

CASE STUDY

Buriram: The Economics of Refuse Derived Fuel Production



Refuse derived fuel is produced from combustible components of municipal solid waste, such as nonrecyclable plastics. Photo credit: ADB.

A town in northeastern Thailand studies the viability of converting waste to energy to improve waste disposal.

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Overview

Asian cities, such as Buriram municipality in northeastern Thailand, face the immense challenge of finding cost-effective methods for diverting solid waste from landfill sites in the interest of long-term public and environmental health.

The Asian Development Bank (ADB) provided technical assistance on mainstreaming solid waste management to Buriram and four other cities in Asia. Key assistance was a review and upgrade of municipal 10-year plans for solid waste management plus one tailored project per city. Issues covered were waste avoidance, minimization, and recycling; waste haulage and disposal; and information, education, and communication campaigns.

At the request of Buriram's municipal officers, the project team conducted a pre-feasibility study on

whether refuse derived fuels or RDF could provide a possible method for diverting waste from landfill. This is a process in which waste is separated and prepared to “RDF 2” quality specification, then transported and sold to modern cement kiln owners that buy it as a coal substitute for the heating process.

Project snapshot

Dates	<ul style="list-style-type: none"> • April 2015: Project start • March 2017: Project end
Cost	<ul style="list-style-type: none"> • US\$ 1.4 million: Total cost of technical assistance over 2 years
Institutions and Stakeholders	<p>Financing</p> <ul style="list-style-type: none"> • <u>Asian Development Bank</u> <p>Others</p> <ul style="list-style-type: none"> • Government of Thailand’s Pollution Control Department (PCD), Ministry of Natural Resources and Environment, Department of Energy, Ministry of Energy and Business, and Buriram Municipality: Stakeholders

Challenges

One of the challenges for the project was that many small to medium domestic companies had already approached Buriram municipal officers promoting waste-to-energy plants, and in particular, refuse derived fuels. Municipal officers expressed high optimism for refuse derived fuels as a solution to the issue of ever increasing quantities of solid waste going to landfill.

However, based on industry experience, such projects may not be viable in small cities in northeast Thailand due to relatively small waste quantities and high transport costs, among other factors. The pre-feasibility study reviewed current project economics under a base case model and developed case scenarios to highlight factors that would be needed to make such projects viable in the future.

The other challenge with regard to waste collection, despite the system being reasonably efficient, is the current landfill design and implementation. For example, all stages of the landfill, whether complete or operational, have a flat slope resulting in excess landfill leachate due to high rainwater infiltration rates through the cells cover. The flat slope allows local depressions to form and act as recharge points for rainwater, which increases leachate volumes.

The city estimates the remaining landfill could last 4 years. However, the project found that if it is

redesigned to maximize airspace and minimize landfill leachate, then it will last for more than 20 years without major attempts to divert waste.

Solutions

According to the pre-feasibility study, the base case model shows a significant negative return. Solutions would need to take into account the substantial investor returns needed for a high-risk project. Such solutions can be broadly divided into two categories. Most immediate would be a subsidy via direct Buriram Municipality tipping fees paid to the refuse derived fuels developer and/or central government capital subsidies.

Buriram would need to take a policy decision on whether it has a strong intention to push refuse derived fuels as a solution forward and use subsidy mechanisms to bring project economics into line with target investor returns, or to let the market factors take their course.

In this case, Buriram should first determine the amount of tipping fee it is willing to pay for refuse derived fuels. Two alternative schemes may be considered:

- Refuse delivery fee of 500 baht per ton paid by other municipalities and third-party commercial/institutional customers
- Weighted average tipping fee of 400 baht per ton by including “free” service for Buriram residential waste

Once Buriram determined the assumed tipping fee contribution, then it should be possible to calculate the amount of capital cost contribution necessary to make the project economics work. Such capital costs might be applied for on a grant basis from the central government. Under this scenario, Buriram should pursue the competitive bid structure outlined in the action plan so as to minimize its own tipping fee contribution.

With regard to upgrade of the landfill site, the project provided preliminary design and costing of a controlled facility. The project team recommended that the municipality would be able to run the revised landfill to an appropriate standard without external support.

Financial tables for a refuse derived fuel facility and operation

A: Capital Expenditure (CAPEX)

No.	Items	Price in US\$	Price in THB	Value
1.	Equipment	4,635,162	166,865,837	
2.	Civil works	1,986,498	71,513,930	
3.	Total	6,621,660	238,379,767	
	Sensitivity	1		

4.	Electrical/Mechanical		years depreciation	20
5.	Civil works		years depreciation	50
6.	Annual depreciation E&M		US\$	231,758
7.	Annual depreciation civil works		US\$	39,730
8.	Annual depreciation E&M		THB	8,343,292
9.	Annual depreciation civil works		THB	1,430,279

E&M = Electrical and mechanical, THB = Thai baht, US\$ = US dollar

B: Operating Expenditure (OPEX)

No.	Item	Price	Unit	Price	Unit
1	Electrical cost	3,300,717	THB/year	91,687	US\$/year
2	Chemical and petro cost	2,753,925	THB/year	76,498	US\$/year
3	Maintenance cost	6,716,485	THB/year	186,569	US\$/year
4	Labour cost	3,600,000	THB/year	100,000	US\$/year
?	Total	16,371,128	THB/year	454,754	US\$/year

