COMITÉ TECHNIQUE AGRICOLE DE
LA MRC DE LA RIVIÈRE-DU-NORD / INTERSAN

Revue bibliographique sur la valorisation agricole du biogaz

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TECSULT

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1 INTRODUCTION

Lors de la troisième réunion du comité technique agricole de la MRC de La Rivière-du-Nord / Intersan tenue le 21 août 2003, il a été convenu de conduire une revue bibliographique des expériences vécues ailleurs dans le monde, particulièrement aux États-Unis, en matière de valorisation agricole des biogaz. TECSULT a ainsi été mandaté pour effectuer cette revue bibliographique, principalement par le biais d'une recherche sur Internet et en consultant les différents gestionnaires des autres sites d'enfouissement d'Intersan.

2 CONTEXTE

Tous les sites d'enfouissement produisent des biogaz qui résultent de la décomposition des matières résiduelles organiques (papier, nourriture, résidus verts). Le méthane et le dioxyde de carbone sont les principaux produits de la composition des résidus organiques et représentent 99% des biogaz. Le méthane peut être nocif pour la santé s'il n'est pas géré convenablement et de plus, est un gaz à effet de serre équivalent à 21 fois l'effet du dioxyde de carbone. Cependant, le méthane représente une importante source d'énergie qui peut être utilisée pour alimenter en énergie les serres.

S'il est bien traité, le méthane peut être utilisé comme combustible pour les moteurs à combustion, les turbines, les fours et les serres. Actuellement, il y a plus de 340 projets de valorisation énergétique de gaz d'enfouissement aux États-Unis et environ une vingtaine au Canada. Au Québec, les sites d'enfouissement de Magog (Intersan), Saint-Michel (consortium de la ville de Montréal et Gazmont), Lachenaie (BFI) et Sainte-Cécile-de-Milton (Roland Thibeault inc.) valorisent le biogaz comme source d'énergie.

Parmi ces projets de valorisation énergétique des biogaz, six d'entre eux aux États-Unis et deux au Canada utilisent le biogaz pour alimenter en énergie des serres. Les projets américains sont situés en Indiana (2), Missouri (2), Caroline du Nord et New Jersey, alors que les deux projets canadiens opèrent en Colombie-Britannique (Vancouver et Langley).

Les projets de valorisation énergétique des biogaz permettent ainsi de générer économiquement une énergie propre et renouvelable, de réduire les émissions de gaz à effet de serre et de répondre aux préoccupations relatives aux odeurs. Par exemple, le *Landfill Methane Outreach Program* (LMOP) du USEPA estime que le biogaz extrait d'un site d'enfouissement contenant 1 million de tonnes de déchets peut alimenter en énergie une serre d'environ deux (2) hectares à un coût plus économique que le gaz naturel (1,80$-3,80$/MMBTU vs 5,00$/MMBTU).

Le LMOP du USEPA est un programme américain fédéral qui vise à promouvoir la valorisation énergétique des biogaz des sites d'enfouissement et qui assiste les gestionnaires de ces sites à mettre en œuvre de telles initiatives. À cet effet, le LMOP a développé un guide intitulé *A Landfill Gas-to-Energy Project Development Handbook* qui présente et explique en détails

toutes les étapes pour développer un projet de valorisation énergétique des biogaz d'un site d'enfouissement.

Au Canada, le Bureau national de la prévention de la pollution (BNPP) est le point central d'Environnement Canada pour l'élaboration de nouveaux concepts et instruments stratégiques qui facilitent la transition vers la prévention de la pollution. Ainsi, le BNPP a notamment préparé le *Guide pour la gestion des biogaz provenant des lieux d'enfouissement*, dans le but d'encourager un recouvrement d'une plus grande envergure des biogaz accumulés dans les lieux d'enfouissement canadiens; ce guide constitue un cadre de référence pour la mise en œuvre d'une démarche efficace pour la gestion des biogaz.

3 EXPERIENCES DE WASTE MANAGEMENT EN MATIERE DE VALORISATION ENERGETIQUE DES BIOGAZ

Waste Management, la maison-mère d'Intersan, exploite à l'heure actuelle des systèmes de valorisation énergétique des biogaz dans 21 états américains. Les biogaz produits par Waste Management sont utilisés par d'importantes compagnies de transport, de produits chimiques ou de production d'électricité. La valorisation se fait en utilisant deux procédés, soit en produisant de l'électricité à l'aide des biogaz ou en utilisant directement les biogaz afin d'alimenter des bouilloires ou fournaises.

Au total, 70 lieux d'enfouissement technique appartenant à Waste Management aux États-Unis valorisent les biogaz. De ces 70 sites, 42 produisent de l'électricité et fournissent une puissance de l'ordre de 188 MW, soit suffisamment pour approvisionner en énergie plus de 160 000 maisons ou l'équivalent de 5 millions de barils de pétrole par année. Aux 28 autres sites, Waste Management valorise les biogaz en combustible pour le fonctionnement de divers équipements. Une fiche de projet préparée par le LMOP du USEPA et présentée à l'annexe 1 résume les activités de Waste Management en matière de valorisation énergétique des gaz de site d'enfouissement.

Dans le comté de Northampton en Pennsylvanie, Waste Management possède et opère un site d'enfouissement dont le biogaz a été brûlé pendant de nombreuses années. Afin de valoriser ce biogaz, Waste Management a formé un partenariat avec un organisme à but non lucratif de développement économique appelé le *Green Knights Economic Development Corporation* (GKEDC) pour construire une centrale électrique de 8MW. Le GKEDC a financé la construction de cette centrale opérée aujourd'hui par Waste Management et utilise les revenus issus de la vente d'électricité pour promouvoir le développement économique dans cette région où l'activité économique avait considérablement ralenti. Ce projet, dont une fiche de description plus exhaustive est présentée à l'annexe 1, a remporté le prix de projet valorisation énergétique de biogaz de l'année 2000 décerné par le LMOP du USEPA.

Par ailleurs, au site d'enfouissement d'Intersan à Magog, les biogaz sont valorisés de façon novatrice en vue de réduire la consommation en carburant de chauffage des installations.

4 VALORISATION AGRICOLE DU BIOGAZ

Tel que mentionné précédemment, quelques projets de valorisation du biogaz servent actuellement à alimenter en énergie des serres aux États-Unis et au Canada. Les paragraphes suivants résument quatre de ces projets (deux dans chaque pays) qui sont davantage décrits dans des fiches présentées en annexe.

4.1 Projets canadiens de valorisation agricole du biogaz

Les projets canadiens sélectionnés par cette revue bibliographique comprennent les projets de valorisation énergétique des gaz d'enfouissement de Vancouver et de Jackman, tous deux situés en Colombie-Britannique.

4.1.1 Projet de valorisation énergétique du gaz d'enfouissement de Vancouver

La fiche du projet de valorisation énergétique du biogaz de Vancouver est présentée à l'annexe 2. Il s'agit d'un projet en partenariat réunissant la Ville de Vancouver, la société Maxim Energy Group Ltd., BC Hydro et l'entreprise agro-alimentaire CanAgro.

Le site d'enfouissement de Vancouver appartient à la Ville de Vancouver et celle-ci en assure l'exploitation. Il est situé dans la municipalité de Delta, en Colombie-Britannique et dessert une population d'environ 900 000 habitants. Le site d'enfouissement est exploité depuis 1966 et l'on s'attend à continuer à y déposer des déchets pendant 40 autres années.

Reconnaissant l'occasion de valorisation énergétique du gaz d'enfouissement que présentaient les activités de captage qui se déroulaient sur le lieu d'enfouissement, la Ville a sélectionné la société Maxim pour concevoir, construire et exploiter une installation d'utilisation du gaz d'enfouissement du site d'enfouissement de Vancouver. Maxim a ainsi construit une centrale électrique de 5,5 MW alimentée par le gaz d'enfouissement extrait du lieu d'enfouissement. L'électricité ainsi produite est acheminée vers le réseau électrique de BC Hydro.

Maxim optimise l'efficacité énergétique globale de ce projet de cogénération en récupérant l'énergie résiduelle sous forme d'eau chaude afin de l'utiliser dans des serres de légumes commerciales se trouvant à 1,6 km du site d'enfouissement et appartenant à CanAgro Produce

Ltd. La proximité des installations de CanAgro constitue ainsi une occasion unique d'améliorer l'efficacité énergétique globale du projet, car cette dernière achète cette énergie résiduelle afin de satisfaire les besoins de chauffage de son complexe de serres commerciales qui s'étend sur 22 hectares et qui produit 29 millions de livres de tomates par année.

Grâce à ce projet, les villes de Vancouver et de Delta a reçu de la Fédération canadienne des municipalités le prix *Sustainable Community Awards for Renewable Energy*, qui récompense les efforts des municipalités en matière de développement durable communautaire.

4.1.2 Projet d'utilisation du gaz d'enfouissement de Jackman

La fiche du projet d'utilisation du gaz d'enfouissement de Jackman est présentée à l'annexe 3. Il s'agit d'un projet en partenariat entre le comté de Langley, Norseman Engineering et l'entreprise Topgro Greenhouses.

Dans le cadre de ce projet, le biogaz issu d'un site d'enfouissement situé dans une zone rurale et fermé depuis 1990 est utilisé par une serre situé à 1,5 km du site.

Lors de la fermeture du site d'enfouissement, un système de captage des biogaz a été installé pour contrôler les odeurs et prévenir la migration des biogaz dans les sols. Le comté de Langley a alors créé une co-entreprise avec Norseman Engineering en vue d'exploiter le biogaz capté. Cette dernière a alors sélectionné Topgro Greenhouses à titre d'utilisateur final du biogaz. Ces deux entreprises ont assuré le financement du projet de valorisation agricole du biogaz, incluant une station de compression du gaz et un gazoduc de 1,5 km. Ainsi, depuis 1995, Topgro utilise le biogaz comme source d'énergie alternative au gaz naturel.

Une des particularités de ce projet est qu'en été, le biogaz est brûlé dans une chaudière polycombustible afin de produire du dioxyde de carbone (CO_2), qui est utilisé afin d'accélérer la croissance des végétaux. D'ailleurs, la combustion du biogaz répond à presque tous les besoins en CO_2 des serres de Topgro.

Les bénéfices de ce projet sont multiples : il répond aux préoccupations relatives aux problèmes d'odeur et de migration des biogaz; il entraîne une diminution des émissions de gaz à effet de serre et des besoins en combustibles fossiles; le comté de Langley et Norseman tirent des

revenus à partir de la récupération d'une ressource qui autrement serait perdue; Topgro est en mesure de réduire ses coûts en carburant et en CO_2.

4.2 Projets américains de valorisation agricole du biogaz

Les projets américains sélectionnés par cette revue bibliographique comprennent une serre de démonstration dans le comté de Burlington au New Jersey, ainsi que le Projet *EnergyXchange Renewable Energy Center* en Caroline du Nord.

4.2.1 Projet de serre de démonstration du comté de Burlington au New-Jersey

Le projet de serre de recherche et de démonstration du comté de Burlington au New-Jersey est une entreprise conjointe du comté de Burlington et du *New Jersey Eco-Complex*. Il s'agit d'une serre de 46 000 pi^2 (4 275 m^2) situé au sein du complexe de valorisation environnementale des ressources du comté à Colombus. La serre est alimentée en énergie, pour le chauffage et l'électricité, à partir d'une unité de cogénération de 430 KW alimentée par le biogaz du site d'enfouissement qui est sur le même site.

La serre permet de produire à l'année longue des tomates d'excellente qualité, grâce à un éclairage supplémentaire et un système hydroponique alimentés en énergie produite par des micro-turbines à partir du biogaz du site d'enfouissement. L'environnement dans la serre est maintenu dans des conditions idéales pour la production de tomates, notamment par un système de chauffage du plancher et de la serre à eau chaude, des écrans thermiques, des ventilateurs combinés à des filtres à air, un système d'injection du dioxyde de carbone, un système d'irrigation ainsi qu'un système de climatisation pour les mois d'été, le tout contrôlé par un ordinateur central.

L'annexe 4 présente un article sur les activités de recherche en cours dans la serre de démonstration du comté de Burlington, ainsi que quelques photos du site. Ces recherches ont permis de développer des techniques de production de tomates dont les rendements sont grandement supérieurs à ceux obtenus sur une ferme. En effet, il a été démontré que les plants de la serre de Burlington peuvent produire environ 100 livres de tomates sur une surface de 70 pi^2 (7 kg/m^2) en 10 semaines.

Ce projet de démonstration tente dans la mesure du possible de reproduire les défis que les producteurs de serre doivent faire face et comprend même une analyse détaillée des coûts et des revenus associés à la production de tomates en serre. Ce projet permet ainsi de fournir l'information nécessaire aux producteurs pour qu'ils puissent prendre des décisions éclairées concernant leur production.

4.2.2 Projet EnergyXchange Renewable Energy Center en Caroline du Nord

Le projet *EnergyXchange Renewable Energy Center* est situé aux pieds de la chaîne des Black Mountains dans l'ouest de la Caroline du Nord. L'objectif de EnergyXchange, un organisme à but non lucratif, est de démontrer l'efficacité de l'utilisation du biogaz de site d'enfouissement comme source d'énergie pour de petites entreprises d'horticulture et d'artisanat et pour répondre aux besoins locaux en énergie.

Le site du projet inclus trois serres, une infrastructure de production hydroponique, deux ateliers d'artisanat (un pour la poterie et un autre pour le verre soufflé), une galerie d'art et un centre pour les visiteurs.

Le biogaz du site d'enfouissement local répond à tous les besoins en énergie du projet, que ce soit pour la production artisanale que pour le chauffage des immeubles et des serres.

Le projet s'est vu décerner par le LMOP du USEPA le prix de projet de l'année 2002.

L'annexe 5 présente davantage d'informations sur le projet EnergyXchange.

5 CONCLUSION

Cette revue bibliographique a permis de mettre en exergue le potentiel énergique des biogaz issus des sites d'enfouissement, ainsi que l'implication de Waste Management dans la valorisation énergétique de ces biogaz dans le cadre de partenariats durables.

