One Man's Trash:
Garbage into Fuel in Kathmandu, Nepal

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Vision

To eliminate causes of violence in Kathmandu by implementing and publicizing an excellent source of alternative energy.

Context

A primary driver of conflict in Kathmandu, Nepal is the failure of the city's infrastructure to support its rapidly growing population. The most visible (and odiferous) result of this inadequacy is the spectacular buildup of garbage in public places. Ad hoc waste disposal creates immediate conflicts between neighbors as well as between citizens and the city over dumping rights and collection responsibility. It also has more severe consequences. People commonly burn garbage piles to remove them, contributing to the city's exceptionally poor air quality and compromising public health. Kathmandu Metropolitan City (KMC), the municipal body that manages solid waste, currently carries all collected garbage to the overflowing Sisdol landfill. KMC has kept the site open beyond its designated 2011 closing date because funding and licensing complications have kept a new site from opening. Leachate from the landfill flows directly into the nearby Khor River making it undrinkable, and local villagers periodically protest by blocking roads to the landfill and effectively stopping waste collection in the city.

A second effect of inadequate urban infrastructure is frequent shortages of liquefied petroleum gas (LPG). Nearly all residents use LPG to cook due to the planned power outages ("load-shedding") of roughly twelve hours per day during the winter. This results in up to daylong waits to buy expensive fuel. The inefficiency of gas distribution sparks resentment against the government, which is a serious problem in Nepal. For example, in early 2012, a bomb detonation at the main gate of the Nepal Oil Corporation killed three people; a small terrorist group, the SJMM, claimed responsibility and stated that the attack was a response to the government's role in high fuel prices. These prices will most likely continue to increase notwithstanding, as the Nepal Electricity Authority predicts an increase in energy demand of about 8.3% per year for the foreseeable future.[1]

Approach

Biogas reactor (or digester) technology can help negate the conditions that cause violence by eliminating waste and producing combustible gas. A digester – essentially an airtight tank with an inlet, an outlet and a gas valve – provides an environment for naturally occurring microbes to break down organic material into methane-rich "biogas" suitable for cooking, lighting and electricity generation. A digester operating at a steady state can effectively eliminate all input organic waste by converting up to 80% of its mass to biogas and the remainder into a nitrate-rich slurry that serves as an excellent fertilizer.[2] 70% of the waste that Kathmandu produces on a daily basis is organic,[3] the city is surrounded by farms that need fertilizer, and there is a constant demand for cooking gas. Kathmandu has abundant inputs – organic waste – and outlets – stoves, generators and farms – for potential digesters.

The Biogas Support Program (BSP) is a NGO originally founded by the Dutch government but now supported by a Nepali governmental organization, the Alternative Energy Promotion Center (AEPC). BSP has already installed hundreds of thousands of biogas digesters in Nepal's rural areas and trained people to use them; in 2005 it won an Ashden award.[4] BSP is the organization best suited to help implement biogas technology in Kathmandu. However its original purpose was expressly to reduce rural Nepalis' reliance on fuel-wood and kerosene.[5] It designed most of the plants it has installed for a rural context; these accept cow dung as their primary feedstock. As Bhushan Tuladhar of the NGO ENPHO commented in 2010, Nepal has a "good system for promoting dung-based biogas plants, but nothing for municipal waste-based biogas."[6] A 2011 review found that there were about 100 community- and institution-based biogas digesters in the greater Kathmandu area, many of which accept organic garbage.[7] The BSP supported some of these, but has not done more due to gaps in funding and organizational trouble. In any case, their collective impact on the roughly 370 metric tons of organic waste that Kathmandu's ~ 1,000,000 residents produce daily is insignificant.[8]

I aim to help the BSP meet its stated goal of "developing smaller biogas systems for common household and kitchen waste for both urban and rural households"[9] by executing and publicizing a "flagship" urban biogas project. When the digester is operating at full capacity I will connect its beneficiaries with members of the media in order to give them a platform to present it as a model for the rest of Kathmandu and all cities facing comparable challenges.

