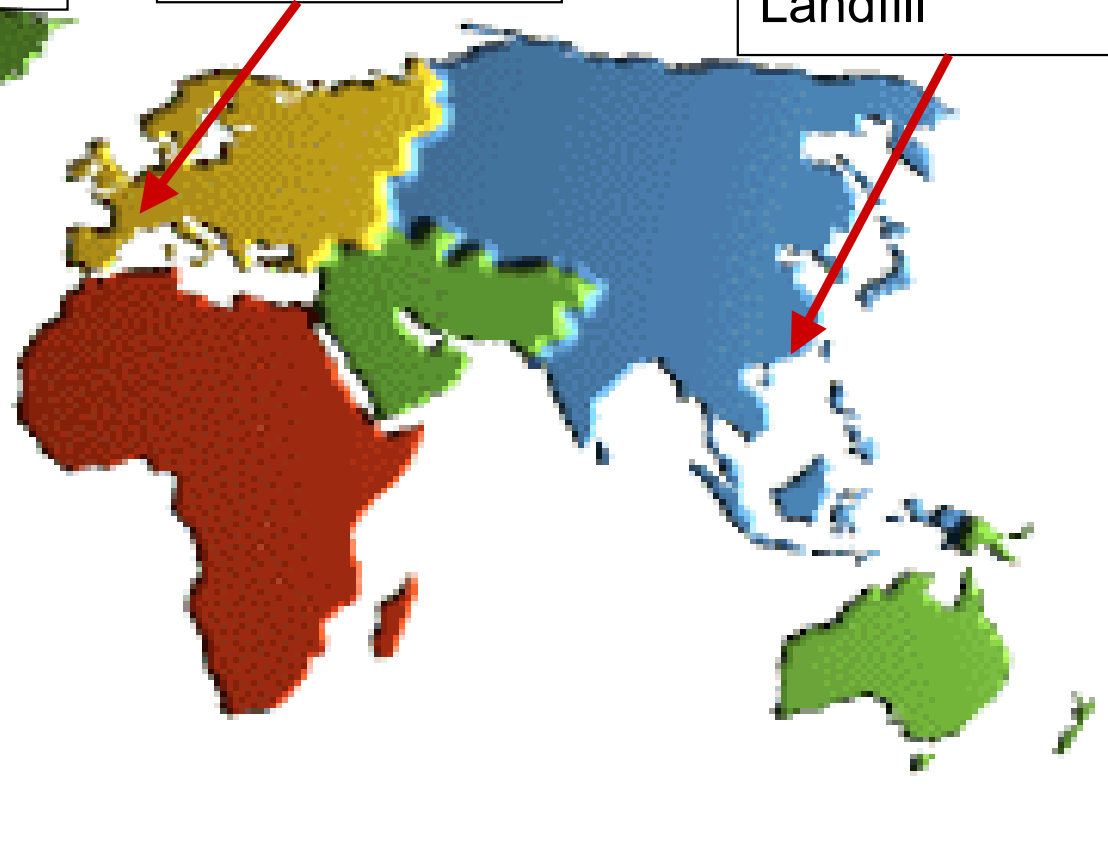
US : Cranberry  
Creek Landfill

US : Greentree  
Landfill

France : REP  
Energie

China : Xingfeng  
Landfill

Brazil : SASA  
Landfill



# Landfill Gas Utilisation projects



Site : CRANBERRY CREEK LANDFILL, USA

## ● Technology : Direct Use

- Partnership between Veolia ES Cranberry Creek Landfill and a nearby Ocean Spray plant
- LFG is compressed, filtered and dried at an onsite compressor station and conveyed from the landfill to the plant through a 2.4 km pipeline.
- Methane gas from this pipeline powers the Ocean Spray's steam boilers, that energise the cranberry concentrator.

## ● Benefits :

- Greenhouse gas emissions reductions : 6,300 tonnes a year (comparable to the elimination of the CO<sub>2</sub> emissions produced from 12,000 automobiles)
- Ocean Spray cut fuel costs by 25 %.

→ In 2006, the site received the « GOLD STAR AWARD » from SWANA (Solid Waste Association of North America)

Reference



Cranberry Creek Landfill,  
Wisconsin, USA

# Landfill Gas Utilisation projects

## Site : XINGFENG LANDFILL, China

- Ownership: Guangzhou Government
- Contracts to VES: Landfill design, design coordination and 8 years operation ;  
Separate LFG design, build and operate contract

## ● Technology : Reciprocating Engines

- Two 970 kW reciprocating engines / gensets for electricity production
- Additional modular units to be added as recovered landfill gas increases
- Reciprocating engines use medium grade LFG as fuel. It is necessary to condensate and remove particulates of the landfill gas.