Quelques projets de valorisation agricole des biogaz pour l'approvisionnement énergétique de serres sont actuellement mis en œuvre tant au Canada qu'aux États-Unis. Ces projets permettent d'assurer aux propriétaires de ces serres d'obtenir une énergie propre à faible coût et aux gestionnaires de sites d'enfouissement de participer à la récupération d'une ressource qui autrement serait perdue et de répondre aux préoccupations du public en ce qui concerne les problèmes des odeurs et de migration des biogaz dans les sols. Il est à noter que certains de ces projets ont remporté des prix soulignant leur contribution à l'avancement de la valorisation énergétique des biogaz.

Ces projets de valorisation agricole des biogaz constituent des exemples de succès dont le Comité technique agricole de la MRC de La Rivière-du-Nord / Intersan pourrait s'inspirer afin de mettre en valeur les biogaz du lieu d'enfouissement sanitaire de Sainte-Sophie. À cet effet, les étapes suivantes sont suggérées au Comité à titre de plan d'action à court terme:

a) Approfondissement de la connaissance des projets existants de valorisation agricole des biogaz (documentation, visites, etc.).
b) Création d'une structure organisationnelle telle qu'une organisation à but non lucratif qui sera en charge de la promotion du projet de valorisation agricole du biogaz.
c) Identification d'une vocation principale, définition de projets potentiels et étude de faisabilité technique, socio-économique et environnementale de ces projets.
d) Recherche et identification de partenaires investisseurs (privés et gouvernementaux).
e) Recherche et identification de partenaires de recherche, i.e. universités.

De plus, l'annexe 6 présente un schéma des étapes à suivre recommandées par le LMOP du USEPA pour développer un projet de valorisation énergétique du biogaz de sites d'enfouissement.

6 RÉFÉRENCES

Comté de Langley. www.township.langley.bc.ca

EnergyXchange. www.energyxchange.org (site non fonctionnel au moment de la revue bibliographique)

Environnement Canada, Bureau national de la prévention de la pollution. *Utilisation des gaz d'enfouissement*. www.ec.gc.ca/nopp/lfg

Green Knights Economic Development Corporation. www.gkedc.com

Landfill Gas Industry Alliance. www.lfgindustry.org

Rutgers University, Department of Bioresources Engineering. http://aesop.rutgers.edu/~ccea/burlproj.htm

Rutgers University, EcoComplex. www.ecocomplex.rutgers.edu

USEPA, Landfill Methane Outreach Program. www.epa.gov/lmop

Ville de Vancouver. www.city.vancouver.bc.ca

Waste Management Inc. www.wm.com

ANNEXE 1

Valorisation énergétique des biogaz par Waste Management Inc.

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Waste Management, Inc.

Forming Partnerships to Lead the Landfill Gas Energy Industry

Waste Management, Inc. (WMI) provides comprehensive waste management services and undertakes projects that collect landfill gas and convert it to usable energy. WMI owns and operates nearly 300 landfills throughout the United States and has formed a joint venture partnership to operate more than 30 landfill gas energy (LFGE) projects. WMI also collaborates with a variety of other energy-services contractors, including Landfill Energy Systems, TORO Energy, and Ameresco Energy Services. For its efforts to promote and expand LFGE projects, the U.S. Environmental Protection Agency (EPA) recognized WMI as a Landfill Methane Outreach Program (LMOP) Industry Partner of the Year in 1999.

Project Description

WMI has been working independently and through partnerships to develop LFGE power production facilities. WMI operates more than 30 landfill gas powered electric generating plants throughout the United States, several of which have been in operation since the mid-1980s. These plants employ reciprocating engines and combustion turbines that use landfill gas as the primary fuel source. In 1986, WMI formed Bio-Energy Partners whose plants produced nearly 1.2 billion kWh of energy in 2000 using landfill gas.

WMI recently entered into a unique partnership with Green Knights Economic Development Corporation (GKEDC), a nonprofit corporation formed by local citizens in Northampton County, Pennsylvania, to construct an 8 MW LFGE facility. The revenue from this project helps promote economic development in the region. In addition, WMI entered into a partnership with the Omaha Public Power District (OPPD) to provide local energy. OPPD owns—while WMI developed and operates—a 3.2 MW LFGE facility at WMI's Douglas County Landfill near Omaha, Nebraska. WMI undertook this project in hopes of spurring interest in green power purchases in the absence of deregulation or competition.

In addition to being a power provider, WMI has also been involved in direct sales of landfill gas to end users. Since 1988, WMI has delivered landfill gas directly to Ford Motor Company, via an approximately four-mile pipeline, to help fuel boilers and reciprocating engines at Ford facilities. WMI also directly sells landfill gas to Emory Chemical, Blue Circle Cement, PECO, SC Johnson, and Ogden.

Benefits

By actively seeking and maintaining partnerships, WMI expanded its options for developing facilities that use landfill gas for energy production. WMI continues to look for ways to reduce emissions of greenhouse gases.

Summary of Benefits

- *Generates clean, renewable energy*
- *Reduces greenhouse gas emissions*
- *Builds partnerships within communities*

What Is Landfill Gas?

Most of the waste we generate ends up in landfills, where it decomposes and produces landfill gas. Landfill gas, if uncontrolled, can contribute to local smog and present health and safety hazards. Additionally, landfill gas is approximately 50 percent methane, a potent greenhouse gas that contributes to global climate change. Methane, however, is also a reliable and renewable fuel source that can be collected an used in a variety of applications.

FOR FURTHER INFORMATION

LMOP is a voluntary program that assists project developers, utilities, landfill owners/operators, energy users, and communities to encourage new LFGE projects. LMOP has developed a variety of tools (e.g., profiles, fact sheets, project development manuals, and software) to facilitate the development of LFGE projects. Hundreds of landfills across the country—and around the world—are good candidates for a LFGE project. To find out more, please contact:

U.S. Environmental Protection Agency
Landfill Methane Outreach Program
Climate Protection Partnership Division
1200 Pennsylvania Avenue, NW
Mailcode 6202J
Washington, DC 20460
Tel: 1-888-782-7937
Fax: 1-202-775-6680
Web site: www.epa.gov/lmop

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Last updated on Monday, August 18th, 2003
URL: http://www.epa.gov/landfill/products/wmi.htm

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Green Knight Economic Development Project

Developing Local Economies and Protecting the Environment

The towns of Wind Gap, Pen Argyl, and Plainfield Township in Northampton County, Pennsylvania, are known as the "Slate Belt." In recent years, local industries that once provided jobs and economic stability to residents, such as quarry, textile, ladies garment, and railroad industries, have declined. A number of local initiatives are underway to help boost economic development, including a landfill gas energy (LFGE) project.

Waste Management, Inc. (WMI) owns and operates a local landfill where landfill gas had been flared for years. WMI, however, was looking for ways to put the gas to more productive use. While they could have captured the gas and sold it for profit, WMI chose to involve and benefit the local community. A volunteer task force, comprised of residents served by three municipalities and WMI, conceived the innovative idea to create an independent, nonprofit corporation—the Green Knight Economic Development Corporation (GKEDC)—that would own the power production facility and use the revenue from the sale of the electricity to fund local economic development efforts. This project earned the U.S. Environmental Protection Agency's (EPA's) Landfill Methane Outreach Program (LMOP) Project of the Year Award in 2000.

Project Description

GKEDC's mission is to promote economic development within the three towns. Each town has equal representation on the board, which determines how to invest the revenue from selling the gas. Because GKEDC is a nonprofit organization, they are also eligible for project development grants and subsidies.

WMI's Grand Central Sanitary Landfill generates more than 6.5 million cubic feet of landfill gas daily. WMI designed and operates a 10 MW power plant on site, which GKEDC owns. GKEDC received a $9.2 million loan from a local bank to construct the LFGE facility, with WMI guaranteeing the loan. GKEDC sells the power to a local utility, then uses the proceeds to develop projects that benefit the three municipalities comprising the Pen Argyl School District. In March 2001, GKEDC began selling energy to Exelon Power Team, an energy marketer. GKEDC used the profits from the sale to fund local economic development and civic/educational projects. Because the plant was designed and constructed to be readily retrofitted with heat recovery equipment, it has the potential produce thermal energy that can be sold to any industry sited nearby.

Benefits

This project resulted in economic, social, and environmental benefits.

GKEDC's nonprofit status allows them to perform important actions that would not be viable for WMI, such as soliciting donations, seeking grants, and applying for government subsidies. Most importantly, GKEDC's organizational structure puts the local community in charge of its own economic redevelopment. In addition, the project reduces methane emissions from the landfill and generates a source of clean, renewable energy.

Summary of Benefits

- *Provides funding for local economic development*
- *Empowers the community*
- *Promotes public-private cooperation*
- *Reduces greenhouse gas emissions*
- *Generates clean, renewable energy*

What Is Landfill Gas?

Most of the waste we generate ends up in landfills, where it decomposes and produces landfill gas. Landfill gas released into the air smells bad, contributes to local smog, and is an explosion hazard. Additionally, landfill gas is about 50 percent methane, a potent greenhouse gas that contributes to global climate change. However, this methane is also a reliable and renewable fuel source that, if not collected, goes to waste.

For Further Information

LMOP is a voluntary program that assists project developers, utilities, landfill owners/operators, energy users, and communities to encourage new LFGE projects. LMOP has developed a variety of tools (e.g., profiles, fact sheets, project development manuals, and software) to facilitate the development of LFGE projects. Hundreds of landfills across the country—and around the world—are good candidates for a LFGE project. To find out more, please contact:

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Web site: www.epa.gov/lmop

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The Unique Structure of the LFGTE Project at Grand Central Landfill Benefits the Community

Mark C. Messics, P.E. and James M. Policelli, P.E.

The region known as the Slate Belt in eastern Pennsylvania is an area of mostly small towns and farmland. Historically, the agricultural economy was strongly supplemented by slate quarrying and garment and textile manufacturing. Today, the quarrying and garment industries are a very small fraction of their former size and the textile plants are gone completely. A large fraction of the residents drive out of the area for employment. It is difficult to keep young people in the area once they finish school. Within one part of the Slate Belt are three communities (totaling 11,000 residents) whose largest nearby industry is Waste Management's Grand Central Sanitary Landfill.

Since the implementation of environmental requirements to collect and control gas emissions from landfills, opportunities for the productive and practical utilization of landfill methane have sprung into being. The transition to electricity deregulation further improved the practicality of these opportunities. With the need for jobs in the Slate Belt and the availability of idled industrial land, the arena was ripe for an innovative initiative to merge the landfill gas (LFG) energy potential with the need for economic development in the region.

Waste Management (WM) officials recognized this opportunity for the communities and moved creatively to bring it to reality. WM nurtured the formation of a three-community, non-profit corporation, the Green Knight Economic Development Corporation (GKEDC), to build and own a LFG energy center. WM also donated 20 acres of nearby land to the county for industrial development. The expectation is that low-cost energy from the energy center will entice industry to locate in the area.

GKEDC exists due to the efforts of its all-volunteer board of directors who have the foresight to see how the project can financially benefit the communities. A local bank has provided the project financing, thus, allowing the project to come to fruition. While GKEDC is the owner of the energy center and party to all energy sale contracts, WM is serving as project manager and will operate the facility under contract to GKEDC. WM has guaranteed the project-financing loan and has provided GKEDC with operational guarantees.

The concept that WM envisioned for the energy center involved the use of three Solar Centaur gas turbines to generate 10 megawatts of electric power. Thinking even more innovatively, WM planned the energy center so that it could be readily retrofitted with back-end heat recovery in the future. A stand-alone heat recovery project may provide low-cost district heating/cooling to nearby industries; hence a further incentive for industry to locate here. The result would be a "green", combined heat and power complex. These provisions added perhaps two percent to the overall cost of the center, but could be pivotal in the economics of a future stand-alone heat recovery project.

For the small surrounding communities, a local 10 MW power plant is no small issue. The project had to work through a seemingly endless string of delays including those from state and local regulatory agencies, utility companies, and obstructive activists. Although the project is nearing completion, the delays have cost the GKEDC a large amount in unrealized income. Siting compromises have resulted in a costlier initial installation and higher economic hurdles for any potential back-end heat recovery projects.

Le gaz d'enfouissement

Projet d'utilisation du gaz d'enfouissement de Magog

Aperçu

Le gaz d'enfouissement émis par un lieu d'enfouissement de taille moyenne est utilisé directement de façon novatrice en vue de réduire la consommation en carburant associée à l'exploitation de l'installation.

Résumé de 2001	
Déchets présents	~2 200 000 tonnes
Déchets reçus	147 000 tonnes
Capacité du lieu d'enfouissement	~2 300 000 tonnes
CH_4 capté	876 000 m^3
Teneur (%) en CH_4 du gaz d'enfouissement	50%
Gaz d'enfouissement torché	1 752 000 m^3
Énergie générée	1 600 000 BTU*
Réduction des émissions de gaz à effet de serre(Tonnes équivalent-CO_2)	
Combustion de gaz d'enfouissement	13 200

*** Utilisés tout au long de la saison froide.**

Le lieu d'enfouissement de Magog appartient à la société Intersan (division de Canadian Waste Services Inc.) et celle-ci en assure l'exploitation. Il est situé dans le canton résidentiel rural de Magog, au Québec, à environ 120 kilomètres au sud-est de Montréal.

Le lieu d'enfouissement de Magog a commencé à recevoir des déchets municipaux, industriels et commerciaux en 1970. Puisque ce lieu d'enfouissement a presque atteint sa capacité permise, Intersan cherche à obtenir l'autorisation de l'agrandir et, donc, d'en prolonger l'exploitation. L'expansion proposée comprend des plans visant la mise en oeuvre d'un lieu d'enfouissement à bioréacteur et d'un système pleine grandeur de captage actif de gaz d'enfouissement.