A wide scale implementation of biogas technology in Kathmandu would eliminate a great deal of conflict: It would create an input for most of the garbage that nobody knows what to do with and a source for much of the fuel that everybody wants. It would give city residents the ability to meet needs that the government presently neglects. This project will prove and promote the capacity of urban biogas and help it to realize its role, in the words of one Indian op-ed columnist, as "the future of energy."[10]

1 Forte, A. J. (2011). *A glimpse into community and institutional biogas plants in Nepal*. Books on Demand GmbH, Norderstedt Germany.

2 Ministry of Urban Development, Government of India. (2000). Solid waste management manual. Retrieved from http://urbanindia.nic.in/publicinfo/swm/swm_manual.htm

3 Dangi, M. B., Pretz, C. R., Urynowicz, M. A., Gerow, K. G., & Reddy, J. M. (2011). Municipal solid waste generation in Kathmandu, Nepal. *Journal Of Environmental Management*, *92*(1), 240-249.

4 Cf. http://www.ashden.org/winners/bsp

5 Bajgain, S. & Shakya, I. (2005). *The Nepal biogas support program: A successful model of public private partnership for rural household energy supply.* Repro Vision Press Pvt. Ltd., Kathmandu, Nepal

6 Tuladar, B. (2010, April). *Organic waste management in Nepal.* PowerPoint presentation retrieved from http://www.sswm.info/

7 Forte, op. cit.

8 Dangi, M.B., Pretz, C.R., Urynowicz, M.A., Gerow, K.G., Reddy, J.M. (2011). Municipal solid waste generation in Kathmandu, Nepal. *Journal of Environmental Management.* Jan;92(1):240-9. doi: 10.1016/j.jenvman.2010.09.005. Epub 2010 Sep 29.

9 Bajgain & Shakya, op. cit.

10 Sriraj, K. (2012). Biogas is the future of energy. *The Pioneer*, 27 Sep. 2012.

Personal Background and Qualifications

I spent the spring semester of 2012 in Kathmandu as part of a School for International Training (SIT) program, for which I conducted an independent study project on waste management in the Kathmandu Valley. I met and interviewed a number of people about the impact of waste on their lives, from garbage pickers to scrap dealers to municipal officials. I made contacts with the Municipal Association of Nepal (MUAN), an interdepartmental governmental agency; the Green Clean Pokhara Movement and Himalayan Roots to Fruits (HR2F), two NGOs; and the former mayor of Nepal's second largest city, Pokhara.

I have rudimentary capacities in the Nepali and Tibetan languages, both of which are spoken in Kathmandu, and access to networks of translators through friends associated with SIT and HR2F. My status as a foreigner will draw attention to this project, which is an asset since the project's ultimate goal is publicity for biogas technology.

I am going to use these advantages to demonstrate the capacity of biogas technology to radically improve life in cities. I will start by helping a community install a biogas digester. The community will be selected based on its capacity to get optimal outcomes from the technology. Outcomes will be measured by the number of people the community serves with the digester and how effectively that service meets their needs. I will serve the community as a facilitator by connecting it with experts in the field of biogas, contractors who can make a lasting installation, and members of the media who can spread news of benefits. The three key assets that suit me for this work are drive, time, and funding.

Implementation Schedule

Build a team: June 17 - 31. I will organize a small team of committed people. It will comprise people I worked with last year: translators from the HR2F and Indira Parajuli, Networking Coordinator for MUAN. I also plan to include the most influential members of Nepal's biogas community, whom I have not met in person: Anita Manandhar, a friend of the director of my study abroad program who has initiated biogas installations in villages; Laxman Neupane, a Research Fellow for climate change, renewable energy, and livelihood initiatives at the Centre for Policy Studies and Rural Development; Dr. Indira Shakya, a Senior Sanitation and Energy Expert for the BSP; Samir Thapa, assistant director of the AEPC, who has said that "it is essential for [Nepal] to invest, promote and construct many more community and institutional biogas plants;" and Jagan Nath Shrestha, head of the Center for Energy Studies at Tribhuvan University, "one of the most important and active promoters of biogas in Nepal."[11] Ms. Manandhar and Mr. Neupane have informed this proposal via email correspondence over the past two months and have offered to support the project moving forward. I am in the process of presenting the project to the other three as part of its pre-implementation.

