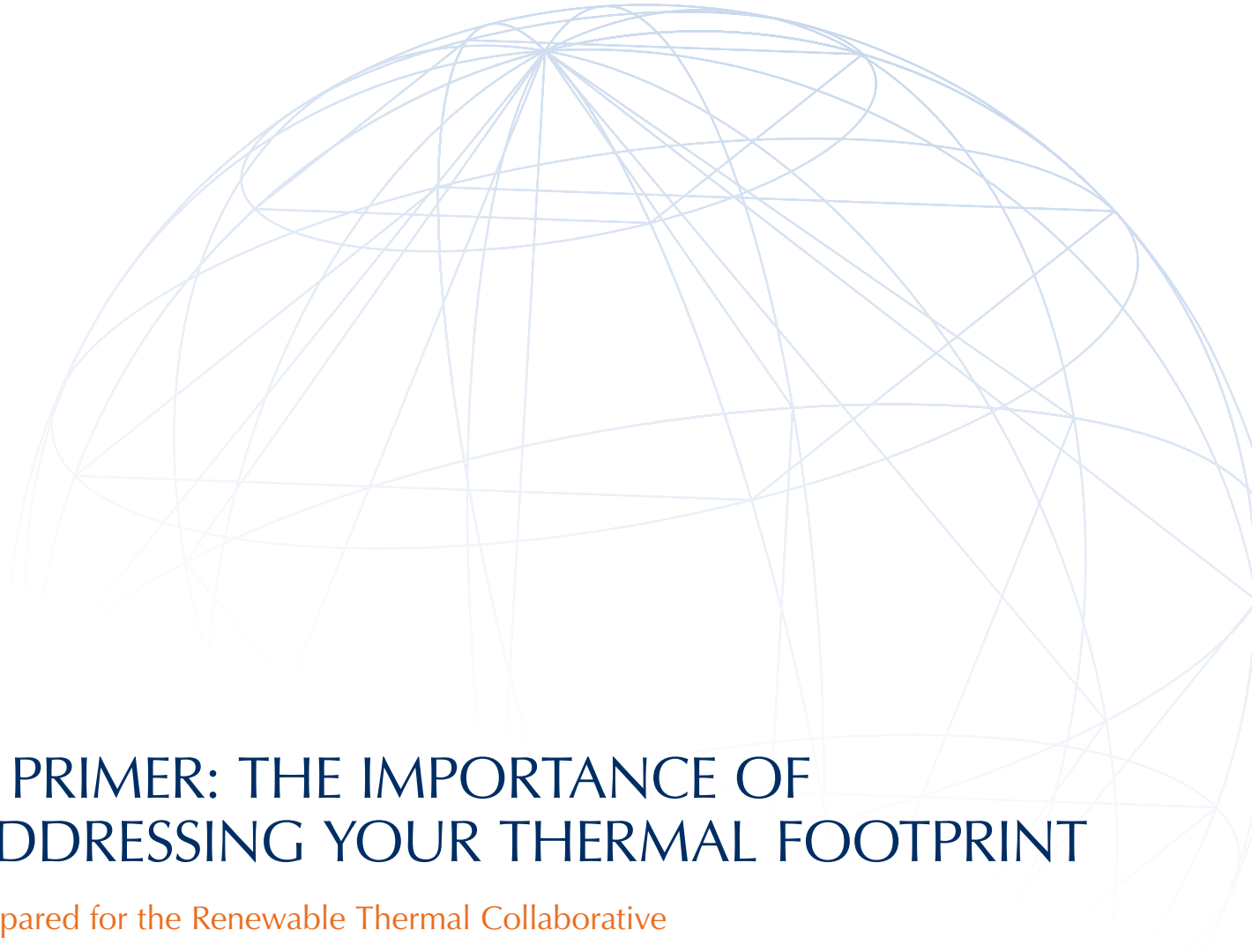
TECHNOLOGY

A PRIMER: THE IMPORTANCE OF ADDRESSING YOUR THERMAL FOOTPRINT

A report by

The Center for Climate and Energy Solutions
and David Gardiner and Associates for the
Renewable Thermal Collaborative

March 2019



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The report that follows, produced by the Center for Climate and Energy Solutions and David Gardiner and Associates, collects first-hand interviews and case studies of renewable thermal solutions implemented by RTC members and sponsors.