Technologie

Présentement, le gaz d'enfouissement est capté à partir d'une chambre d'accès située dans le système de contrôle du lixiviat du lieu d'enfouissement. À l'aide d'un compresseur, le gaz d'enfouissement est acheminé, sous pression, par l'intermédiaire d'un gazoduc de 80 mètres de longueur et est injecté dans une citerne de stockage de gaz d'enfouissement. Le gaz d'enfouissement sous pression est par la suite utilisé pour alimenter quatre appareils de chauffage suspendus de 400 000 BTU situés dans le garage d'entretien des véhicules du lieu d'enfouissement.

Le gaz d'enfouissement utilisé à titre de carburant de chauffage remplace le gaz naturel auquel on aurait autrement recours pour chauffer l'immeuble, ce qui contribue à la réduction globale de la consommation de combustibles fossiles.

Au sein de ses installations de Magog, Intersan utilise également des torchères (dont le système d'allumage par étincelle est alimenté à l'énergie solaire) pour limiter les odeurs qui émanent de plusieurs chambres d'accès du système de contrôle du lixiviat.

Les plans visant l'expansion future du lieu d'enfouissement comprennent la mise en oeuvre d'un lieu d'enfouissement à bioréacteur et l'installation d'un système de captage actif en vue d'accroître la quantité de gaz d'enfouissement disponible à des fins énergétiques. Cela pourrait permettre aux décideurs de songer à d'autres options pour l'utilisation du gaz d'enfouissement, telles que des applications de chauffage (localisé-industriel) à plus grande échelle ou la production d'électricité.

Avantages

Voici certains des avantages que l'on a pu tirer de l'approche d'Intersan quant à la gestion du gaz d'enfouissement émis par le lieu d'enfouissement de Magog:

- On a pu réduire les odeurs émanant des chambres d'accès du système de contrôle du lixiviat
- On a pu réduire la quantité de combustibles fossiles consommés par Intersan pour chauffer son garage
- On a pu réduire les coûts d'exploitation de l'installation
- L'exploitation du gaz d'enfouissement entraîne une réduction des rejets de gaz à effet de serre dans l'atmosphère et permet l'utilisation à bon escient d'une ressource qui, autrement, serait perdue.

Renseignements supplémentaires

Environnement Canada
Bureau national de la prévention de la pollution
Place Vincent Massey
351, boul. St-Joseph
Hull (Québec) K1A 0H3
Canada

Organisme-ressource	Ressources Internet
Canadian Waste Services Inc.	http://www.canadianwaste.ca/
Landfill Gas Industry Alliance	http://www.lfgindustry.org/

Gaz d'enfouissement:

Produit par la décomposition biologique de déchets se trouvant dans un lieu d'enfouissement, le gaz d'enfouissement représente tant un danger pour l'environnement qu'une source unique d'énergie renouvelable. Bien qu'il soit principalement composé de dioxyde de carbone et de méthane, le gaz d'enfouissement contient également souvent des composés à l'état de trace

tels que l'hydrogène sulfuré, les thiols, le chlorure de vinyle et de nombreux autres composés organiques volatils. Parmi les préoccupations souvent liées au gaz d'enfouissement, on trouve les odeurs, les effets sur la qualité de l'air et les risques d'explosion. S'il est rejeté dans l'atmosphère à l'état brut, le gaz d'enfouissement s'avère également un puissant gaz à effet de serre qui contribue aux modifications climatiques à l'échelle mondiale. Le captage du gaz d'enfouissement pour en diminuer les effets permet aussi la création d'une source d'énergie verte. Le méthane que contient le gaz d'enfouissement constitue une source d'énergie pouvant être utilisée pour générer de l'électricité, chauffer des immeubles, alimenter des procédés industriels ou assurer le fonctionnement de certains véhicules. L'utilisation de l'énergie tirée du gaz d'enfouissement contribue non seulement à la réduction des effets environnementaux à l'échelle locale, mais permet également d'éviter le recours aux combustibles fossiles qui seraient autrement nécessaires pour générer une quantité d'énergie équivalente. Le captage et l'utilisation du gaz d'enfouissement représentent une importante occasion de réduire les rejets de gaz à effet de serre dans l'atmosphère.

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ANNEXE 2

Projet de valorisation énergétique des biogaz de Vancouver

THE DELTA Optimist

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NEWS

$10 million green energy project providing fuel source for greenhouse

by Maureen Gulyas

CanAgro, one of the largest greenhouses in Delta, flipped the switch on a landfill gas green energy project this week, more than a year after the plan was given final approval by the municipality.

On Wednesday, CanAgro officially began the process of harnessing the methane gas generated by the Vancouver Landfill in Burns Bog to heat its operation.

Before co-generation, the landfill methane, produced by rotting garbage, was flared into the atmosphere.

The landfill is about 1.6 km from the CanAgro's 80th Street greenhouse, a 22-hectare facility that grows 29 million pounds of tomatoes annually.

The $10-million green energy project will provide Maxim Power, a Calgary-based independent power producer, with electricity to sell on the open market, while CanAgro will use the power from the methane to heat the greenhouse.

The process, called co-generation, is widely used in Europe.

An underground gas pipeline was constructed from the Burns Bog landfill to transport the methane to the co-generation facility at CanAgro.

The co-generation process will generate 5.5 megawatts of electrical power. Maxim has contracted with B.C. Hydro to provide electrical power, and with CanAgro to provide the greenhouse with a heating source that will be less expensive than using natural gas.

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Le gaz d'enfouissement

Projet de valorisation énergétique du gaz d'enfouissement de Vancouver

Bureau national de la prévention de la pollution

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Aperçu

La Ville de Vancouver et la société Maxim Energy Group Ltd. collaborant en vue de mettre en oeuvre un projet de valorisation énergétique du gaz d'enfouissement au sein du lieu d'enfouissement de Vancouver.

Résumé de 2001	
Déchets présents	11 500 000 tonnes
Déchets reçus	390 000 tonnes
Capacité du lieu d'enfouissement	30 000 000 tonnes
CH_4 capté	16 600 000 m^3
Teneur (%) en CH_4 du gaz d'enfouissement	54%
Gaz d'enfouissement torché	30 680 000 m^3
Énergie générée	À partir de 2003
Énergie thermique récupérée	À partir de 2003
Réduction des émissions de gaz à effet de serre(Tonnes équivalent-CO_2)	
Combustion de gaz d'enfouissement	~250 000
Réduction de recours aux combustibles fossiles	À partir de 2003

Le lieu d'enfouissement de Vancouver appartient à la Ville de Vancouver et celle-ci en assure l'exploitation. Il est situé dans la municipalité de Delta, en Colombie-Britannique et dessert une population d'environ 900 000 habitants.

Le lieu d'enfouissement est exploité depuis 1966 et l'on s'attend à continuer à y déposer des déchets pendant 40 autres années

Realisation du projet

Dans le cadre des mesures visant la gestion environnementale du lieu d'enfouissement, la Ville a mis en oeuvre un système de captage et de torchage du gaz d'enfouissement en 1991. Ce dernier a été installé principalement dans le but d'atténuer les odeurs. Une partie du gaz d'enfouissement capté est utilisé pour chauffer l'immeuble servant à la gestion du lieu d'enfouissement et l'alimenter en eau chaude, ce qui constitue un avantage supplémentaire du système.

Reconnaissant l'occasion de valorisation énergétique du gaz d'enfouissement que présentaient les activités de captage qui se déroulaient sur le lieu d'enfouissement, la Ville a lancé un appel d'offres en vue d'obtenir des propositions visant l'utilisation du gaz d'enfouissement. À la suite de l'évaluation des propositions, la société Maxim a été sélectionnée pour concevoir, construire et exploiter une installation d'utilisation du gaz d'enfouissement qui lui appartiendrait sur le site du lieu d'enfouissement de Vancouver.

Maxim prévoit générer de l'électricité à partir du gaz d'enfouissement en vue de la vendre à BC Hydro. Une convention d'achat a été conclue avec BC Hydro en vertu du programme «Green Energy Projects» de cette dernière.

Maxim prévoit également optimiser l'efficacité énergétique globale du projet en récupérant l'énergie résiduelle afin de l'utiliser dans des serres de légumes se trouvant à proximité et appartenant à CanAgro Produce Ltd.

On s'attend à ce que la construction de l'installation d'utilisation débute au cours de l'année 2002 en prévision d'un démarrage au cours des premiers mois de 2003.

Chronologie	
1966	Ouverture du lieu d'enfouissement
1991	Installation de la phase initiale du système de captage et de torchage du gaz d'enfouissement
2000/2001	Expansion du système de captage et de torchage du gaz d'enfouissement
2001	La Ville obtient des propositions pour l'élaboration de l'utilisation du gaz d'enfouissement
2001/2002	Expansion supplémentaire du système de captage et de torchage du gaz d'enfouissement
2002	La Ville sélectionne la société Maxim Energy à titre de promoteur du projet d'utilisation du gaz d'enfouissement
2002/2003	Années au cours desquelles on prévoit construire et démarrer l'installation d'utilisation du gaz d'enfouissement

Technologie

Le système de captage et de torchage du gaz d'enfouissement du lieu d'enfouissement de Vancouver a été construit de façon progressive, au fur et à mesure du remplissage du lieu d'enfouissement.

L'étape initiale de ce système comportait 190 puits de captage verticaux, un important réseau de canalisations de captage, deux ventilateurs et deux torchères. Ce segment du système de maîtrise du gaz d'enfouissement a été installé en 1991 et couvre environ 84 hectares au sein du lieu d'enfouissement.

Construite en 2001, la deuxième phase du système a entraîné l'installation de 156 puits supplémentaires, de 28 nouveaux drains de condensat, de plus de 10 000 mètres de canalisations de captage supplémentaires, de deux ventilateurs et de deux torchères supplémentaires, et d'une interconnexion destinée à la future installation d'utilisation du gaz d'enfouissement. Le deuxième segment du système de maîtrise du gaz d'enfouissement couvre environ 56 hectares additionnels au sein du lieu d'enfouissement.

La Ville s'affaire présentement à la mise en oeuvre de la troisième phase de l'expansion du système de contrôle du gaz d'enfouissement. Les détails de conception en cours d'élaboration font appel tant à des tranchées horizontales qu'à des puits verticaux pour l'extraction du gaz d'enfouissement au fur et à mesure de remplissage du lieu d'enfouissement. La construction de cette troisième phase est prévue pour 2002.

La Ville continuera d'agrandir le système de captage de gaz d'enfouissement en vue de répondre aux besoins du lieu d'enfouissement.

Maxim prévoit construire une centrale électrique de cinq mégawatts qui sera alimentée par le gaz d'enfouissement extrait du lieu d'enfouissement. L'électricité ainsi produite sera acheminée vers le réseau en vertu de l'entente de 20 ans qui lie Maxim et BC Hydro.

L'énergie résiduelle de la centrale sera récupérée sous forme d'eau chaude. Cette dernière sera achetée par CanAgro en vue de répondre aux besoins de chauffage de son complexe de serres commerciales situé à proximité.

Maxim détient l'option d'utiliser toute quantité de gaz d'enfouissement supplémentaire captée par la Ville en raison de l'expansion future du système de captage de gaz d'enfouissement.

Leçons

Voici certaines des leçons clés que l'on a pu tirer de la réussite du projet de valorisation énergétique du gaz d'enfouissement de Vancouver:

- La participation du secteur privé a permis à la Ville de procéder à l'exploitation commerciale du gaz d'enfouissement à titre de source d'énergie
- La Ville maintient son engagement envers la mise en oeuvre continue d'efforts visant le captage du gaz d'enfouissement émis par le lieu d'enfouissement
- Le programme «Green Energy Projects» de BC Hydro établit le marché de base pour l'électricité issue du gaz d'enfouissement
- La proximité des installations de CanAgro constitue une occasion unique d'améliorer l'efficacité énergétique globale du projet

Avantages

- En procédant au captage actif du gaz d'enfouissement émis par le lieu d'enfouissement, la Ville s'acquitte de son obligation de gérer les émanations et de répondre aux préoccupations relatives aux odeurs à proximité du lieu d'enfouissement. Le torchage du gaz d'enfouissement a considérablement réduit les émissions de gaz à effet de serre du lieu d'enfouissement.
- La Ville perçoit des redevances d'environ 200 000 dollars par année pour sa participation à la récupération d'une ressource qui, autrement, représenterait un fardeau.
- Les avantages de l'utilisation du gaz d'enfouissement pour générer de l'électricité sont multiples. Cette utilisation entraîne en effet une réduction des émissions globales du lieu d'enfouissement et permet l'obtention d'une source d'énergie verte qui réduit le besoin de consommer des combustibles fossiles afin de générer une quantité équivalente d'énergie. De même, la récupération de l'énergie résiduelle en vue de l'utiliser dans des serres permet de réduire encore plus la consommation de combustibles fossiles.
- La production d'énergie verte à partir du gaz d'enfouissement permet l'utilisation à bon escient d'une ressource qui, autrement, serait perdue. La production d'électricité à partir du gaz d'enfouissement offre une source écologique et renouvelable d'énergie.

