The Best Practice on Waste Management in Korea
– SUDOKWON Landfill Site –
I. OVERVIEW of SL Corp.

Track Record

Aims

◆ To practice sound waste management as well as maximize resource recovery
◆ Transforming the world largest landfill into the world’s best environmental and cultural attraction

Basic Landfill O&M
- Run by “SUDOKWON Landfill O&M Union”
- Started waste carry-in and Simple landfill operation

LTRC (GTRC)
- Set up R&D department
- Enhanced technology development & laboratory analysis
- Reinforced LTRC (Landfill technology research center) with new recruit

Global Contribution
- Conducting feasibility study and national waste management planning, waste Management facility operation, staff training, etc

HISTORY
1991 Basic Landfill O & M
2000 Organization Reform.
2004 LTRC (GTRC)
2006 LFG Power Plant
2010 Global Contribution

Organizaton Reformation
“SUDOKWON Landfill Site Management Corp.” inaugurated its obligation as a public entity under the Ministry of Environment, Korea

LFG Power Plant
- Started the operation of 50 MW landfill gas power plant and CDM Project
- Made the Master plan for the future use of SUDOKWON Landfill

To practice sound waste management as well as maximize resource recovery

Transforming the world largest landfill into the world’s best environmental and cultural attraction
I. OVERVIEW of SL Corp.

Current Status of SUDOKWON Landfill

(Annual statistic report on incoming wastes: 2015)

<table>
<thead>
<tr>
<th>Size (Million m²)</th>
<th>Capacity (Million tons)</th>
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<tbody>
<tr>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
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<tr>
<td>Landfill</td>
<td>15</td>
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<tr>
<td>Others</td>
<td>2</td>
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<td></td>
<td>228</td>
</tr>
</tbody>
</table>

Incoming Wastes

Total 3,664,833 tons
<14,778 tons/day>

- General Industrial Wastes: 1,614,457 tons (44%)
- C&D Wastes: 1,428,688 tons (39%)
- Household Wastes: 621,688 tons (17%)

※ Incoming ratio according to the waste incoming regions: Seoul 46%, Incheon 19%, Kyeong-gi 35%
I. OVERVIEW of SL Corp.

Current Status of SUDOKWON Landfill

※ Incoming from : 58 districts of Seoul, Gyeonggi and Incheon regions (23 Million People)
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Waste Management System in Korea

Volume-Based Waste Charging System

Waste treatment cost on each polluter based on the amount of waste generated with free collection service for recyclable wastes
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Profit Structure

Tipping Fees
(Charged by Waste Volume)

Tipping fees vary according to category and volume of wastes (As of 2016)
1. Municipal solid waste - $36
2. Construction & Demolition wastes - $77
3. Industrial wastes - vary from 33-$100

Levy
(for installment of infrastructure)

Profits
(from various business)

Local Governments
(Seoul, Incheon, Etc.)

LFG sales,
CDM projects,
Gas stations,
R&D projects,
Etc.

Extra earning

Others

Landfill Operation & Administration

Facilities & Infrastructure Development

Project Investment

Interest receipts,
Article sales,
Etc.

Interest receipts,
Article sales,
Etc.
II. Relationship with Residents

To solve environmental problems + economic & social benefits

Korea waste management in the past (80s) & the present

Past (1980s)

Present
II. Relationship with Residents

Sanitary Landfill Installation

✓ Acquisition of reclaimed land
- Seoul City & MOE purchased the reclaimed land from a major company.
  ※ Land Acquisition cost: 45 million US$ (Seoul 71.3%, MOE 28.7%)
- Seoul City & MOE installed a landfill and decided to use the landfill with Gyeonggi and Incheon.
  ※ Population of metropolitan area: around 23 millions

✓ Initial installation cost of SUDOKWON landfill
- Initial installation cost of 1st landfill is 32 million US$ paid by Seoul, Incheon, Gyeonggi
  (Seoul: 24 million, Incheon: 4 million, Gyeonggi: 4 million US$)
- Raising the MSW fund by the three Municipalities
  : MSW(Municipal Solid Waste) fund has been raised from the three municipalities (Seoul, Incheon, Gyeonggi) for installation of landfill facilities in SUDOKWON landfill
II. Relationship with Residents