Partner with a community: June 24 - July 7. My team will select a community in which to install a biogas digester. Selection will be based on *a.)* the community's capacity to arrange inputs and outlets for the digester and *b.)* its readiness to take ownership of the digester and maintain it in the years following installation. Right now the best candidate is a monastery that abuts the taxi park next to the Swayambhunath temple complex, one of Nepal's most popular tourist destinations. Ms. Manandhar has suggested this site because it could serve, and be maintained by, a clearly defined group (viz. the monastery's monks - other biogas projects have failed due to confusion over who is responsible); the monastery is also well positioned to make the project more visible to the many locals and tourists who use the taxi park. Most importantly, due to its status as a community center, the monastery could effectively advertise itself as a repository for garbage and source of gas for the densely populated area that surrounds it.

Network: July 8 - 21. My team will connect the community with biogas experts who will help them choose an appropriate digester design, in terms of size, material, style and placement.

Install: July 22 - 28. My team will connect the community with contractors who will install their chosen digester for them. Alternatively, community members may choose to buy materials for a digester from a vendor and install it themselves. In this case we will provide whatever information and labor they require. (A six person team can install a 10 m^3 digester in as few as two days.[12])

Support: July 29 - August 27. My team will serve as a financial and informational resource for the community as it encounters inevitable difficulties with the operation of the digester. We will learn with them how to make it work optimally. The time period for this stage coincides with the hottest, wettest time of year in Kathmandu, during which the conditions for digestion are the best.[13]

Publicize: August 12 - 27. My team will design and execute a public event after the digester is breaking down garbage and producing gas at a steady rate in order to showcase the urban digester's waste-management efficacy and the benefits of biogas over LPG.

Measures

Performance goals for the digester

1) *Loading*: Consume greater than 2 kg (> 4 lbs) organic solids per m^3 per day. (m^3 refers to the capacity of the digester.)

2) *Yield*: Produce greater than .25 m^3 (> 9 ft^3) of biogas biogas per kg of consumed solids per day

Performance goals for the community

1) *Input:* Consume all the organic waste produced by at least four people per m^3 of digester capacity per day. I.e. a 6 m^3 digester should eliminate the organic waste produced by twenty-four people. This goal is based on a citywide average organic garbage production rate of 0.5 kg per capita and the projected performance of the digester.[14]

2) *Output*: Meet all cooking gas demand of two households per m^3 of digester capacity per day. This goal is based on an average household energy demand of 2 kwh per day and the projected performance of the digester.[15]

Conclusion

The use of biogas technology creates conditions for peace between people by turning garbage into fuel. Several global trends to which Kathmandu and other "third world" cities are especially susceptible make this technology exceptionally useful: Radical population growth requires radical waste management and energy generation solutions; climate change and the increasing scarcity and cost of fossil fuels make alternative energy a profitable necessity; and the concentration of wealth to the very wealthy demands means of creating value at a community level. Biogas technology has the potential to become an integral part of future cities. The purpose of this project is to promote it by realizing its value for one community.

11 Quotes in this paragraph from Forte, op. cit.

12 Company publication. Shenzhen Puxin Technology co. ltd. URL: http://puxinkj.oinsite1.cn/_d269997658.htm. Retrieved 7 February 2013.

13 "NORMALS FROM 1981-2010". Department of Hydrology and Meteorology (Nepal). Retrieved 7 February 2013.

14 Dangi et. al., op. cit.

15 Nepal country situation. *Energypedia*. URL: https://energypedia.info/index.php/Nepal_Country_Situation#Demand.2C_Generation_.26_Installed_Capacity Retrieved on 9 February 2013.