Renseignements supplémentaires

Environnement Canada
Bureau national de la prévention de la pollution
Place Vincent Massey
351, boul. St-Joseph
Hull (Québec) K1A 0H3
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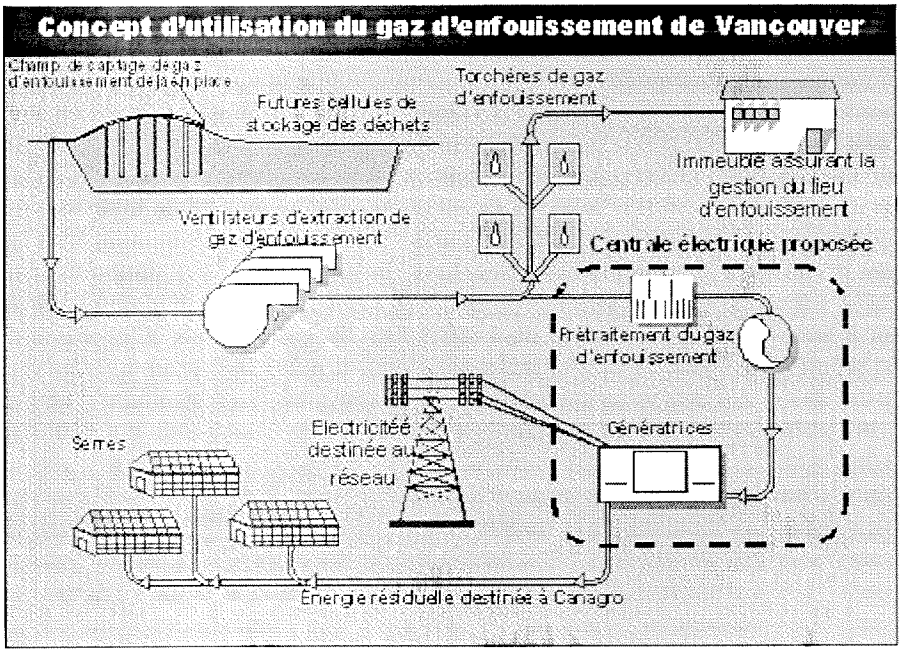
Organisme-ressource	Ressources Internet
Maxim Energy Group Ltd.	http://www.maximenergy.com/
Ville de Vancouver	http://www.city.vancouver.bc.ca/
BC Hydro	http://www.bchydro.com/
Landfill Gas Industry Alliance	http://www.lfgindustry.org/

Gaz d'enfouissement:

Produit par la décomposition biologique de déchets se trouvant dans un lieu d'enfouissement, le gaz d'enfouissement représente tant un danger pour l'environnement qu'une source unique d'énergie renouvelable. Bien qu'il soit principalement composé de dioxyde de carbone et de méthane, le gaz d'enfouissement contient également souvent des composés à l'état de trace tels que l'hydrogène sulfuré, les thiols, le chlorure de vinyle et de nombreux autres composés organiques volatils. Parmi les préoccupations souvent liées au gaz d'enfouissement, on trouve les odeurs, les effets sur la qualité de l'air et les risques d'explosion. S'il est rejeté dans l'atmosphère à l'état brut, le gaz d'enfouissement s'avère également un puissant gaz à effet de serre qui contribue aux modifications climatiques à l'échelle mondiale. Le captage du gaz d'enfouissement pour en diminuer les effets permet aussi la création d'une source d'énergie verte. Le méthane que contient le gaz d'enfouissement constitue une source d'énergie pouvant être utilisée pour générer de l'électricité, chauffer des immeubles, alimenter des procédés industriels ou assurer le fonctionnement de certains véhicules. L'utilisation de l'énergie tirée du gaz d'enfouissement contribue non seulement à la réduction des effets environnementaux à l'échelle locale, mais permet également d'éviter le recours aux combustibles fossiles qui seraient autrement nécessaires pour générer une quantité d'énergie équivalente. Le captage et l'utilisation du gaz d'enfouissement représentent une importante occasion de réduire les rejets de gaz à effet de serre dans l'atmosphère.



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ANNEXE 3

Projet d'utilisation du gaz d'enfouissement de Jackman,
Colombie-Britannique

Bureau national de la prévention de la pollution

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Le Bureau national de la prévention de la pollution

Le gaz d'enfouissement

Projet d'utilisation du gaz d'enfouissement de Jackman

Aperçu

Le gaz d'enfouissement issu d'un lieu d'enfouissement fermé de moindre envergure est utilisé de façon novatrice par une serre avoisinante.

Résumé de 2001	
Déchets présents	~400 000 tonnes
Déchets reçus	0 tonnes
Capacité du lieu d'enfouissement	~400 000 tonnes
CH_4 capté	310 000 m^3
Teneur (%) en CH_4 du gaz d'enfouissement	45%
Gaz d'enfouissement torché	0 m^3
Énergie générée	11 100 000 000 BTU, soit assez d'énergie pour chauffer environ 220 foyers*
Réduction des émissions de gaz à effet de serre(Tonnes équivalent-CO_2)	
Combustion de gaz d'enfouissement	4 700

*** Fondé sur une consommation de 50 millions BTU par foyer/année.**

Le lieu d'enfouissement fermé de Jackman appartient au comté de Langley et est situé dans la zone rurale et résidentielle d'Aldergrove, dans le comté de Langley, en Colombie-Britannique.

Ce lieu d'enfouissement a commencé à recevoir des déchets solides municipaux en 1956. Le comte s'en est porté acquérer en 1973 et en a poursuivi l'exploitation jusqu'en 1990, année au cours de laquelle le lieu d'enfouissement a été fermé.

Réalisation du projet

À la suite de la fermeture du lieu d'enfouissement, le comté a mis en oeuvre un plan de fermeture officiel comprenant les étapes suivantes:

- Recouvrement du lieu d'enfouissement
- Contrôle environnemental
- Gestion des eaux de surface
- Milieu humide aménagé
- Captage du gaz d'enfouissement

Le système de captage du gaz d'enfouissement a été installé pour contrôler les odeurs et pour prévenir la migration du gaz dans les sols entourant le lieu d'enfouissement. Le captage et le torchage du gaz d'enfouissement ont permis d'utiliser ce gaz à d'autres fins. Le comté a alors créé une coentreprise avec Norseman Engineering en vue d'exploiter le gaz d'enfouissement capté.

Norseman a par la suite sélectionné l'entreprise avoisinante Topgro Greenhouses limited à titre d'utilisateur final potentiel du gaz d'enfouissement.

Les serres commerciales de Topgro sont situées à environ 1,5 kilomètre du lieu d'enfouissement.

Norseman a négocié des ententes avec le comté en vue d'assurer l'accès au gaz d'enfouissement et avec Topgro pour la vente de ce dernier en vue d'une utilisation dans les serres. Topgro et Norseman ont assuré l'investissement de capitaux pour la conception du projet.

Norseman a construit une station de compression et un gazoduc menant aux installations de Topgro. L'utilisation du gaz d'enfouissement dans les serres de cette dernière a débuté en janvier 1995.

Norseman exploite le système de captage de gaz d'enfouissement et assume les responsabilités liées au contrôle des odeurs et à la migration de ce gaz.

Chronologie	
1990	Fermeture du lieu d'enfouissement
1991	Construction d'un système de captage de gaz d'enfouissement (40 puits, 1 torchère)
1988 - 1994	Recouvrement progressif du lieu d'enfouissement
1994	Construction d'un gazoduc
1995	Début de l'utilisation du gaz d'enfouissement dans les serres de Topgro

Technologie

Le système d'utilisation du gaz d'enfouissement de Jackman comporte les composantes suivantes:

- Champ de captage de gaz d'enfouissement
- Station de compression et gazoduc
- Chaudière polycombustible

Le gaz d'enfouissement est capté par 40 puits d'extraction verticaux forés à même les déchets du lieu d'enfouissement. Un réseau de canalisations lie les puits à une station centrale de compression.

Cette station compte un compresseur à piston de 250 HP qui crée un vide au sein des puits d'extraction, met le gaz d'enfouissement capté sous pression et en permet l'acheminement aux serres de Topgro par l'entremise d'un gazoduc de 1,5 kilomètre.

Au sein des installations de Topgro, trois chaudières sont utilisées pour chauffer l'eau qui circule dans les serres afin de maintenir des températures de croissance optimales tout au long de l'année. Deux de ces chaudières fonctionnent au gaz naturel, tandis que la troisième a été modifiée pour fonctionner tant au gaz d'enfouissement qu'au gaz naturel.

En été, le gaz d'enfouissement est brûlé dans la chaudière polycombustible afin de produire du dioxyde de carbone (CO_2). On utilise ce dernier dans les serres en vue de promouvoir une croissance rapide et saine des végétaux. La combustion du gaz d'enfouissement répond à presque tous les besoins en CO_2 de serres.

Puisque les végétaux sont très sensibles à certains contaminants atmosphériques, l'évaluation des produits de la combustion du gaz d'enfouissement représente une priorité. Des tests approfondis effectués pendant un certain nombre d'années ont confirmé le caractère adéquat des émissions de la chaudière polycombustible. L'utilisation de CO_2 issu du gaz d'enfouissement se poursuit de façon expérimentale et continue d'être soumise à des tests.

Les chutes récentes des quantités de gaz d'enfouissement captées au sein du lieu d'enfouissement ont amené les responsables à songer a l'expansion du champ de puits de captage.

Leçons

Voici certaines des leçons clés que l'on a pu tirer de la réussite du projet d'utilisation du gaz d'enfouissement de Jackman:

- La proximité de l'utilisateur de gaz d'enfouissement (soit Topgro) s'est avérée essentielle à la réussite du projet
- Une étude approfondie et la confirmation du caractère adéquat des produits de la combustion du gaz d'enfouissement ont permis la découverte d'une application supplémentaire pour ce dernier, soit la production de CO2
- L'utilisation du gaz d'enfouissement pour la production de CO2 et à titre de carburant de chauffage engendre un accroissement global de la demande en gaz d'enfouissement et permet d'équilibrer les fluctuations saisonnières
- La participation du secteur privé a permis la concrétisation du projet d'utilisation du gaz d'enfouissement tout en limitant les effets indésirables potentiels de ce dernier

Avantages

- Le captage actif du gaz d'enfouissement répond aux préoccupations du comté quant aux problèmes possibles liés aux odeurs et à la migration souterraine.
- Les avantages de l'utilisation du gaz d'enfouissement pour la production d'électricité sont multiples. Cette utilisation entraîne en effet une réduction des émissions globales du lieu d'enfouissement et permet l'obtention d'une source d'énergie verte qui réduit le besoin de consommer des combustibles fossiles afin de générer une quantité équivalente d'énergie.
- Norseman tire des revenus de la vente de gaz d'enfouissement, tandis que Topgro est en mesure de réduire ses coûts en carburant et en CO2.
- Le comté perçoit des redevances pour sa participation à la récupération d'une ressource qui, autrement, représenterait un fardeau.
- L'utilisation du gaz d'enfouissement réduit les rejets de gaz à effet de serre dans l'atmosphère et permet l'utilisation à bon escient d'une ressource qui, autrement, serait perdue.

Renseignements supplémentaires

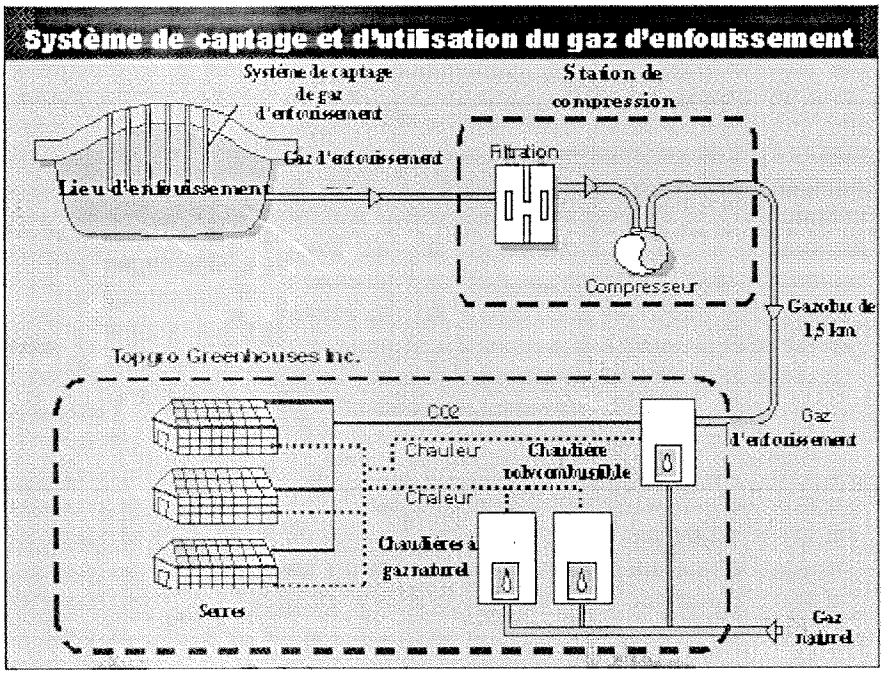
Environnement Canada
Bureau national de la prévention de la pollution
Place Vincent Massey
351, boul. St-Joseph
Hull (Québec) K1A 0H3
Canada

Organisme-ressource	Ressources Internet
Norseman Engineering	(604) 946 - 0111
Comté de Langley	http://www.township.langley.bc.ca/
Landfill Gas Industry Alliance	http://www.lfgindustry.org/

Gaz d'enfouissement:

Produit par la décomposition biologique de déchets se trouvant dans un lieu d'enfouissement, le gaz d'enfouissement représente tant un danger pour l'environnement qu'une source unique d'énergie renouvelable. Bien qu'il soit

principalement composé de dioxyde de carbone et de méthane, le gaz d'enfouissement contient également souvent des composés à l'état de trace tels que l'hydrogène sulfuré, les thiols, le chlorure de vinyle et de nombreux autres composés organiques volatils. Parmi les préoccupations souvent liées au gaz d'enfouissement, on trouve les odeurs, les effets sur la qualité de l'air et les risques d'explosion. S'il est rejeté dans l'atmosphère à l'état brut, le gaz d'enfouissement s'avère également un puissant gaz à effet de serre qui contribue aux modifications climatiques à l'échelle mondiale. Le captage du gaz d'enfouissement pour en diminuer les effets permet aussi la création d'une source d'énergie verte. Le méthane que contient le gaz d'enfouissement constitue une source d'énergie pouvant être utilisée pour générer de l'électricité, chauffer des immeubles, alimenter des procédés industriels ou assurer le fonctionnement de certains véhicules. L'utilisation de l'énergie tirée du gaz d'enfouissement contribue non seulement à la réduction des effets environnementaux à l'échelle locale, mais permet également d'éviter le recours aux combustibles fossiles qui seraient autrement nécessaires pour générer une quantité d'énergie équivalente. Le captage et l'utilisation du gaz d'enfouissement représentent une importante occasion de réduire les rejets de gaz à effet de serre dans l'atmosphère.