The relationship with residents

- SL Corp. laid the groundwork for participation of residents by enacting the law on 「Promotion of installation of waste disposal facilities and assistance, ETC. to adjacent area act」

The ways to support affected areas based on law

**SL Corp.**
- Raising fund for residents
- Managing the fund
- Planning to support residents
- Implementing supportive projects for residents

**Resident Council**
- Discussing convenience facilities for residents
- Discussing supportive projects for residents
- Recommending monitoring members among residents
II. Relationship with Residents

- **Target**: Residents within 2km radius (38,000 people)
- **Fund**: 10% of waste tipping fees (about $10 million/year) for 38 thousand residents
- **Examples**: Regular medical check up
  - Scholarships for students
  - Sports Park (football, baseball, basket/volleyball, tennis, running track)
  - Community Centers
  - Multipurpose Senior Centers
  - Discount of admission fees (golf & horse-riding course, swimming pool)
  - Overseas Field Trip
- **Others**: Employment for various works
  - (waste inspection, smell monitoring, gardening)
  - Operating Snack bars during Festivals
II. Relationship with Residents

Supporting public facilities
III. Main Business

Main Facilities

Sanitary Landfill/Waste Management System

Eco-Friendly Sanitary Landfill Operation
- Quick, Safe & Sanitary landfill operating system
- Eco-friendly Waste management technology

Leachate Treatment System

Leachate Treatment Technology
- Design Capacity: 6,700 ton/d
  (Daily processing amount: 4,300 ton/d)
- Aim to ‘Zero discharge Leachate Treatment System’

Solid Recovered Fuel (SRF) Plant

SRF Plant
- Design Capacity: 200 ton/d
- Converting wastes into fuel and energy

Solid Recovered Fuel (SRF) Plant

CDM Project for Recycling Landfill Gas
- UNFCCC Issue more than 900,000 CO₂ tons of CERs annually to SL Corp.

Sludge Recovery Plant

Sludge Recovery Plant
- Capacity: 200 ton/d
- Turning sewage sludge into fuel

Food Waste Effluent Biogas Plant

Food Waste Effluent Biogas Plant
- Capacity: 500 tons/d
- Anaerobic digestion-based biogas production (25,000 m³/day)
III. Main Business

Integrated carry-in Management System

Household Waste, Construction Waste, General industrial Waste

Enter Weighbridge
- Auto vehicle recognition, gross weighing & waste character inspection
- Random selection of incoming vehicles for careful inspection (penalty and shut out for illegal waste)

Landfill Site
- Location tracking systems on every vehicle to be controlled from entry to exit via the landfill site-wide Wi-Fi network
- Joint inspection by local resident guard and SLC staff
- Unloading waste

Car wash
- Auto estimation of waste incoming amount

Exit

Unfolding, tramping and compacting, soil covering

Perfect carry-in and Investigation
Prevention of Environmental pollution
Advance prevention of illegal waste
III. Main Business

Eco-friendly Landfill

Landfill Site Cross Section

- Landfill gas extraction wells (699)
- Deodorizer spraying
- External bank
- Work area (active face)
- Interim cover 0.5m
- Daily cover 0.2m
- Leachate collection wells (75)
- Groundwater monitoring wells
- Angle meter
- Leachate conveyance pipeline
- Leachate collection
- Leachate catchment
- Landfill bottom impermeable liner [solidified layer]
- 50MW landfill gas power plant
- Leachate treatment facility

What is soil covering?
Unloaded waste is compacted to 4.5m thick, and 0.5m thick interim cover soil is placed on top of it. After completing waste burial each day, 0.2m thick daily cover soil is placed over waste to prevent contamination.
III. Main Business

**Leachate Treatment Plant**

**Biogas Power Generation**

Methane generated in the anaerobic digestion process is refined and supplied to fuel the 2.4MW power plant and automobiles for establishing a resource recycling system.
III. Main Business