## ● Benefits :

- CDM project being developed for this site
- Reduced greenhouse gas emissions – expected 5 million tCO<sub>2</sub>e to the end of 2012
- Alleviate electricity shortages

## Reference



Xingfeng Landfill, Guangzhou, China



# Landfill Gas Utilization projects



Site : REP ENERGIE, France

● Technology : Combined Cycle

11 MW  
9300 Nm<sup>3</sup> LFG / hr recovered

{	- 3 high pressure boilers (each with a steam capacity of 30 t/hr)
	- 1 steam turbine

→ In 2005, selected under French Government tender for renewable energy project from Biomass / Biogas to meet EU 2010 target

**Since 2006**

Total : 25 MW  
17 000 Nm<sup>3</sup> LFG / hr recovered

{	-1 gas turbine	<b>Combined cycle</b>
	-1 additional boiler	
	-1 additional steam turbine	

● Benefits :

- Reduced GHG emissions : 74,000 tonnes CO<sub>2</sub>e avoided emissions
- Reduced fuel consumption : 16,400 toe saved
- The installed capacity of 25 MW is equivalent to the consumption of 80,000 inhabitants.

Reference



REP Landfill, Claye Souilly,  
France

# Landfill Gas Utilisation projects



Site : Greentree Landfill, USA

## Technology : Pipeline Quality

- Conversion of landfill gas (17,000 m<sup>3</sup>/hr), which is otherwise burned in a flare, into pipeline quality methane gas.
- At the landfill, a processing facility processes and separates the natural gas from the remainder of the landfill gas. This natural gas is then transported by the project's pipeline to an interstate natural gas pipeline located near the landfill site.

## Benefits :

- Reduced greenhouse gas emissions
- « Green Energy » to be purchased by electricity producer
- The produced energy (the equivalent of 40 MW of electricity) is enough to satisfy the needs of 45,000 homes.

Reference



Greentree Landfill,  
Pennsylvania, USA

# Landfill Gas Utilisation projects



Site : SASA LANDFILL, Brazil

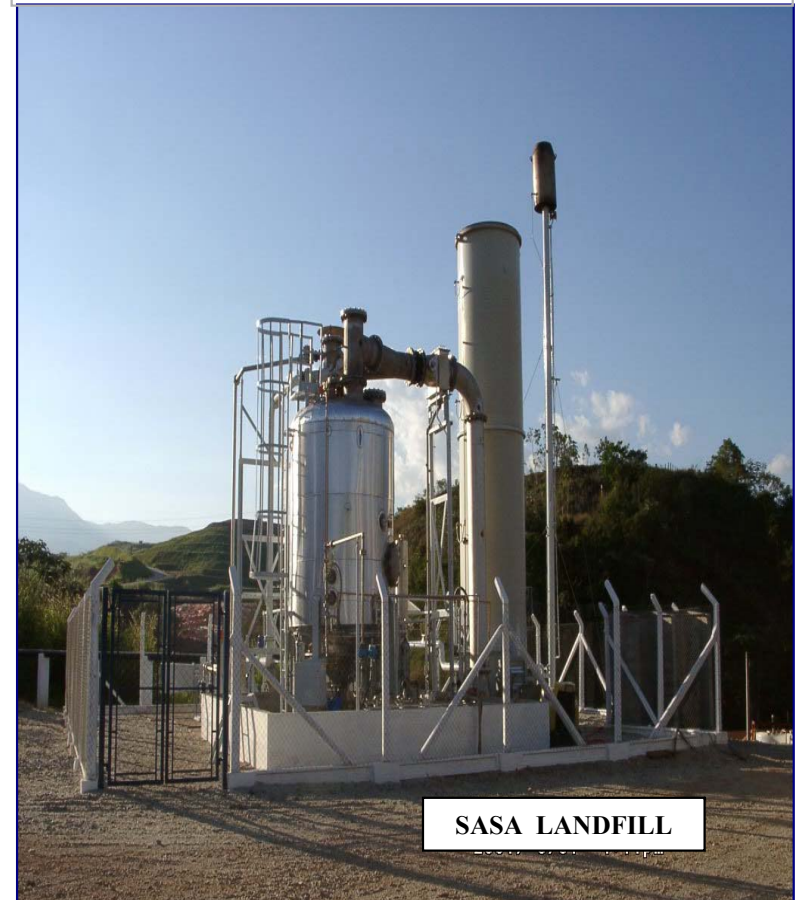
● Technology : Leachate Evaporator

- Treats up to 19m<sup>3</sup> / day of leachate using LFG as fuel for evaporator