ABOUT THE RENEWABLE THERMAL COLLABORATIVE

The Renewable Thermal Collaborative (RTC) serves as the leading coalition for organizations that are committed to scaling up renewable heating and cooling at their facilities and dramatically cutting carbon emissions. RTC members recognize the growing demand and necessity for renewable heating and cooling and the urgent need to meet this demand in a manner that delivers sustainable, cost-competitive options at scale.

As a coalition, the RTC offers value to members by providing "power in numbers." The RTC is the only place to focus on renewable heating and cooling and where large thermal energy users come together collaboratively to understand the problems in the market, learn from each other, and overcome these barriers to renewable heating and cooling. The RTC offers an implementation-focused, collaborative platform operating under the umbrella of the Renewable Energy Buyers Alliance (REBA) to advance the needs of manufacturers and state and local governments to tackle barriers to renewable thermal energy.

The Renewable Thermal Collaborative is facilitated by the Center for Climate and Energy Solutions, David Gardiner and Associates, and World Wildlife Fund.

For additional resources by the RTC, please visit http://www.renewablethermal.org.

EXECUTIVE SUMMARY

This report is intended to help commercial, industrial, and institutional (C&I) organizations set targets for renewable thermal energy usage. Drawing on interviews with leaders on the energy consumer side and case studies from renewable thermal energy suppliers, readers will find wide-ranging guidance, key considerations, and emerging best practices that can help their organizations understand specific thermal opportunities and establish goals that align with their objectives.

Voluntary C&I renewable electricity procurements have been one of the most exciting trends of the past ten years. The market has moved from cautious initial efforts and innovations to a rapidly-expanding domestic and global market that is changing the global power generation portfolio. Renewable thermal energy offers the same opportunities for innovation, for collaboration, for expansion of leading practices, and for changing the way businesses and institutions create energy.

THE NEED FOR RENEWABLE THERMAL SOLUTIONS

Thermal energy is a key component of United States and global energy use, particularly in the industrial and buildings sectors. Energy used for heating and cooling is 50 percent of final energy use globally[1] and contributes 39 percent of greenhouse gas emissions from energy-related sources. The majority of this energy use is powered with fossil fuels: 40 percent natural gas, 20 percent coal, 20 percent oil; only 10 percent of the heat production is powered with renewable energy.[2,3]

Thermal energy is especially important in the industrial and buildings sectors. Globally, industrial heat makes up two-thirds of industrial energy demand and almost one-fifth of total energy consumption.[4]

THE IMPORTANCE OF SETTING TARGETS

Hundreds of companies, state and local governments, and institutions worldwide have set clean energy targets—for renewable energy use, energy efficiency or energy use reduction—or greenhouse gas reduction targets. RE100, EP100, and the Science Based Targets Initiative are just some of the platforms helping organizations set and pursue ambitious goals. These efforts continue to gain momentum: new companies, localities, and institutions are making commitments and expanding the market's active engagements on renewable energy.

Goal-setting has been an important factor in accelerating domestic and global clean energy markets. Goals send a critical signal to suppliers that massive demand for good solutions—technical, financial, and environmental—exists. And goals encourage accountability, engagement, and reward for those pursuing and achieving them.

C&I buyers' renewable electricity goals have been powerful market drivers. So too can influential buyers' renewable thermal goals.

The experiences and insights shared in the following pages are intended to help the organizations starting down this path.