WTE Facilities

Renewable Energy (electricity) Production

Approx. 100,000 households
Approx. 340 million kWh each year

Carbon Emission Right

800,000 tons of CO₂ each year

Power Sales Revenue

Approx. 33 million USD each year

Landfill gas recycling for the CDM project
Registered as a CDM project with the UNFCCC in the landfill gas application area for the first time in Korea

Landfill
- 1,024 locations including vertical gas collection pipes
- Using vacuum pressure, gas leakage/emission prevention

Landfill Gas Collection/Transfer
- Use of high-pressure blower
- Approx. 308km-long gas conveyance pipelines

50MW Landfill Gas Power Generation
- One 50MW unit, 1.2 million kWh/day power generation
- 6 units in total, 680m³/min. gas combustion

Power Transmission
III. Main Business

Other Bio-gas Plants

<2.4MW Power Plant>
- Mission: To generate Electricity
- Construction period: Apr. 2015 ~ Nov. 2015 (7 Months)
- Capacity: 800 Tons/day
- Investment Cost: $2 million (Only gas engine system)

<Bio-gas Generation Facility of the Greater Seoul>
- Mission: To provide methane as auxiliary energy
- Capacity: 500 Tons/day
- Investment Cost: $34 million
III. Main Business

- 50MW Landfill Gas Power-Plant Project
- Environmental & economical benefit
- Power Generation
- Odor Removal
- GHG Reduction
- Supply of electric power [Renewable Energy]

Waste of resource (simple incineration)
Landfill
Green House Gas (GHG)
Discharge of Waste

SUDOKWON [Seoul, Incheon, Gyeonggi]
III. Main Business

New Technology and Patents

Enhanced Stance as an Organization Specialized in Waste Treatment

Independent/joint research and technology development

Based on the knowhow of operating the world’s largest landfill site, SLC is leading resource recycling through systematic research on waste treatment, recycling, reuse, etc.

2014 and 2015 Korea Invention Patent Exhibition
Won the Gold/Silver/Bronze medallions

Technology Support for Waste Treatment Facility

With its technological capability and over 20 year experience of operating the landfill site, the institution has provided technological assistance for the stable installation/operation of landfill facilities.
III. Main Business

Integrated Air Monitoring System

By detecting odor and fine dusts from the landfill site in real time, the air monitoring system identifies origins of odor generation and odor moving routes so that prompt responses can be taken prior to environmental problem expanding. Odor monitoring sensors are installed at the outlets of odor-evoking facilities and key spots in the inside and outside of the landfill and operated 24 hours every day.

**Odor Monitoring**
- Hydrogen sulfide, ammonia, VOCs
- Sensors are operated at 22 internal/external spots to monitor the odor situation and analyze relevance.

**Outlet Monitoring**
- 11 sets of odor senses are installed at the outlets of 7 odor-generating facilities to monitor real-time air quality.

**Fine Dust Monitoring**
- To reduce the migration of dust towards surrounding areas, fine dust measuring instruments are installed at 8 spots at 4 points along the site boundaries to monitor real-time fine dust levels in the landfill and reinforce their control.

**Residents’ Monitoring**
- Thirty-seven local resident monitors living near the landfill site perform the real-time air quality monitoring of surrounding areas.

**Odor Modeling**
- Odor modeling is performed to anticipate real-time odor distribution, analyze or trace back causes of odor.

**Integrated Monitoring Performance**
Using a state-of-the-art odor control system, minimize civil complaint about odor.

- Maintain odor levels at around the site boundaries below 50% of the permitted level.
- * Maintain hydrogen sulfide levels no higher than 0.005ppm (below 1% of the permitted level)
III. Main Business

Overseas Business

- MOU
- MP/FS conduction
- Construction/operation
- New project development

- Hawaii
- Honduras
- Colombia
- Peru
- Russia
- Sudan
- Kuwait
- Pakistan
- China
- Vietnam
- Cambodia
- Philippine
- Indonesia
- Australia
- South Africa
- Mozambique
- Tanzania
- Angola
- Peru

The Sudokwon landfill site of Korea is the world's largest in its scale and sets an international example.