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Le Voie verte, site Web d'Environnement Canada

Mise à jour le : 2003-02-21
Contenu revu le : 2003-02-21

Avis importants
URL de cette page: http://www.ec.gc.ca/nopp/lfg/FR/issue11.cfm

ANNEXE 4

Projet de serre de démonstration du comté de Burlington, New-Jersey

ECOCOMPLEX

Endeavors

Agricultural and Environmental Research Endeavors

The EcoComplex conducts research on activity, and aspects related to landfill gas recovery and utilization, that is, using methane as an energy source, as well as preventing carbon dioxide from reaching the atmosphere. In controlled-environment agriculture, as for industrial use. The renewable energy resource may be used for heat production, and to generate electricity: from heating homes and businesses to providing power for controlled-environment agriculture. The recovery and utilization of landfill methane and carbon dioxide also mitigates the emission of greenhouse gases to the our atmosphere, and that's good for our environment.

Through monitoring landfill bioactivity; categorizing waste materials, estimating life cycles of and categorizing consumer electronics; investigating how to demanufacture electrical equipment; analyzing trash and predicting and studying landfill gas cleanup, we are [illegible] about it in addition as a resource.

We are also studying organics recycling and waste minimization, seeking to maximize recovery of nutrients and water, and to reduce organic wastes from crop production. The National Aeronautics and Space Administration (NASA) funds some of this research because of its promising applications in space exploration, as well as here on earth.

The EcoComplex's one-acre greenhouse is a commercial, real-life demonstration of landfill gas cogeneration at work. The greenhouse, office, and lab spaces at the facility are heated by landfill gas, as are the aquaculture and agriculture systems that allow for year-round production of food crops.

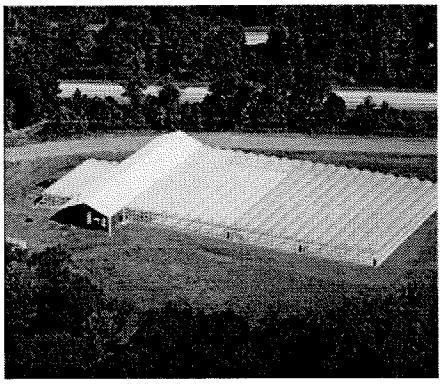
Research on biomass production are being investigated at the EcoComplex as well as intensive, year-round crop production. These efforts work in conjunction with New Jersey's Open Space Preservation Program to ensure the continued viability of agriculture in New Jersey in light of the changing marketplace.

The EcoComplex is also exploring ethanol production in New Jersey as a renewable fuel source for automobiles. Locally grown field corn, plant biomass, and municipal solid wastes are being considered as feedstocks for the ethanol.

New, clean-burning, power-generating equipment such as fuel cells and microturbines, fueled by landfill gas, are demonstrated at the EcoComplex. The environmental and economic benefits of these technologies are available for homes and businesses to see firsthand.

R&D RESEARCH/DEMONSTRATION GREENHOUSE USING METHANE GAS FROM A LANDFILL FOR CO-GENERATION

Gene Giacomelli
Director of CCEA
Department of Bioresource Engineering
Rutgers University
20 Ag Extension Way
New Brunswick, NJ USA 08901-8500



ABSTRACT:

A research/demonstration greenhouse for the production of greenhouse tomatoes using the single truss tomato production system (STTPS) has been designed and erected in Florence, New Jersey, at the Burlington County Resource Recovery Facility. The facility will demonstrate the potential for using methane gas from landfills or other sources for heating and lighting to maximize crop production while minimizing energy costs. The main greenhouse is 76.97 meters long with 7 bays at 10.97 m with each bay being 51.81 m long. The headhouse is 14.6 m wide and 62.2 m long is placed between the main greenhouse area and a 10.97 m wide and 27.4 m long nursery facility. Tomatoes grown on transportable benches are moved to the workers for pruning, inspection and harvest. Hives of bees provide pollination. Supplemental lighting is provided by 430 watt HID (high intensity discharge) high-pressure sodium lamps. Power will be supplied to the lights by a 430 KW co-generation unit operating on methane gas produced by the adjacent landfill. Rejected heat from the co-generation engine will be stored in the floor. A floor heating system and overhead 50 mm hot water steel pipe provide heating. Ventilation is accomplished through electric fans and a calibrated and screened inlet ventilation window. Evaporative cooling is also provided by a high pressure fog system. Currently 3 sections are glazed with glass and 4 sections are glazed with two layers of polyethylene film.

Introduction:

This Burlington County Research and Demonstration Greenhouse research facility is a part of the New Jersey Ecocomplex. The Ecocomplex is the nation's first research, teaching and technology transfer experiment station focusing on environmental issues. The project is funded by the Burlington County Board of Chosen Freeholders with assistance from the New Jersey Economic Development Authority.

The faculty of the Bioresource Engineering Department has been conducting extensive research over a period of years on greenhouse design, energy conservation, alternate energy use, unique tomato production systems and automatic handling of transplants using machine vision and robotics. The design of the R&D greenhouse discussed here is a synthesis of many of these research activities into a New Jersey Agricultural Experiment Station Paper # NJAES P03130-13-96 demonstration unit of modest production size. The size of the greenhouse research and demonstration facility is limited at this location because of the terrain which is surrounded by designated wetlands, Figure 1. The concepts being introduced into the design include, use of methane gas as a primary energy source, computer models which predict date of first flower based on PAR (photosynthetically active radiation) energy received, supplemental lighting to achieve model predictions, floor heating and energy storage systems, polyethylene film double glazing, the single truss tomato production system, screening for insect control and the use of thermal screens for

cooling and energy conservation. Ebb and flood hydroponic crop production in conjunction with transportable benching will be featured in the growing system. Robotic transplanting and computer vision analysis for seedling selection will also be demonstrated in an extended research phase. In addition several computer models have been developed which can be used in the design of a production facility as described in this paper, including an economic model, a growth model and a materials handling model.

Materials and Methods

Greenhouse Design

The greenhouse as shown in Figures 2 and 3 is 76.97 meters long with 7 bays, 10.97 meters wide with each bay being 51.81 m long. The headhouse is 14.6 m wide and 62.2 m long and provides areas for an office, storage and work space for sorting, packing, handling and transplanting of the crop. At one end of the headhouse the boiler and the mechanical room are located and electric service entrance equipment. Nearby, the 600 KW co-generation unit will be located on a slab outside the headhouse near the electric panel. Located adjacent to this area are the liquid fertilizer irrigation storage tanks, stainless steel screens and nutrient and water holding tanks for the hydroponic growing system. In addition to the main greenhouse there is a 10.97 m by 27.4 m plant nursery facility for producing the large number of transplants required for STTPS production systems. The nursery area is separated from the main greenhouse growing area to isolate and separate the younger from the older plants in the two areas of production.

The greenhouse design features two glazings. The nursery area and three sections of the greenhouse growing area are glazed with glass and 4 sections glazed with two layers of air-inflated, polyethylene film. The greenhouse manufacturer chosen, features an interchangeable design from glass to polyethylene film. The ridge and furrow design has aluminum gutters which will receive either glass glazing bars or flat or curved aluminum bars to support the polyethylene film. To change the glazing only the support members need to be changed. At any time in the future at modest cost, the greenhouse can be changed to whichever glazing proves to be appropriate for this installation based on data collected, which includes amount of PAR (photosynthetically active radiation) received and the thermal energy required for heating in each section. These differences will be correlated along with crop performance and yields.

The floor of the greenhouse features a floor heating system of 19 mm polybutylene pipe, spaced on 30.5 cm centers. Each pipe loop is 103 m long and is connected to a double return header system as indicated in Figures 4 and 5. The double return header system ensures that each 'slug' of water travels the same distance to and from the boiler and co-generator unit located in the headhouse. Equal distances create equal friction which in turn provides equal flow in each loop without the need for control valves or changes in pipe diameter. The floor of the greenhouse has a very large thermal mass. Waste heat from the co-generator will be captured and stored in the floor as the warm water is circulated throughout the floor heating system. The generator can operate for long periods of time without affecting air temperature in the

greenhouse because of the huge energy storage capability of the greenhouse floor. During periods when heat is required the heat stored in the floor will be transmitted to the greenhouse based on the temperature difference between the floor and the aerial environment. Traffic paths are paved in each bay and at the ends of the greenhouse. The rest of the entire floor is of sand construction with an impermeable barrier under the sand to collect all water which escapes from the irrigation system. This design limits unwanted runoff and potential ground water pollution and creates an environmentally neutral greenhouse.

Environmental Control System

The aerial and root environment of the greenhouse is controlled separately by an Argus computer system with sensors mounted in each zone throughout the crop area. Overhead hot water loops of 5 cm pipe, see Figure 4, provide the heating capacity required in cold weather and augments the floor heat heating system. The overhead loop is very responsive and the floor loop has a large response time delay to the control system. Three and four way mixing valves on the hot water system anticipate the needs of the greenhouse and based on outside temperatures control the temperature of the water in the system. As the air temperature approaches the set point the valve position is changed so that more of the water is recirculated and less comes from the boiler. At the time the sensor is satisfied and the pump stops the temperature of the water in the large pipe loop is near the greenhouse set point temperature. This ensures that there will be a minimum overrun of the set point. When a mixing valve is not used the temperature in the overhead pipe loop will be near the boiler temperature when the pump stops. This high temperature water provides a tremendous energy source causing an overrun of the setpoint, particularly in mild weather. The importance of the mixing valve has become more evident as energy conservation and heating efficiency have become important in greenhouse operation. The computer system also controls time of day set points in the several zones within the greenhouse and records temperatures so that the manager can determine the temperature at several locations in the greenhouse at any time of day. Hot water for the overhead system is supplied from a 1176 KW boiler powered by propane or methane biogas from the adjacent landfill.

Overhead thermal screens are used to reduce heat loss at night in the winter and reduce daytime temperatures during the warmer parts of the year. At the control of the computer, the thermal screen is retracted or extended depending upon the need. During the heating period at night the screen will be extended to seal off the attic space from the crop growing area. The use of thermal screens has reduced the energy loss from the greenhouse on average about 30%.

During the cooling mode the thermal screens are operated by the computer based on inside temperature and the amount of PAR radiation entering the greenhouse. Light is critical for optimum plant growth but as leaf temperatures increase photosynthesis is adversely affected. The computer balances the need for PAR with the high leaf temperatures and extends the thermal screen during periods of high light levels if the ventilation system can not keep up with the temperature set points.

Ventilation is accomplished mechanically by exhaust fans coupled to a calibrated window inlet. The design ventilation rate using thermal screens for summer shading is 1.7 cubic meters per square meter at 2.54 mm pressure. Screening is installed on the ventilation inlets as indicated in Figure 7 and performance of the ventilation system with and without the screening is illustrated in Figure 8. The window opening is designed to give the incoming air an apparent velocity of 3.6 meters/sec. This causes minimum static pressure drop on the fans and provides a very high velocity to the incoming air. The jet effect of the air entering the greenhouse through the controlled inlet causes excellent mixing between the greenhouse ambient air and the incoming air, see Figure 6. During periods of cold weather the cold incoming air is thoroughly mixed by this process before it strikes any of the plant material and subcools the growing area near the ventilation inlet. The air in the greenhouse is mixed much like the jet action of a water hose inserted into a barrel causes mixing of the contained solution.

Further temperature control is provided by evaporative cooling during extreme weather. High-pressure fog nozzles are placed over the center walkway in each section and along the ventilation inlet. Water under high pressure is injected into the greenhouse environment at these locations. The very small droplet size provides for rapid evaporation into the greenhouse air with the energy to evaporate the water coming from the greenhouse air. Cooling can occur to the limit of the wet bulb temperature. It is possible during clear days to experience a 6°C degree drop in temperature of the incoming ventilation air at the window and since the nozzles are placed over the walkway in each section, provides cooling throughout the growing area. On more humid days the temperature drop may be reduced only 3°C. When the evaporative fog system is operating, the greenhouse ventilation system operates to provide an air exchange of approximately 25% of a volume change per minute. This rate provides a balance between controlling greenhouse humidity and discharging the fog before it has had time to evaporate and cool the greenhouse ambient air. A ventilation rate which is too high reduces the efficiency of cooling by exhausting cooled air while a ventilation rate which is too low does not lower the humidity in the greenhouse which controls the amount of water vapor being evaporated. The ventilation rate is adjusted by the Argus computer controlled environmental control system.

STTPS System

The STTPS (single truss tomato production system) has been developed to mechanize tomato production in greenhouses. Conventional greenhouse production provides a spacing of 2.5 plants sq meter. This space is required to provide for maintaining and harvesting the crop. In the STTPS, tomatoes are grown on transportable benches at a nominal density of 10 plants per square meter, four times the normal density because no access aisles are required for workers to care for the crop. Tomato plants are planted on transportable benches, pruned above the first flowers and moved to the workers for the required operations, including pruning and harvest. Pollination is provided by hives of bees spaced throughout the growing area.

The transportable benches used in this system are 4.9 m long and 1.4 m wide. Two are placed across the 10.9 m bay leaving a 46 cm access and management aisle between them and allowing for a small clearance between the end of the benches and the greenhouse supporting posts, see Figure 4. There are 68 benches per zone which move on bearings and rollers on two rails which provide support beneath them. Special equipment allows the benches to index with a conveyor in the aisles on each side of the greenhouse for transport to the headhouse. With a 16 by 4 plant spacing, there are 64 plants per bench or 9.3 plants per square meter.

Several options are available for moving the single truss tomatoes throughout the greenhouse. These include moving the benches in a loop within the greenhouse bay and having the workers stationed at either end of the bay. As the benches reach the end of the greenhouse bay the workers prune, examine or harvest depending upon the need. The workers perform tasks on one half of the bench in one aisle at the end of the greenhouse and on the other half of the bench in the other aisle at the other end, see Figure 9. Another option is to move the benches on the conveying system to the headhouse where the bench configuration allows for workers to operate on both sides of the bench. Normally the benches are moved to the headhouse following the final harvest. At that point the remaining vegetative material is removed and taken to a


compost site at the Resource Recovery facility. The empty benches are cleaned and replanted with transplants brought to the work area from the 10.97 by 27.4 nursery greenhouse. The completed benches are then moved back to the appropriate growing area in the greenhouse. Currently these and other options are being pursued during the early stages of operation.