● Benefits :

- Developed as a Clean Development Mechanism (CDM) project
- VES' first registered project and carbon transaction !
- GhG emission reductions estimated at 700,000 tCO<sub>2</sub>e over 10 years

Reference



Tremembe Landfill, Brazil



# Utilisation Selection Factors

- Various technologies exist for the utilisation of LFG. Selection of the best alternative for a specific site is dependent upon a number of factors including:
  - **projected recoverable LFG ;**
  - **presence and location of suitable markets;**
  - **market price for end products;**
  - **environmental and regulatory factors; and**
  - **capital and operating costs of utilisation system options, including processing and transporting issues/costs.**



# Incentive for Landfill Gas Project development

- There has been increased development of landfill gas utilisation projects in a number of developed countries thanks to national incentive systems (Feed-in tariffs, green certificates, subsidies...)
- These types of national incentives are not yet available in most developing countries.
- However, a different form of incentive that helps the transfer of landfill gas recovery technology into developing countries is the **Clean Development Mechanism (CDM)**.



# Onyx Alexandria (VES Egypt) – A CDM Project Example

# CDM Project - Alexandria, Egypt



## Onyx Alexandria (VES Egypt)

Landfills operated as part of global waste management contract

## CDM Project – consists of :

- Upgrade of the landfill gas collection system
- Commissioning of a leachate evaporator (Borg El Arab)
- Potential GhG emission reductions of approx. 3,700,000 t CO<sub>2</sub>eq.

## Sale of CERs

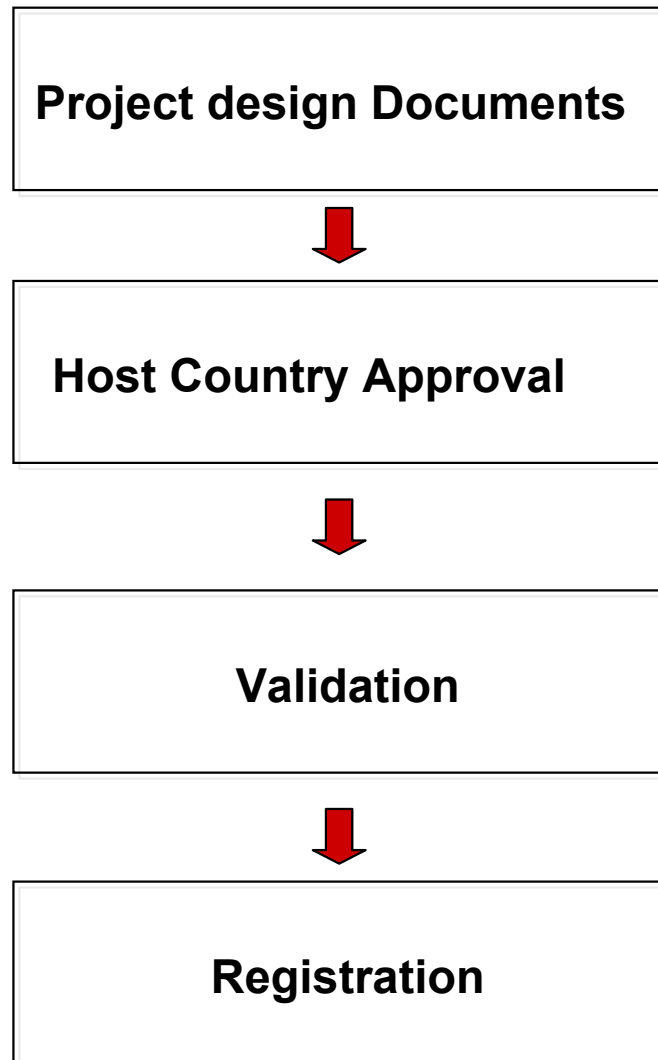
2005 : Signed ERPA with World Bank for first tranche of CERs (30%)



# CDM Project - Alexandria, Egypt



## CDM Project Cycle



## Completed Steps

- ✓ **2005** - Prepared Project Design Documents; EIA completed by Consultant
- ✓ **December 2005** - Conducted Stakeholder meetings
- ✓ **January 2006** - Letter of No Objection received from the Egyptian DNA
- ✓ **April 2006** - Validation Completed
- ✓ **June / July 2006** - Received Egyptian / Spanish / French DNA LOA
- ✓ **August 2006** - Submitted PDD for Registration to the CDM Executive Board
- ✓ **15 December 2006** - project registered !