- OECD Environmental Impact Assessment on South Korea
III. Main Business

Case study

Joint Study on SWM in Punjab, Pakistan

- Project Outline
  - Period: Jun 2006 ~ Jul 2007 (13 months)
  - Financed by KOICA-WB
  - Target Area: Punjab in Pakistan
  - Conducted by SL Corp., KEI & Sunjin Eng.

- Aims
  - To develop technical, institutional, financial, private and public involvement frameworks to improve WM
  - To review existing WM system

- Work Scope
  - Pre-FS for SWM system for Lahore and Sialkot
  - Promotion of public awareness of SWM
  - Workshops and training programs
III. Main Business

Case study

LFG and Solar Power Generation Project for Reducing GHG Emissions from Landfill in Ulaanbaatar, Mongolia

• Project Outline
  ✓ Landfill wastes in Ulaanbaatar (2009~2020) : 6.3 million ton
  ✓ Landfill size 24.6ha, waste in-take 1,300ton/d
  ✓ Pre-F.S on LFG Utilization & Solar Power Plant
  ✓ To submit the project proposal and concept note to GCF

• History
  ✓ Held a Seminar regarding the technology cooperation with Mongolia national University, Ministry of Environment & Tourism, Ulaanbaatar city hall, Ministry of Energy, Xac Bank (June 2018)
  ✓ Meeting with Xac Bank, GCF Focal Point, Ulaanbaatar city hall, Ministry of Energy, Embassy of Republic of Korea (Aug 2018)
  ✓ Workshop on the result of Pre-FS (Oct 2018)
### III. Main Business

#### Case study

LFG and Solar Power Generation Project for Reducing GHG Emissions from Landfill in Ulaanbaatar, Mongolia

<table>
<thead>
<tr>
<th>Project name</th>
<th>LFG and Solar Power Generation Project for Reducing GHG Emissions from Landfill in Ulaanbaatar, Mongolia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Narangiin Enger (NEDS) landfill</td>
</tr>
<tr>
<td>Plant Capacity</td>
<td>LFG 2MW &amp; Solar power plant 5MW</td>
</tr>
<tr>
<td>Project structure</td>
<td>PPP</td>
</tr>
<tr>
<td>Investment Cost</td>
<td>22,587 thousand USD (estimated)</td>
</tr>
<tr>
<td>Project Period</td>
<td>2020~2041 &lt;2 years (construction), 20 years (operation)&gt;</td>
</tr>
<tr>
<td>Financing Plan</td>
<td>GCF</td>
</tr>
</tbody>
</table>
III. Main Business

Case study

Bali W2E(Waste to Energy) Project in Indonesia

• Project Outline
  ✓ Period: Nov 2015 ~ June 2016 (7 months)
  ✓ Financed by KOPIA (200,00$)
  ✓ Target Area: Bali in Indonesia
  ✓ Conducted by SL Corp., & KOMIPPO

• Aims
  ✓ To reduce odor and emissions by LFG treatment
  ✓ To Extend life-span of current landfill by reducing daily
    landfilled MSW
  ✓ To Produce renewable energy from waste and reduce GHG

• Work Scope
  ✓ To conduct FS for SWM system for Bali and submit the BOT type
    project proposal to Bali province
III. Main Business

Case study

LFG Energy Project in Nam Son Landfill for Hanoi, Vietnam

• Project Outline
  ✓ Landfill size 40ha, daily incoming waste 5,500 ton/d
  ✓ 3~5 MW LFG Utilization Project
  ✓ Financed by KEITI

• History
  ✓ Delegation members of URENCO visited in SL Corp. for field trip (Jun, 2016)
  ✓ KOREAN Consortium had a contract with KEITI to conduct the F.S (Oct, 2016)
  ✓ Kick-off Meeting between URENCO and KOREAN Consortium (Nov, 2016)
  ✓ MOU between URENCO and KOREAN Consortium (Nov, 2016)
  ✓ Installed the Gas collection pipe to measure the quantity of LFG (Feb, 2017)
III. Main Business