CARGILL: EXPLORING OPTIONS FOR RENEWABLE THERMAL TECHNOLOGIES IN THE AGRICULTURAL SECTOR

CARGILL HAS EMERGED AS A LEADER FOR ITS AMBITIOUS CORPORATE SUSTAINABILITY STRATEGY. THE RENEWABLE THERMAL COLLABORATIVE SPOKE WITH SUSTAINABILITY DIRECTOR PETER DAHM TO DISCUSS HOW THE COMPANY IS PURSUING RENEWABLE THERMAL AT ITS FACILITIES.

As a leader in corporate sustainability, how are Cargill's sustainability objectives related to greenhouse gas emissions and energy? And how does reducing your thermal energy footprint fit into your overall goals?

Cargill aspires to be a leader in nourishing the world in a safe, responsible, and sustainable way. To do so, we identified different focus areas important to our company, including climate change. Cargill has a fairly sizable greenhouse gas emissions footprint, mostly driven by energy use. Therefore, in developing a strategy on climate change, our energy consumption is critical to our operational footprint and how we reduce our emissions levels. Being a large manufacturing and processing business, our operational footprint is very large. 80 percent of it is driven by thermal energy, representing about 60 percent of our Scope 1 and 2 greenhouse gas emissions. That's part of our motivation for joining the Renewable Thermal Collaborative—there just aren't as many solutions available in the thermal space as there are in the electrical space for renewables.

Additionally, one of Cargill's objectives in the climate change space is deciding to set a science-based target. As part of that target, we set a goal to reduce our absolute greenhouse gas emissions by 10 percent by 2025 relative to a 2017 baseline. Meanwhile, since Cargill is a growing company, to achieve that aggressive goal, we're ultimately going to need thermal solutions.

How have you approached finding renewable thermal solutions, and what are some of the biggest challenges you have had to address in developing that strategy?

There are three buckets we consider when trying to reduce our greenhouse gas emissions. There's the energy conservation aspect—understanding how much energy we're using, why we're using it, and looking for opportunities to save. The second bucket is technical solutions—capital projects that are going to reduce our energy consumption or change the source of energy. The third bucket is renewable solutions, such as virtual power purchase agreements or some sort of feed-in tariffs where we're able to procure green energy.

The challenge is that there aren't those offsite renewable mechanisms for the thermal space that are present for the electricity space. Implementing existing renewable thermal technologies is very site- and location-dependent. When looking at biomass, for example, we have to ask, does the site have access to biomass? Does the site have enough space to store it? The reality is, when you start to layer up those criteria, very few sites actually make it through. We either need additional technologies that maybe remove some of those barriers or we need some sort of an analogous off-site mechanism that we could engage in.

Besides being location-specific, there are economic challenges. Theoretically, you could transport biomass 1,000 miles, it's just too expensive to do it. There may even be regulatory constraints as well that would preclude you from deploying a renewable technology that you're familiar with. Finally, renewable thermal solutions tend to be very individualized from an engineering perspective, so are not easily scalable. When you're dealing with a large number of plants, in order to make a real material change in terms of our overall emissions, it takes a lot of resources to deploy each individual solution.

It sounds like most of your projects are biomass-based, such as your biomass project in Uberlandia, Minas Gerais, Brazil. What made such projects more attractive than other types of solutions you might have considered?

Many of our plants have an agricultural by-product that can be burned. In some places where our plants are located, like in Uberlandia, Brazil, there's not much

natural gas infrastructure. In that case, burning wood chips for fuel is readily available and is actually the best alternative. In Uberlandia in particular, we went one step further and have a managed forest where we grow eucalyptus to power some of our plants down there in order to make it even more of a closed-loop, renewable system.

The challenge is that we have plants under construction right now that are in areas where coal is the only viable alternative. In those cases, we don't really have an alternative and that's where we run into challenges. That's part of our motivation for joining the RTC—our interest in joining with other companies to help further the options available.

If another agricultural company wanted to get started on renewable thermal projects, what advice would you offer them to help them get started?