# CDM Project - Alexandria, Egypt



## CDM Project Cycle

Implementation



Monitoring



Verification



Issue CERs

- ✓ Leachate evaporator installed at the Borg El Arab landfill; flares and initial phase of collection system have been installed on both sites
- ✓ Landfill gas monitoring is on-going
  - **October, 2007** - Additional monitoring equipment being installed
  - **October, 2007** - Verification process by external Verifier was launched.
  - **First Quarter, 2008** - Issue first CERs for payment.

# Veolia Environmental Services' experience in the Kyoto project mechanisms



- Veolia Environmental Services has two registered projects.
- The group has other on-going projects, under preparation or being evaluated :
  - Projects in South America, in partnership with VE subsidiary Proactiva.
  - In Asia and in Africa / Middle East for the CDM
  - In Eastern Europe for the Joint Implementation.



## The benefits of CDM projects in terms of Sustainable Development :

- Continuous improvement - environmental controls
- Transfer of technology
- Reinforced local participation
- Technical training of on-site staff



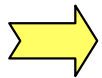
# CDM Project Development - Observations / recommendations



# CDM Project Development - Observations / recommendations

## Project design Documents

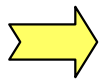
- Future emission reductions from LFG projects are based on first order mathematical models; existing registered projects are producing less CERs than forecasted in PDDs.



Models used in PDD should be :

- prepared by experienced modellers
- adapted to site-specific conditions and parameters

- CDM EB Rules / Methodologies / tools are evolving :



Project developers must keep abreast of CDM EB Methodologies /  
Decisions / Clarifications

# CDM Project Development - Observations / recommendations



## Validation

- Delays experienced in the Validation step.



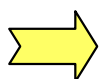
- Ensure project design documents are complete :
  - Clearly explain compliance with the applied baseline and monitoring methodology
  - Ensure justification of “additionality” is provided
- Selection of an available DOE with sector experience
- Follow-up on the established schedule



# CDM Project Development - Observations / recommendations

## Host Government Approval

- Each host country establishes their own CDM approval process

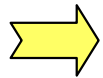
- 
- Develop understanding of country requirements early-on in the project development process
  - Interface with the Designated National Authority
  - Ensure approval letters include the 3 points required by the CDM Guidelines :
    - The Party has ratified the Kyoto Protocol
    - The approval of voluntary participation in the project activity
    - Host Country : the project contributes to sustainable development

# CDM Project Development - Observations / recommendations



## Implementation

- Early landfill gas projects showing shortfall in delivered CERs compared to amount forecasted in the PDDs



Proper landfill gas collection system design, construction and operation required to maximise CER production



# CDM Project Development - Observations / recommendations

## Monitoring

- Monitoring requirements specified in CDM methodologies for LFG projects have become more and more complex
  - Continuous monitoring of LFG flow, quality, T, P, ...
  - Flaring unit – combustion efficiency in addition to the temperature of combustion, hours of operation...

- Need to ensure proper instrumentation (flowmeters, gauges, emission monitoring ) installed and calibrated according to manufacturer's specifications
- Install secure data storage system and conduct routine QA / QC







# Measuring Performance

- One measure of performance for CDM projects is the “**CER issuance success rate**” :

$$= \frac{\text{CERs Issued}}{\text{CERs estimated in PDD for the same period}}$$

- As of 2<sup>nd</sup> October 2007, registered landfill gas projects having reached the issuance step had a “ **CER issuance success rate** “ of **35%**.
- This under-delivery can be attributed to several possible reasons :
  - an **over-estimation of emission reductions by the FOD model** because of :
    - lack of available site specific data (waste quantity and composition, moisture content...)
    - Operational constraints not considered
  - **technical issues**, especially when projects are based on old sites (leachate levels, poor containment systems, inadequate compaction / cover...)
  - **delays in the installation of required equipment**
  - **Insufficient monitoring data**

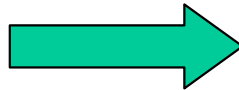
**→ Still in the early phases of project implementation**

**→ Need to take into account the level of uncertainty of future CER estimation when entering into negotiation for sales**

# From uncontrolled dump sites to environmentally sound landfills



## Uncontrolled Dumpsites



## Modern Sanitary Landfills





# Conclusion

- Landfill gas recovery and utilisation technologies are proven and reliable.
- There is a significant potential to transfer these technologies into developing countries under the CDM.
- The supplemental revenue generated by the sale of energy from landfill gas or emission credits can contribute to the development of environmentally sound waste treatment facilities in developing countries and other sustainable development benefits.
- VES supports efforts to promote these projects and to remove development barriers.



# Thank you for your attention !

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