THB = Thai baht, US\$ = US dollar

C: Income Statement (THB)

Income Statement (THB)		Year				
		1	2	3	4	5
1	Revenues	33,256,519	34,606,106	34,745,719	34,908,600	35,094,750
2	Operating expenditures	29,866,195	29,866,195	29,866,195	29,866,195	29,866,195
3	Operating results (EBITDA)	3,390,324	4,739,911	4,879,524	5,042,405	5,228,555
4	Other costs	9,773,570	9,773,570	9,773,570	9,773,570	9,773,570
4.1	Depreciation costs civil works	1,430,279	1,430,279	1,430,279	1,430,279	1,430,279
4.2	Depreciation costs E&M	8,343,292	8,343,292	8,343,292	8,343,292	8,343,292
4.3	Interest bank loans	0	0	0	0	0
5	Net profit/loss before corporate income tax	-6,383,247	-5,033,659	-4,894,047	-4,731,165	-4,545,015
6	Corporate income tax	0	0	0	0	0

7	Net profit/loss after corporate income tax	-6,383,247	-5,033,659	-4,894,047	-4,731,165	-4,545,015
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EBITDA = Earnings before interest, tax, depreciation, and amortization, E&M = Electrical and mechanical, THB = Thai baht

Results

The project team reviewed the municipality's Solid Waste Management Plan which covers the spectrum of related issues: waste avoidance, minimization, and recycling; waste haulage and disposal; and information, education, and communication campaigns. Revised waste characterization data with projections were integrated in a comprehensive and integrated system based on ADB's solid waste management plan template.

In addition to improving the landfill site, the municipality will enhance its waste minimization program through a range of information, education, and communication campaigns. These will include promoting the use of biodegradable bags and food containers, and the 3Rs – reduce, reuse, recycle and segregating waste. The valuable segregated waste can then be sold.

Other integrated solid waste management activities are:

- Allow controlled scavenging at controlled landfills to obtain high level of recycling efficiency.
- Consider increasing the waste collection and disposal fees consistent with the proposed national legislation and apply the extra revenue for the ongoing waste minimization campaigns.
- Promote organic waste composting at household level, with support from the municipality. This will significantly lower the amount of waste generated per day because food waste constitutes a large fraction of the waste in Buriram.

Landfill management was satisfactory, but there is a need for a different design and operational approach, which includes:

- Minimizing leachate generation by applying a suitable daily soil cover to the compacted waste placed at the appropriate slope and shape. This will minimize infiltration and therefore leachate generation. The current practice of having flat tops on both the operating or completed landfill cells should be avoided.
- Overtopping individual cells into one overall mound to maximize airspace, rather than a series of separate mounds on one site as practiced at present.
- Upgrading of buildings, weighbridge, and roads.

Lessons

Waste to energy and refuse derived fuels marketing

It is common for sales and marketing representatives to push the idea that waste diversion opportunities

are feasible, when in reality they may not be economically viable. This makes it difficult to refocus clients toward realistic engineering and costing, but it is possible when realistic data is presented and by having knowledgeable and independent team members.

The best results were achieved when the project team presented the pre-feasibility study to some proponents of refuse derived fuels. The companies then admitted that their proposal was not economically viable under present conditions. It should be noted, however, that refuse derived fuel production can be made feasible if major technological hurdles are overcome and subsidies are applied, as is the case with any marginal proposal.

This approach of closing the loop with the marketing teams was very successful, and could be adopted as a case study for adoption in other cities to explain refuse derived fuel and waste to energy realities. Given the findings of the study, Buriram may get few if any offers from highly qualified, experienced companies for refuse derived fuel facilities. Given the paucity of realistic bids in the short to medium term, a quasi-negotiated approach rather than a full competitive bid approach may be necessary.

Landfill design and operation

The current landfill design requirements in Thailand limit the mound height to effectively four lifts or 10 to 12 meters. This greatly reduces site development efficiency in terms of airspace per unit area, and therefore increases the development costs and reduces landfill life. This approach also results in flat top landfills, which increases leachate generation rates that may lead to environmental issues.

The project team presented this issue to the most senior members of Thailand's Pollution Control Department and recommended the restriction be removed to improve landfill life and cost efficiency, and minimize the environmental impact.

Resources

Asian Development Bank. 2017. *Integrated Solid Waste Management for Local Governments: A Practical Guide*. Mandaluyong City.

Asian Development Bank. *Regional Capacity Development Technical Assistance on Mainstreaming Solid Waste Management in Asia*

Integrated Solid Waste Management Plan: Buriram

Related links

Summary: *Improving Waste Management - Solutions from Five Asian Cities*

Case Study: *Mahasarakham - Privatizing Landfill Operations*

Case Study: *Mandalay City - Outsourcing Waste Collection Services*

Case Study: *Quezon City- Making Waste Management a Rewarding Investment*

Case Study: *Sorsogon City- Options for Developing a New Landfill*



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Andrew McIntyre heads the project administration unit of the East Asia Urban and Social Sectors Division at ADB. Earlier, he led ADB's Future Cities Program, operationalizing a One ADB approach to better engage with Asian cities over the long term, by facilitating cross-sectoral knowledge and financing partners, broadening project pipelines, and ensuring integrated results.

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