I would advise them to start by evaluating their own footprint. Look at what residues are coming out of your plants to see if there are possibilities. Also, look at what geographies you are located in. Some locations are more mature in the biomass area. For example, Brazil has tons of biomass—there may be cost-saving opportunities there. At the same time, technical challenges and complexities should not be underestimated. Coal may be a little bit more uniform as a fuel, whereas biomass can be any one of multiple things, which may require blending, for example. Biomass can often be a more complex solution.

Do you have any advice for a company from a project financing perspective?

It's helpful to start to bring greenhouse gas emissions into the decision-making process. Cargill is in the process of exploring an internal carbon price, which will ultimately make these projects appear more attractive and will serve as a tool to help our company live its values. It can be challenging to translate a company's overarching vision into how operational decisions are made.

ABOUT PETER DAHM

Peter Dahm is the Sustainability Director for Operations and Natural Resources in Cargill's Sustainability Hub. He owns the sustainability goals as they apply to Cargill's operations and acts as the liaison to Cargill's plant operations groups globally. Peter is responsible for the development and implementation of strategies to meet those sustainability targets. Prior to his current role, Peter held several positions of increasing responsibility in engineering, finance, and strategy development. He holds a B.S. in mechanical engineering from the University of California, Davis and an MBA from the University of Illinois, Champaign-Urbana.

City of Philadelphia

CITY OF PHILADELPHIA: EXPLORING OPTIONS FOR RENEWABLE THERMAL TECHNOLOGIES IN THE MUNICIPAL SECTOR

PHILADELPHIA HAS GOALS TO REDUCE ITS MUNICIPAL GREENHOUSE GAS EMISSIONS 50 PERCENT BY 2030 AND TO HAVE 100 PERCENT RENEWABLE ELECTRICITY BY 2030. THE RENEWABLE THERMAL COLLABORATIVE SPOKE WITH ENERGY MANAGER ADAM AGALLOCO AT THE CITY OF PHILADELPHIA, TO DISCUSS HOW THE CITY IS APPROACHING ITS ENERGY STRATEGY.

As a leader in sustainability on the municipal level, how are Philadelphia's sustainability objectives related to greenhouse gas emissions and energy? And how does reducing the city's thermal energy footprint fit into your overall goals?

We have two different sets of municipal goals. For municipal operations, our goal is a 50 percent reduction in greenhouse gas emissions by 2030 from 2006 levels. We broadly talk about achieving that goal in two ways: one is through energy conservation and efficiency, and the other is through sourcing 100 percent renewable electricity by 2030. While we don't address our thermal energy footprint specifically with respect to our goal for municipal operations, we know that to get beyond the 50 percent reduction will require a lot of work on our thermal energy footprint. We have already started to look at what some of the solutions could be, whether it's geothermal systems, renewable natural gas, or other similar opportunities.

Across the city, we have a goal of reducing emissions 80 percent from 2006 levels by 2050, and here is where we specifically call out our thermal footprint. We don't have a prescriptive plan, but our Powering Our Future report has a section devoted to low carbon thermal energy. That's why we're working to learn more about potential solutions through our membership with the Renewable Thermal Collaborative.

Why are some of the biggest challenges you have encountered when examining different ways to address thermal needs?

Philadelphia has a diversity of buildings and facilities and we know there is not necessarily enough renewable natural gas or biogas available to satisfy those facilities. A solution that works for a skyscraper downtown is going to be different than what is going to work for a recreation center located in a less dense part of the city. For example, a geothermal heat pump might make sense for some spaces, while another heating system, like variable refrigerant flow, might make more sense for others. Renewable natural gas might work for both, but supplies may be limited to it as a resource. Figuring out the right fit is certainly a significant challenge as we define our strategy.

What are some of the obstacles the city has faced when trying to scale up renewable thermal?

The low price of natural gas is the single largest obstacle. Right now, the economics don't work for a lot of renewable thermal projects. Typically, our facilities have a lot of needs, so fuel switching is not a top-of-the-list item. When you look at some of our older buildings, they have existing infrastructure that's designed for steam or hot water heating. Switching a building like that to any sort of thermal solution is going to be challenging, particularly if you're not using a boiler as your heating source, which might not make the most sense in the long term.