Supplemental Lighting

Low winter light levels limit tomato production in our latitude. Supplemental lighting is required to maintain uniform year-round production demanded by marketing systems located in areas of high population density like New Jersey. Supplemental lighting is provided by 430 watt high pressure sodium fixtures capable of delivering PAR lighting as required throughout the year. Six lamp fixtures are spaced at 1.83 meters across the bay and and there are 18 lamps spaced at 2.54 meters along the bay. The total of 108 lamps per bay gives a spacing of 4.65 square meters per lamp and radiation of 92 watts per square meter, see Figure 10.

The energy for the HPS lamps will be supplied from the power grid or from the co-generation unit powered by the biogas from the landfill. This type of load, used on off-peak hours is very beneficial for power companies with daytime peaking energy consumption.

One of the advantages of the STTPS is that the canopy is horizontal and lends

itself to supplemental lighting. Early experiments (McAvoy, 1984, McAvoy et al. 1988 & 1989) led quickly to the conclusion that in supplemental lighting of tomatoes there were advantages, relative to traditional growing, to working with a plant terminated after the first fruit truss develops. Supplemental light is most effectively utilized if a horizontal plane can quickly be filled with foliage (high LAI, leaf area index) with all the active foliage at a uniform distance from the light source to provide a uniform intensity. In a multicluster plant the weight per cluster is variable and in later stages of growth insect infestations, disease and mechanical injury problems increase with time to potentially reduce production.

Giniger et.al., (1988) found that light received during the seedling stage from emergence to flowering was always strongly correlated with the time to first anthesis. An equation was developed to predict flowering based on the PAR received by the seedling. On the other hand, light received during the period from flowering to harvest was strongly correlated with the total amount of fruit. Another equation was developed for the production stage which predicted yield based on PAR received. These two linear equations are used in a growth model.

Management of Supplemental Lighting

Natural and supplemental light is monitored by the Argus system so that the total PAR can be held constant for each crop throughout the year. The required amount is provided by the HPS lamps by varying the length of operation throughout the day. At one extreme the targeted amount of light is provided almost completely from May to September in New Jersey. At the other extreme during the darker and shorter daylength period supplemental light is required to maintain a constant schedule. In each crop the actual light is monitored on a continuous basis and the input of supplemental light adjusted throughout the period to achieve the desired total by the end of the vegetative stage. Current modeling and case studies indicate that a feasible strategy involves a combination of daily total monitoring in combination with expected historical averages for the period.

Results

The research/demonstration greenhouse was dedicated on April 9, 1996 by New Jersey Governor, Christine Whitman. The program featured an address by Dr. Merle Jensen on the future of CCEA. The first tomato crop has been harvested with production averaging .9 kilograms per plant. The STTPS system allows the cropping schedule to be repeated 5 times throughout the year. It is anticipated that succeeding crops will equal or surpass this yield. To date, no chemical applications for disease and insect control have been used. The ventilation inlet screening may account for some of this. PAR readings are being taken comparing the two glazing sections and energy measurements are being made on each section as well. The materials handling system is working well. All of the environmental control systems including floor heating, overhead heating and ventilation and evaporative cooling have performed to date as expected. Labor is being provided by 6 people from the Burlington County's Occupational Training Center. These workers are seeding, transplanting, pruning and harvesting the crop.

The screening illustrated in Figure 7 has performed well and is designed to exclude white fly and larger insects. Figure 8 indicates that the system is operating safely below the the design static pressure limit of 2.54 mm. When the pressure increases about this level the screening will be cleaned. Previous experience in an experimental greenhouse indicated that no cleaning was necessary the first year.

Summary

A series of coordinated research projects were completed to create the knowledge base necessary for the design and management of the single-truss tomato production system being used in this greenhouse facility. They include:

* biogas utilization

* effects of HPS lighting on tomato plant growth

* development of a plant factory model

* computer simulation and validation of the cropping system

* screening seedling to improve uniformity

* design of transport and elevation system

* tomato production in rockwool on ebb-flood benches

* comparison of labor standards

This facility, using methane gas from the landfill for co-generation for the energy required for supplemental lighting and the ventilation system and the substitution of methane for natural gas for the production of hot water used in the heating system provides a great opportunity to learn more about the system on a larger scale. Studies at this research/demonstration facility will detemine if the STTPS has great potential for the production of high quality tomatoes for the large New York City and Philadelphia metropolitan markets.

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CCEA Home | Send Email

Charles Morissette

Objet: Landfill gas project

Dear Mr. Morissette,
I received your message through Professor Bill Roberts who is retired from our University. Yes, the EcoComplex demonstration greenhouse project (http://ecocomplex.rutgers.edu) is still in operation. I suggest you contact either Dave Specca (specca@aesop.rutgers.edu) or Joe Willis (jwillis@AESOP.RUTGERS.EDU) to arrange for a visit.
Best wishes,
A.J.

Original Message -----
From: "Charles Morissette" <c.morissette@tecsult.com>
To: <giacomel@bioresource.rutgers.edu>
Cc: <roberts@bioresource.rutgers.edu>
Sent: Monday, September 22, 2003 12:41 PM
Subject: Burlington County Research and Demonstration Greenhouse

> Mr. Giacomelli and Roberts,
>
> We are looking for ways to develop a landfill gaz to energy project in an
> agricultural area here in Quebec. Thus we are interested to know more about
> Burlington County Research and Demonstration Greenhouse at Burlington County
> Resources Recovery Facility. Is this project still ongoing and is it
> possible to make a visit of this project site ? Thanks in advance for your
> reply.
>
>
> Charles Morissette

--
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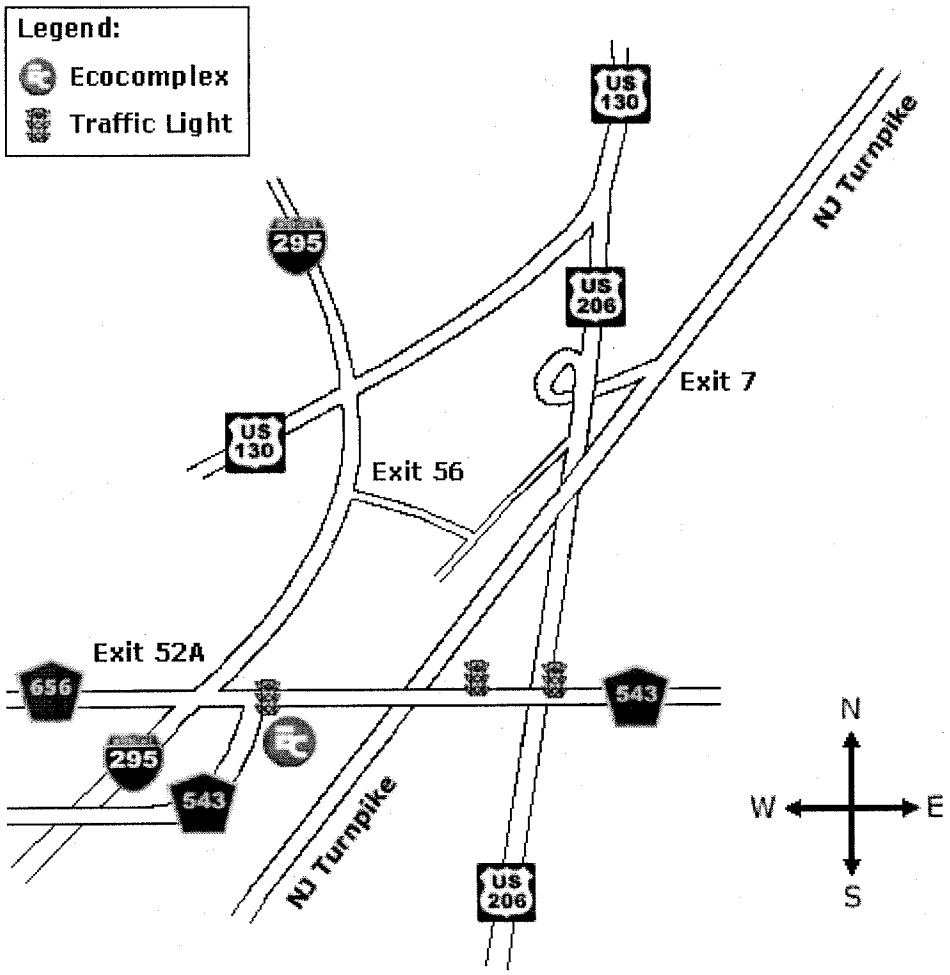
20 Ag Extension Way
New Brunswick, NJ 08901-8500
Phone: 732-932-9534; Fax: 732-932-7931
http://aesop.rutgers.edu/~horteng


Legend:
Ecocomplex
Traffic Light
US 130
295
US 206
NJ Turnpike
Exit 7
US 130
Exit 56
Exit 52A
656
543
295
543
NJ Turnpike
US 206
N
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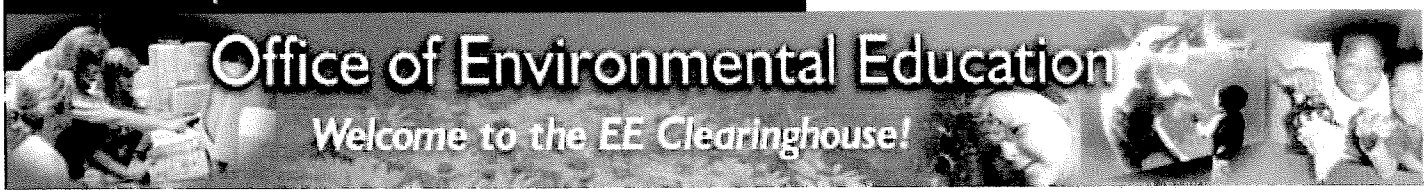
ANNEXE 5

Projet *EnergyXchange Renewable Energy Center*,
Caroline du Nord

North Carolina Department of Environment and Natural Resources



Environmental Education Centers in North Carolina

EnergyXchange Renewable Energy Center
Burnsville, NC

Mission:
The mission of EnergyXchange is to demonstrate the responsible use of landfill gas as an energy source for small enterprise in craft and horticulture, and to meet local energy needs.

Contact Information:
EnergyXchange
Route 2 Box 959-A
Burnsville, NC 28714
Email Address: energy@yancey.main.nc.us
Phone: 828-675-5541 Fax: 828-675-5542
World Wide Web Address: www.energyxchange.org

Operator: Non-profit organization

Location:
From Spruce Pine, NC: Follow 19R South toward Burnsville. Turn right in Highway 80 North. Go approximately 3 miles, then turn left at sign toward old landfill.

From Burnsville, NC: Follow Highway 19E North toward Spruce Pine. Turn left on Highway 80 North. Go approximately 3 miles, then turn left at sign toward old landfill.

Visitor Information: Audience served: Teachers, K-12 students, college students, adults. Open Monday-Friday 9:00 a.m. to 4:00 p.m. (Weekends by appointment only). Call for fee information.

Total Annual Visitation: ~3,000
(includes visitors and on site environmental education program participants)

Program Participants:
Students: ~500
Adults: ~200

Outreach: ~100

Program/Site Features: EnergyXchange's staff offers programs to school, professional, and civic groups. Topics include: landfill gas, waste reduction, recycling, global warming, and greenhouse gases. Programs can also be customized.

Unique Site Features: Landfill gas to energy system, on-site clay studio, glass blowing studio, and visitor center.

River Basin: French Broad

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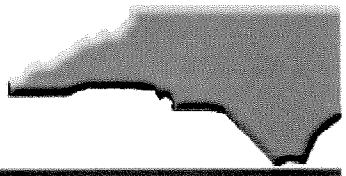
SAVE our STATE

North Carolina's voice for the sustainable use of our natural resources.



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2002 NC Sustainable Business Award Winner

EnergyXchange

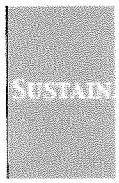
The mission of EnergyXchange is to demonstrate the responsible use of landfill gas as an energy source for small enterprise in craft studios and horticulture.

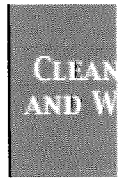
EnergyXchange is located at the foot of the Black Mountain Range in Western North Carolina. The site includes two craft studios (one for pottery and one for glass blowing), three greenhouses, three cold frames, an aquaponics facility, a public gallery and a visitor center.

Landfill gas fuels all energy needs, such as firing the pottery kiln and glass furnaces, as well as heating all buildings and greenhouses.

Save Our State, P.O. Box 88, Raleigh, NC 27602
919-839-2111
E-mail: info@sosnc.org

Photos courtesy of NC Division of Tourism, Film and Sports Development



Feature

Trash into treasure

Cheap, clean fuel might be as close as your local dump. Just ask a band of renegade thinkers in North Carolina.

by Amy Rawe

FOR THIRTY YEARS, residents of western North Carolina's Yancey and Mitchell counties hauled their trash to a mountainside dump, thinking that was the end of it. Little did they know their garbage would fuel a modern-day alchemy project. Today methane gas from their rotting refuse heats artists' studios and a native plant nursery in an extraordinary venture that draws hundreds of visitors, anxious to learn the secrets of turning trash into treasure.

The unlikely alchemists--local administrators, educators, and visionaries--created the nonprofit EnergyXChange to turn the defunct landfill into a haven for artists and gardeners. In three-and-a-half years, they have transformed the dump, closed in 1994, into an orderly campus of Quonset huts that house a glassblowing studio, pottery studio, greenhouses filled with native plant seedlings, a business center, and a gallery. Methane gas from the landfill heats all eight buildings, as well as the glass furnace and kiln--slashing pollution and eliminating the need for fossil fuels.

"Landfill methane recovery is one to the most interesting of the renewable and alternative energy sources," says Amory Lovins, CEO for research at Rocky Mountain Institute, "because it turns leaking methane--a greenhouse gas twenty-one times more potent than carbon dioxide--into useful heat and power." EnergyXChange is among 330 projects nationwide that convert landfill methane into power, keeping more than four million metric tons of greenhouse gases out of the atmosphere in the year 2000 alone. That's the equivalent of getting almost three million cars off the road. At a time when many are calling for alternatives to oil from the Middle East and the Arctic National Wildlife Refuge, tapping landfill methane demonstrates the kind of ingenuity and inspiration that we crave.