Outline of LFG Project in Namson Landfill

**Project Purpose is to**
- Reduce LFG and odor emission into the air
- Produce electricity from LFG (Landfill gas)
- Secure CERs from CDM project

<table>
<thead>
<tr>
<th>Project name</th>
<th>LFG to Energy project in Hanoi, Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Nam Son landfill</td>
</tr>
<tr>
<td>Plant Capacity</td>
<td>5MW (1MWh x 5 units)</td>
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<tr>
<td>Project structure</td>
<td>IPP (Independent Power Producer)</td>
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<tr>
<td>Investment Cost</td>
<td>13,146 thousand USD (estimated)</td>
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<tr>
<td>Project Period</td>
<td>15 months (construction), 15 years (operation)</td>
</tr>
<tr>
<td>Financing Plan</td>
<td>PF (Korea &amp; Vietnam)</td>
</tr>
</tbody>
</table>
• Project Outline
  ✓ Project Period: Sept 2008 ~ Jul 2015
  ✓ Capacity: Landfill 20,000㎡, Leachate treatment facility 40 ton/d
  ✓ Financed by KOICA (Korea International Cooperation Agency)
  ✓ Cost: $6 million - $1.5 million (Sri Lanka), $4.5 million (Korea)

• The Role of SLC in the Project
  ✓ Expert dispatch for landfill construction and O&M
  ✓ Construction supervision as PM
  ✓ Policy and O&M training in Korea

• Project expected Effect
  ✓ The first Sanitary landfill in Sri Lanka
  ✓ Expected to minimize the environmental damage caused by leachate, methane gas etc.
  ✓ Methane avoidance effect by collecting and incinerating landfill gas
Project Outline

- Daily waste generation in Lima: 7,918 ton (collection 87%)
- Landfill size 107ha, waste intake 1,500 ton/d
- LFG Utilization & Improvement of landfill O&M
- Bioreactor to increase LFG generation
  ※ Oceanic climate (annual rainfall 0.5~4.4 mm)
- Financed by KEITI (Korea Environmental Industry Technology Institute)

History

- Environmental facility field trip (Sep 2011)
- LOI between Lima City & SL Corp. (Sep 2011)
- FS for LFG project & sanitary landfill (Mar 2012)
- MOU between MOE & MINAM (Apr 2012)
- Peruvian Delegation visit to Korea (Jun 2012)
III. Main Business

Global Cooperation

Training Course for Sri Lanka (2014)

Training Course for Indonesia (2015)
III. Main Business

2014 Incheon Asian Games
III. Main Business

Wild Flower Complex: Flower Festival

Flower Festival (Chrysanthemum)

Flower Festival (Cosmos)
IV. Future plan

**ECO Energy Town**

Realization of Green Growth: Installation of 4 theme towns

- **Site 1** (Landfill closed)
- **Site 2** (Landfill in operation)
- **Site 3** (Future use)
- **Site 4** (Future use)

Flower garden

**Division** | **Waste Energy Town** | **Bio Energy Town** | **Natural Energy Town** | **Eco-Cultural Town**
---|---|---|---|---
Size | • 10,400 t/d | • about 305 million m<sup>3</sup> | • about 30MW | • 35,000 m<sup>3</sup>
Cost ($) | • 1,430.5 billion | • 24.5 billion | • 259.2 billion | • 33.3 billion
Key facilities | • RDF, sludge recovery plant, Bio gas recovery plant, C&D waste recovery plant | • Bio diesel production, Service station, etc. | • Solar power plant, Wind power plant, etc. | • Research center, Exhibition hall, education center, etc.
Theme Park Project

Bio reactor test project (Zero discharge system)

Simple landfill

Multi-purpose hybrid type landfill

- Period: 2013 ~
- Cost: $2.89 million
- Method: Pumping leachate up to the top of the landfill
- Injection amount: 220 ton/day

✓ Prevent environmental impacts from polluting stream nearby
✓ Save leachate treatment cost and shorten stabilization period
✓ Take more LFG to produce electricity
✓ Help us use the land earlier
THANK YOU

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