What other types of projects you would like to see the city implementing?

I'm interested in renewable natural gas and geothermal projects, plus both ground source or air source heat pumps, which are ready to be deployed right now. We have some smaller variable refrigerant flow systems and heat pump systems that are currently operating in our buildings. As for renewable natural gas, while we do not have any opportunities right now to purchase it, I'm hopeful that we will have more opportunities in the coming months or years.

Do you think it has gotten easier to scale up solutions and try to get people to buy into renewable thermal?

Perhaps in the next few years, or certainly in the next decade, there could be a carbon tax, or some other large policy shift that could change the way renewable thermal looks for Philadelphia. I'm hopeful there will be some kind of bold leadership and that will drive some big changes. On a local scale, the city has just begun working on a business diversification study with Philadelphia Gas Works, the city's natural gas utility through our American Cities Climate Challenge partnership with the Bloomberg Foundation.

What is the biggest difference between what cities are doing around committing to 100 percent renewable electricity and tackling their thermal use?

Renewable electricity does not necessarily have to be done entirely within city boundaries, whereas some renewable thermal projects have to be more local—whether it's maximizing biogas from a waste stream or pulling thermal energy through a heat pump.

The concern I have is, if we don't start figuring out the thermal energy problem, it's going to be an issue that we're not able to fix because it's extremely localized and extremely challenging when compared to just electrification. It could entail retrofitting thousands of buildings, including extremely old buildings like Philadelphia's City Hall. How are we handling these types of legacy facilities?

There is a robust conversation about electrifying everything, and I think there's a lot of opportunity in that solution, but it certainly is not wholly applicable to the reality of the built environment in cities and particularly the old urban environment. My other concern is that if the grid needs to grow significantly in size to handle electrification because of all the thermal needs. I don't think we could fully electrify right now given some of the demand swings and a cold day would be straining the grid considerably.

If you were talking to other cities about renewable thermal and setting a target, what do you think is one of the most important things for them to know before they start developing a target?

For most cities, if they have a climate plan, they're probably thinking about their thermal footprint—it all fits into a climate policy to some extent. However, cities are all a little different. A city like Phoenix will probably have drastically different thinking around thermal energy and how it can use the resources it has, versus a cold weather city like Boston or Chicago. It might make sense for cities like those to set a renewable thermal target or low carbon thermal energy target because they're going to have similar problems with heating as Philadelphia has. The most important thing is making sure your climate plan is thought out and you have a pathway to your carbon goals that fits with your thermal energy profile.

ABOUT ADAM AGALLOCO

Adam Agalloco is the Energy Manager for the city of Philadelphia. In his role, he manages a team of individuals responsible for tracking city government energy use, developing and implementing energy conservation, energy efficiency and renewable energy projects for facilities, and providing strategic procurement of city government's energy supply. The city, through Greenworks, A Vision for a Sustainable Philadelphia, has a broad range of initiatives focused on reducing the City's environmental impact and greenhouse gases. In addition to his role at the city, Adam is a board member of the Philadelphia Energy Authority. Prior to joining the city of Philadelphia, Adam worked for a large wind energy company and a design engineering firm. Adam has a bachelor's degree from Villanova University in mechanical engineering and a master's degree in sustainable design from Philadelphia University. He is a LEED Accredited Professional for Building Design and Construction (LEED AP BD+C) and a Certified Energy Manager (CEM).

MARS, INCORPORATED: EXPLORING OPTIONS FOR RENEWABLE THERMAL TECHNOLOGIES IN THE CONFECTIONERY AND PET FOOD SECTOR

MARS, INCORPORATED HAS GOALS TO MAKE 100 PERCENT OF ITS ENERGY CONSUMPTION TO BE FOSSIL FREE BY 2040 AND HAVING THEIR FACILITIES BE NET ZERO IMPACT. THE RENEWABLE THERMAL COLLABORATIVE SPOKE WITH GLOBAL RENEWABLE ENERGY PROGRAM MANAGER WINSTON CHEN ABOUT ITS STRATEGY TOWARDS MEETING THAT GOAL.