Sidebar

Got Gas?

"If there's one thing that every place has in common, it's landfills," says EnergyXChange board member Phillip Johnson. Communities across the country are taking advantage of the alternative energy source in landfills in surprising ways:

- In Maryland Heights, Missouri, students in the ecology club at Pattonville High School proposed using methane from the nearby Fred Weber landfill quarry to heat their school. Fred Weber, Inc., donated the methane as a gift to the community and spent about $200,000 to get the project started. The school paid $175,000 to bury a 3,600-foot pipeline from the landfill to the school's basement boilers. Saving $40,000 a year, the school expects to pay off its investment in five years and use the methane for at least another ten--or as many as forty years with additional trash.

- Methane from South Carolina's Horry County landfill generates electricity for the state's first green power program. At full capacity, the plant will produce enough electricity for about 9,300 residential customers.
- The Tri-Cities Landfill Generating Facility northeast of Phoenix, Arizona, is the first landfill gas project on Indian lands. A cooperative effort between the Salt River Project and the Salt River Pima-Maricopa Indian Community, the project uses landfill gas and biomass energy to supply electricity.
- In Pen Argyl, Pennsylvania, the Grand Central landfill gas-to-energy project is unique in its community-based structure. The Green Knight Economic Development Corporation sells the green power to a local utility and uses the proceeds for economic development in the three local towns of the Pen Argyl school district.
- Gas from two landfills in Orion, Michigan, fuels steam boilers at the nearby General Motors assembly plant, reducing its coal consumption by 41,000 tons a year and its emissions by 60 percent. The project has saved the GM plant about $500,000 per year, which is expected to continue for the next twenty years.

--AR

And there are more landfills to be tapped. The EPA estimates another 500 sit in prime locations for methane power. A year of such conversion could supply a million homes with electricity.

The North Carolina project may be small, but it's a major contributor to this nationwide transformation. "EnergyXChange has made a huge difference for landfills nationwide," says Shelley Cohen, former program manager for the EPA's Landfill Methane Outreach Program, who helped guide the facility's construction. "By proving that successful projects can be developed at smaller landfills, EnergyXChange has served as a model to many landfill developers who originally thought project development was not feasible at their sites."

Three main organizations joined forces to get EnergyXChange off the ground: the Blue Ridge Resource Conservation and Development Council, the Ashville-based HandMade in America, and Mayland Community College. Council director Stan Steury enlisted help from the EPA's Landfill Methane Outreach Program, and the group was in business.

But the already-large partnership invited even more folks to the table--everyone they could think of--to develop a shared vision for the project. "If we did one thing right on this project, it was to engage the community from the very beginning," Steury says.

In a rural region that's poor in job options but rich in creativity and natural treasures, arts and horticulture are to the local economy and identity what computer technology is to Silicon Valley. The EnergyXChange partners decided early on that they needed to support this heritage when they tapped the landfill. The group decided to use the methane supply, expected to last twelve to twenty years, to support residencies for young artists, as well as local horticulture. Says Becky Anderson, HandMade's executive director, "We could see the potential so clearly that the room was almost crackling with excitement."

STILL, THE GROUP FACED CHALLENGES, including how to raise $1 million to build the Quonset huts and lay the pipes for the gas exchange. "The partnership process really kicked in with fundraising," says Anderson. Each partner cultivated prospects within the domains most familiar to it: HandMade solicited private and state sources, BRRCD worked with environmental and government sources, and Mayland Community College connected with educational foundations.

Four years later, their vision is bearing fruit. Woodruff bends over long rows of seedlings in greenhouses at the former landfill. In a nearby glassblowing studio, thirty-year-old John Geci heats, rolls, and crimps spheres of colored glass into whimsical wine glasses. In the studio next to his, twenty-eight-year-old Liz Sparks coaxes slabs of clay upwards on her potter's wheel, forming delicate vases. They and three other artists are the first of perhaps forty who will benefit from residencies at the EnergyXChange.

According to a national study commissioned by HandMade in America, western North Carolina embraces the third largest concentration of craftspeople in the country, with approximately 4,500 to 5,000 artists. "We want our young artists to be able to stay in the area," says Anderson, "and we want them to have the business skills necessary to market their work." As part of their two- or three-year residencies, the artists at EnergyXChange receive work space at just $200 to $300 per month, access to a shared gallery and office equipment, and training in small-business operations.

"I knew I'd need to learn how to market myself, but I didn't know how to go about it," says Geci. "The EnergyXChange folks make sure we learn that making a living as an artist requires much more than just making the art." But simply being able to make art is a gift, as well: he says that a studio with the 2,140-degree Fahrenheit furnace he uses to heat the glass would cost at least $1,000 per month--prohibitive at this stage of his career. Geci and other resident artists are expected to save $1 million in energy costs during the gas conversion.

The methane tapped by the EnergyXChange powers other aspirations. Through an enterprise called Project Branch Out, Woodruff--along with an assistant, five student interns, and community volunteers--uses the site's four greenhouses to grow native ornamental plants, such as rhododendrons and azaleas, which are staples of the nursery industry in western North Carolina.

Because wild stock is more disease- and drought-resistant than hybridized plants, native ornamentals have been heavily harvested from public lands, sometimes illegally. "By propagating these plants, we are helping take the pressure off of wild harvesting while providing nurserymen with stock," says Woodruff. He looks ahead to producing flowering annuals and, in the aquaponics greenhouse, warm-water fish, culinary herbs, lettuce, peppers, and tomatoes. Once the edible harvest is in, Woodruff wants to distribute food to the hungry. "There's no end to what we'd like to do," he says. "It just keeps growing."

The EnergyXChange hopes to harness the potential of other sites, as well. Jon Ellenbogen, who chairs the EnergyXChange, says that the board is expanding efforts to tap a smaller landfill in nearby Avery County for greenhouses and micro-turbine electricity generation. Engineers are appraising a third landfill in Wilkes County to create a cold-storage facility for apples, and the board plans to help other communities nationally in similar projects.

Meanwhile, the original EnergyXChange site draws a surprising number of visitors, considering its rural location and the fact that it officially opened its doors just last September. "We expect to have more than 1,500 visitors annually," says Woodruff, who adds that groups from France, Poland, Italy, and Canada have already come to the site to learn how it works.

"Because of their vision, the EnergyXChange folks were able to develop, and now showcase, one of the most innovative projects in the country," says Cohen. They've proven that there's hope for transformation in the least likely of places, and yet in ways perfectly true to that place--and that committed individuals and groups can make environmental and economic alchemy an everyday reality.

Amy Rawe is a contributing editor at Hope.

WANT TO LEARN MORE?

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Burnsville, NC 28714
www.energyxchange.org

U.S. EPA LMOP
http://www.epa.gov/lmop

WasteAge.com

Going for the Green

By Chris Voell

Waste Age, May 1, 2003

SOMETIMES LANDFILL GAS-TO-ENERGY (LFGE) project hiccups are unavoidable. Nevertheless, the following projects overcame development barriers, forged strategic alliances and created business opportunities because they recognized that using landfill gas (LFG) for energy was too good of a deal to pass up.

In establishing successful systems that generate renewable energy and reduce greenhouse gas emissions, the projects also earned the U.S. Environmental Protection Agency's (EPA) Landfill Methane Outreach Program (LMOP) 2002 Project and Partner of the Year awards.

LMOP, Washington, D.C., is a voluntary program that helps to reduce greenhouse gas emissions by supporting LFGE project development. In January, LMOP held its Sixth Annual Conference and Project Expo in Washington, D.C., at which time the five awardees were recognized.

LMOP and *Waste Age* magazine are pleased to honor this year's winners.

LMOP Energy Partner of the Year Omaha Public Power District

The Omaha Public Power District (OPPD) is bringing green power to people. Green power is emerging as a power source in many U.S. energy markets as citizens, companies and communities seek to purchase energy produced from renewable sources. LFGE — including what is being supplied by OPPD's Elk City Station — is one source that is fueling green power programs.

Headquartered in Omaha, Neb., OPPD is one of the largest publicly owned electric utilities in the nation and serves more than 280,000 customers in 13 Nebraska counties. Prior to 2002, OPPD had been looking for a renewable power source and had evaluated solar energy, biomass and municipal solid waste.

The district identified LFGE as its most cost-effective, renewable energy option. So the district built a LFGE facility at Waste Management Inc.'s Douglas County Recycling and Disposal Facility, which consists of four generating units and provides electricity generating capacity of 3.2 megawatts (MW). Called the Elk City Station, the facility has been generating power since April 2002 and is the first LFGE project in Nebraska.

This project is designed to reduce methane emissions by approximately 6,750 tons annually and will initially generate enough electricity each year for 2,000 homes, according to project developers. At maximum landfill gas generation, the project will support a capacity of 30 MW, enough power for 23,000 homes. Using LFG will help to displace about 19,000 tons of coal per year that normally would have been used to generate electricity at OPPD's North Omaha Station, the company says.

"The objective of the district and its board has been to provide additional renewable energy to our customers in a way that is increasingly efficient and economical," says OPPD President Fred Petersen. "The landfill gas facility has been very productive in a very short time in accomplishing that."

OPPD underwrites the additional cost of producing electricity through renewable sources, which has helped the program to become successful. The district's marketing and education efforts also have increased project participation.

Outreach efforts were built around themes of "Turning Waste into Watts," "Be a Green Power Partner with OPPD" and "OPPD Is Going Green with Energy." Approximately 4,000 customers have chosen green power, representing almost 1.5

percent of OPPD's customers.

Industry Partner of the Year Onyx Waste Services Inc.

Onyx Waste Services Inc., Milwaukee, has been developing the LFGE potential at its landfills since 1996. The company has five operating LFGE projects, totaling a power generation capability of 30 MWs. Onyx expects this capacity to double in the next few years.

After three and one-half years in development, the Onyx Oak Ridge Landfill, Ballwin, Mo., supplies LFG as a direct fuel to the DaimlerChrysler assembly plant boilers in Fenton, a suburb of St. Louis. Toro Energy, Dallas, helped to facilitate the contractual arrangements for Onyx's Oak Ridge Landfill Project. LFG is sent from the landfill through a 4.5-mile pipeline to DaimlerChrysler.

The project provides up to 70 percent of the plant's boiler steam load, according to Onyx. Two boilers use more than 2 million cubic feet per day of LFG. It is estimated that the landfill will supply LFG to the plant for 25 years.

DaimlerChrysler "is now realizing significant cost savings as well as environmental benefits," says Denis Hagedorn, Daimler's chief power house plant engineer. Moreover, because of the environmental attributes of this project, DaimlerChrysler received the 2002 Governor's Award for Energy Efficiency and the 2002 National Association for Environmental Management (NAEM) Pollution Prevention Award from the St. Louis Chapter.

At the Glacier Ridge Landfill, Mayville, Wis., Onyx has developed a 2-MW project as part of Alliant Energy's "Second Nature" Renewable Energy Program. Alliant Energy, Madison, Wis., an energy holding company with regulated utility providers, serves more than 1.3 million customers in Iowa, Illinois, Minnesota and Wisconsin. Through the Second Nature program, Alliant's customers have a choice in supporting renewable energy sources when purchasing power. The electricity produced from this facility can support 2,000 to 4,000 homes.

Onyx also is working at the landfill with Waukesha Engine, Waukesha, Wis., to develop a new low-emission alternative engine-generator, and working with Alliant to install multiple microturbines. These initiatives will help to expand access to renewable energy, increase distributed energy generation sources and advance the production of less-polluting energy generation technologies, the company says.

The Glacier Ridge Landfill project supports the Wisconsin Governor's 2001 Strategic Energy Policy for the use of renewable energy and distributive energy sources.

Onyx's Zion Landfill, Zion, Ill., began fueling Houston-based Energy Development's (EDI) 5.4 MW facility in July 2002. EDI is a landfill gas energy company that has LFGE projects operating and under development in Australia, the United Kingdom, Greece, France, Taiwan, South Korea and the United States. At the Zion Landfill electricity is sold to power company Commonwealth Edison to supply energy for more than 5,400 homes.

Onyx also operates the Arbor Hills Landfill, Northville, Mich., which is generating 17.5 MWs of electricity. The company's Valley View Landfill, Decatur, Ill., generates 1.5 MWs of power.

In total, Onyx's LFGE projects "offset the use of more than 2.5 million barrels of oil annually, and we plan to explore opportunities at all of our landfills to hopefully double this number in the future," says Bryan Johnson, Onyx project engineer.

State Partner of the Year South Carolina Energy Office

South Carolina is a relative newcomer to LFGE; its first project went online in 2001. However, with the help of LMOP's State Partner, Sonny DuBose of the South Carolina Energy Office (SCEO), Columbia, the state has tried to bring the adage that "many hands make light work" to life.

The SCEO has been active in meeting with regulatory, non-governmental, private and public organizations to advance LFGE projects. For instance, to help develop LFGE projects, the Energy Office has worked with the: Department of Health and Environmental Control; Department of Transportation; Santee Cooper, which has the only LFGE project

currently operating in the state; Waste Management Inc.; Allied Waste Industries, Scottsdale, Ariz., Ameresco, Framingham, Mass.; BMW, Greer, S.C., which is using LFG; and many county representatives.

Because of these efforts:

- The Governor flipped the switch on the first LFGE project in Horry County, S.C., on Oct. 25, 2001, supplying green power in the state through Santee Cooper;
- The largest LFGE conversion project in the state had its grand opening in April, with a pipeline running from Waste Management's Palmetto Landfill in Spartanburg, S.C., approximately 10 miles to supply energy to a BMW assembly plant; and
- Three landfills are under contract for LFGE projects.

The combined environmental benefits of the Horry County/Santee Cooper green power program and the direct-use project with BMW/Waste Management is expected to be the equivalent of reducing the emissions from 130,000 cars, planting 180,000 acres of forest or preventing the use of 1.5 million barrels of oil, according to DuBose.

In 2002, South Carolina became the first state to obtain LMOP Endorser Agreements from the: State Chapter of the Solid Waste Association of North America (SWANA), Silver Spring, Md.; South Carolina Chamber of Commerce; South Carolina Association of Realtors; South Carolina Association of Counties; Municipal Association of South Carolina; and South Carolina Association of Homebuilders. Also, during its 2002 session, the state legislature changed the classification of LFG to a renewable energy source, thanks to SCEO's efforts.

Project of the Year (Tie) Arlington, Texas, Municipal Landfill

Oftentimes, the success of a LFGE project rests with a project developer's ability to build a coalition to see a project through to completion rather than technical feasibility alone. This was true for the alliance between the city of Arlington, city of Ft. Worth, a public utility, a nonprofit environmental foundation and a private renewable energy company.

The Arlington landfill is owned and operated by the city of Arlington, Texas, and accepts approximately 1,200 tons per day of municipal solid waste. In 1997, the city installed a gas collection system that has a LFG production rate of approximately 1,100 cubic feet per minute (cfm). Renovar Energy Corp., Midland, Texas, operates the LFG collection system. So when the city was ready to investigate LFGE, it turned to Renovar.

Renovar determined that the best project, though not the easiest, would be to transport the LFG approximately four miles to the city of Ft. Worth, Texas' Village Creek Wastewater Treatment Plant (WWTP). The WWTP processes approximately 144 million gallons of wastewater each day and generates significant amounts of methane gas during anaerobic digestion. The gas generates electricity and heats the digesters.

Ft. Worth had plans to install two new 5-MW gas turbine generators that would require more methane fuel than it could produce from its own digester gas. This would add to Ft. Worth's ongoing efforts to generate electricity and waste heat for its Village Creek Plant operations. Armed with this knowledge, Renovar met with Ft. Worth to see if the city could use Arlington's extra gas to fuel the new turbines. Renovar then negotiated the sale of LFG for use at the Village Creek Plant through Lone Star Energy Services Inc., an affiliate of the local utility.

Perhaps the biggest challenge in the project was that the only workable pipeline route went through the River Legacy Park, what the community described as "a 1,300-acre oasis on the Trinity River in the heart of north Arlington."

So Renovar cooperated with Arlington's Parks and Recreation Department, the nonprofit River Legacy Foundation, Ft. Worth, and the independent state agency Trinity River Authority (TRA) to cross the park with minimum environmental impacts.

To prevent the pipeline from damaging trees, TRA allowed parts of an existing easement to be used. The boring under the Trinity River was extended hundreds of additional feet beyond the riverbank to avoid a recreational trail and several magnificent older trees. Both Ft. Worth and Arlington also provided adjacent rights of way. And Arlington's

Neighborhood Services Department provided assistance by working through the maze of administrative agencies involved in the project.

Renovar also assisted the River Legacy Foundation in developing displays to educate the public about the LFGE project and its effects on the environment. The displays will be placed in the Park near a hiking trail along the Trinity River and at the River Legacy Living Science Center.

"Developing public/private partnerships are the key to more extensive renewable energy development in this country and globally," says Larry Gilbert, Renovar president. "This project demonstrates that such partnerships can work."

✳✳✳ Project of the Year (Tie) EnergyXChange Renewable Energy Project ✳✳✳

A small, six-acre landfill with less than 500,000 tons of waste in place normally would not be the first pick for a LFGE project. However, the EnergyXChange Project in Burnsville, N.C., has opened people's minds.

To date, the project has:

- Raised $1.5 million in grants and in-kind contributions;
- Reduced greenhouse gas emissions by an estimated 7,500 tons of methane over 10 years;
- Installed two LFG systems;
- Completed 10 horticultural apprenticeships;
- Created two full-time, permanent jobs;
- Started four new native plant businesses, two glass businesses and three pottery businesses; and
- Encouraged 2,000-plus people to visit the LFGE project.

The EnergyXChange program developed in 1999 when the Blue Ridge Resource Conservation and Development Council (RC&D), Sugar Grove, N.C., formed a task force of more than 140 individuals representing more than 40 agencies to discuss the potential uses for LFG from North Carolina's Yancey/Mitchell Counties landfill.

The task force identified two community needs:

- To develop new cash crops for local farmers because burley tobacco was declining as their No. 1 cash crop; and
- To form a business incubator for 'limited resource' potters and glass blowers who were being trained in nearby arts and crafts schools and wanted to start businesses. Handcrafts are a major industry and cultural heritage in the region.

The task force also helped Blue Ridge to identify LFGE project partners that included: Blue Ridge, which has expertise in agriculture and natural resources; Handmade in America, an Asheville, N.C.-based nonprofit specializing in the region's heritage handcrafts; and Maryland Community College, which focuses on education, horticulture and small business development. These three groups gave birth to EnergyXChange.

The EnergyXChange Renewable Energy Center consists of:

- Four greenhouses and three shade structures to house Project Branch Out, which is designed to help the region profit from and protect native flora and plants. A fourth aquaponics greenhouse combines plant and fish production.
- A craft complex of four buildings, including a glass studio, pottery studio, gallery and business/visitor center. The

complex is incubating five glass and pottery businesses. After three years, the existing five businesses will "graduate" and make room for five new businesses.

EnergyXChange also has created an incentive for a similar LFGE project in Avery County, N.C., where a facility is under construction. LFG will be used to fuel a large greenhouse, a Regional Forestry and Horticultural Center and a microturbine demonstration project, as well as will heat a nearby airport hangar.

EnergyXChange has "shown the power of partnerships; drawn nationwide attention to landfill gas energy; spawned development in neighboring areas; and become a model for other projects," says Stan Steury, RC&D project coordinator.

Chris Voell is a LMOP program manager in Washington, D.C.

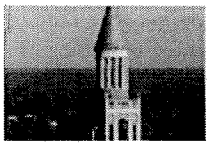
THERE'S NO STOPPING LMOP

Since 1995, the U.S. Environmental Protection Agency's (EPA) Landfill Methane Outreach Program (LMOP) has worked with more than 325 partners and assisted in the development of over 200 landfill gas-to-energy (LFGE) projects.

This year, greenhouse gas reductions from LFGE projects are equivalent to removing roughly 17 million metric tons of carbon, according to the agency. This reduction has the same annual climate benefit as:

- Planting 17 million acres of forest;
- Preventing the use of 130 million barrels of oil; or
- Removing the carbon dioxide emissions of 12 million cars.

— *Chris Voell*



Carolina Week
real news by real students

School of Journalism and Mass Communication at UNC Chapel Hill

Glass from Garbage
by Rich Fowler

For more than 20 years it was a place to dump garbage. Now after being closed for nine years, the landfill on the border of Mitchell and Yancey counties has become a valuable resource.

The EnergyXchange collects methane gas from deep inside the landfill and uses it to power a glass studio, a clay studio, and a plant nursery. The methane is used to heat kilns, furnaces, and greenhouses.

Project Manager Terry Woodruff said that the Environmental Protection Agency was eager to help the pilot program.

"[T]hey were excited that we could be a potential model for over a thousand landfills across the country that could utilize this small scale energy source," he said.

Because methane is a greenhouse gas, collecting and burning it instead of letting it escape into the atmosphere reduces its impact on the environment. The free energy helps budding artists develop their work while they take business courses to help plan their own studios.

John Geci has been in residence as a glassblower at the EnergyXchange for the last two years.

"I was figuring that I was pretty ready to start up my own shop. The finances were quite a concern and this seemed like the perfect stepping stone, being able to walk into a nearly equipped shop and then not having a lot of the bills that a normal shop has," he said.

Geci and Brent Cole are the resident glassblowers. Each pays only $350 a month for rent and all the energy they need to make their glass art. Each of the four pottery residents pays only $200 a month.

The EnergyXchange is developing another landfill in Avery county, and when it is completed, the two sites together will have the same environmental impact as removing 21,000 cars from North Carolina roads.

The EnergyXchange is located near Burnsville, NC, and has an art gallery, greenhouse and visitor center open to the public five days a week.

ANNEXE 6

Étapes pour développer un projet de valorisation énergétique du biogaz

Office of Air and Radiation (6202J)
EPA430-F-02-011
www.epa.gov/lmop
March 2002

LANDFILL METHANE OUTREACH PROGRAM

1. Estimate LFG Recovery Potential and Perform Initial Assessment or Feasibility Study
2. Evaluate Project Economics
3. Establish Project Structure
4. Draft Development Contract
5. Assess Financing Options
6. Negotiate Energy Sales Contract
7. Secure Permits and Approvals
8. Contract for Engineering, Procurement & Construction, and Operation & Maintenance Services
9. Install Project and Start Up Commercial Operation

Potential Benefits Gained By Landfill Owners/Operators From Landfill Gas Energy

Economic

Revenue shares from the sale of landfill gas (LFG) or electricity produced	• Typical revenue for electricity = $0.03/kWh to $0.05/kWh • Typical revenue for gas = $2.00/mmBtu to $4.00/mmBtu • REPI[1] payments (municipal owners only) = 1.5 cents per kWh • Royalty payments for gas extraction (private developer only) vary
Offset the cost of a LFG collection/control system	• Typical capital costs (1 million ton landfill) = $600,000 - $750,000 • Typical O&M costs (1 million ton landfill) = $40,000 - $50,000/yr
Market potential	• LFG = $2.00/mmBtu (avg.) vs. natural gas = $3.00/mmBtu vs. propane = $8.00/mmBtu (avg.)
Other potential sources of revenue	• Emissions reductions trading • Green power/pricing programs

[1] Renewable Energy Production Incentive

Environmental

- Improved local air quality
- Lower greenhouse gas emissions
- Emissions offsets from fossil fuels
- Subsurface gas migration control

Community Image

- Progressive, innovative resource use
- Responsible community planning
- Safer landfill with reduced odors
- Job creation through project development
- Improved economic development near the landfill

Energy

- Reliable, local fuel source
- Less need for use of polluting fossil fuels

One Million Tons of Waste Yields Considerable Benefits

- 1 million tons of waste in place would typically generate about 300 cubic feet per minute (cfm) of LFG, which could then generate approximately 7 million kilowatt hours (kWh) per year.
- 7 million kWh is enough energy to power 700 homes for a year.
- In terms of reducing greenhouse gas emissions, generating 7 million kWh/yr by using LFG has the same environmental benefit of removing the emissions equivalent of more than 8,000 cars from the road for one year.
- Similarly, this use of LFG has the same environmental impact as planting more than 11,000 acres of trees.

Follow the Steps to:

Landfill Gas Energy Project Development

EPA United States Environmental Protection Agency

Work with LMOP through each step of

Landfill Gas Energy Project Development

- Determine who your LMOP representative is
- Join LMOP's partner program
- Work with your LMOP representative at each phase of project development
- Helpful LMOP tools are located at www.epa.gov/lmop

1 Estimate LFG Recovery Potential and Perform Initial Assessment or Feasibility Study

Desired Landfill Characteristics*

- Landfill contains municipal solid waste (MSW)
- Landfill has at least 1 million tons of MSW in place
- Landfill is at least 30 feet deep
- Site receives greater than 25 inches of rainfall annually

* A number of energy projects, however, have been developed at smaller and arid landfills.

Helpful LMOP Tools
- LandGEM or EPLUS software
- Project Development Handbook

2 Evaluate Project Economics

Identify End Users/Sales

- On-site use (gas and electric)
- Nearby direct gas use (sale to industrial end users, such as boilers, kilns)
- Electricity use
- High-Btu upgrade (sales to nearby customers or gas utility)
- Specialty use (greenhouse, vehicle fuel)

Helpful LMOP Tools
- Project Development Handbook
- EPLUS software

3 Establish Project Structure

Identify Who Will Develop/Manage the Project

- Option 1: Develop/manage the project internally
- Option 2: Team with a project developer
- Option 3: Team with a partner (equipment supplier, energy end user, community)

Find a Partner

- Issue a Request for Proposals (RFP)
- Acquire expressions of interest
- Solicit developers
- Negotiate with vendors

Helpful LMOP Tools
- Industry partner list for reference, advice, and distribution of RFPs
- Identifying Partners for Landfill Gas Projects: Preparing Requests for Proposals (RFPs)

4 Draft Development Contract

- Determine gas rights
- Determine rights for potential emission reductions
- Determine partner responsibilities, i.e.:
  - design
  - installation
  - operation and maintenance

Helpful LMOP Tool
- Project Development Handbook

5 Assess Financing Options

- Private equity financing
- Project financing
- Municipal bonds
- Direct municipal funds
- Grants
- Federal, state, and local incentives
- REPI – Renewable Energy Production Incentive

Helpful LMOP Tools
- Funding Landfill Gas Projects: A Guide to Federal, State, and Foundation Resources
- Financing Landfill Gas Projects Fact Sheet

6 Negotiate Energy Sales Contract

- Prepare draft offer contract
- Determine utility or end user need for power or gas demand
- Develop project design and pricing
- Prepare and present bid package
- Review contract terms and conditions
- Sign contract

7 Secure Permits and Approvals

Regulations

- Solid waste permit
- Air permit
- Local permitting issues
- Right-of-ways and easements

Procedures

- Contact and meet regulatory authorities to determine requirements
- Educate about benefits of project and seek approval from landfill neighbors, local officials, and local environmental and public interest groups
- Assemble information, perform calculations and designs
- Submit complete permit applications to regulatory agencies
- Amend permit application (as needed)

Helpful LMOP Tools
- State Primers
- Community Outreach Primer

8 Contract for Engineering, Procurement & Construction (EPC) and Operation & Maintenance (O&M) Services

- Owner/developer solicits bids from EPC/O&M contractors
- Owner/developer selects EPC/O&M contractor
- Owner/developer negotiates contracts
- EPC/O&M contractor conducts engineering design, site preparation, plant construction
- EPC contractor/developer conducts start-up testing

9 Install Project and Start Up Commercial Operation

- Ribbon cutting
- Public tours
- Press releases

Helpful LMOP Tools
- Marketing and Promotion Primer
- Community Outreach Brochure

Ready to get started?

Contact LMOP to help you take the first step: 1-888-782-7937, www.epa.gov/lmop