As a leader in corporate sustainability, can you describe Mars' sustainability objectives related to greenhouse gas emissions and energy, as well as why finding renewable thermal solutions important to Mars and how reducing your thermal energy footprint fits into your overall goals?

We have a 2040 target of 100 percent fossil-free energy and a net-zero emission impact from our direct facilities worldwide, which includes our factory offices and retail locations. The thermal portion of our footprint is one of the most important parts of our business units. Our manufacturing process involves direct heat type requirements. For example, we need to roast cocoa beans in the chocolate making process or to bake cookies. We also need a lot of heat for our pet food manufacturing as well. Even though we are making great progress with electricity, more than half of our total energy is actually coming from thermal. That's why finding a thermal solution to our goal is very important and why we put our commitment in the Renewable Thermal Collaborative.

How do you approach the problem, and what are some of the biggest challenges you've had to address in developing your strategy around reducing your thermal footprint?

We have approached the problem in a couple of different ways. I think the most direct way is to look at our processes to see if we can reduce our usage of thermal somehow, somewhere. That could mean by reducing our overall energy consumption for the manufacturing process, not just thermal but electricity as well. That's number one. We also try to see whether there's a similar way that we can manufacture our product using more electricity instead of natural gas or steam generation.

Our typical process of cooking a pet product is to use natural gas fuel in order to generate steam or heat to dry or bake the product. For us to shift to another fuel source, not only do we need to find a new, renewable fuel, but we have to change the overall process, too. We have to think beyond simply switching from natural gas to electricity. We have to ask what kind of equivalent design or manufacturing process design would also have to change? We are trying to make the same quality end-product, no matter the fuel source. As a manufacturing company, the key challenge is food safety. We want to preserve the quality and safety of our product. It's not as easy as just finding something else to burn during the process of generating heat. We have to find something that can replace natural gas safely and cost-effectively. Those are the most important things to consider.

What other types of technologies would you want to see Mars implementing? What are some of the obstacles the company has faced when trying to scale up renewable thermal?

From a technology standpoint, we are open to any technology. We want to try them all. Our ultimate goal is to find a fit-to-purpose type technology based on the location and the feed stock. For example, not every location is suitable for geothermal. That's limited based on where your site is located, whether or not there's an underground thermal source available nearby that's easily accessible. Those are kind of the considerations we look at: different options based on location and the availability of different types of feed stock so that we match the type of technology that makes the most sense based on the local availability. There's not really a one-size-fits-all thermal solution. We want to learn enough about each

type of technology so that wherever our sites are located, we don't have just one option.

Switching to renewable thermal also has implications on the infrastructure side of the business. From an operational standpoint, staff on site may be used to running a natural gas boiler. If you ask them change to a technology or process that's totally new to them, it will require a mindset change because running and maintaining a natural gas boiler compared to a biomass boiler is different. It takes time for staff to learn, understand the process, and different temperature settings so that's a lot of training involved. There are other operational impacts to the facility as well, like upgrading equipment and upgrading your technical knowledge to run a different set of assets. Eventually people have come to understand the ultimate objective of the company is to achieve our greenhouse gas targets, which requires going through some of the pain in the beginning to learn new strengths. There's significant investment that we need to reconsider, not just capital investment but human investment.

What are the engineering challenges of doing renewable thermal and the biggest difference that you see between using renewable thermal and doing renewable electricity projects for operations?

Let's say I'm an engineer building a factory at Mars. The easy thing for me to do is say, "We built another factory in that country five years ago, let's pull the proof in and try to duplicate that so we don't have to create a whole thing over and over again." The problem when we switch to renewable thermal is there's no precedent because most of our previous factories have been based on natural gas. As someone who has worked at Mars for the last 20 years building tons of quality factories based on natural gas already, now there's something totally new and I have to consider new operating procedures and tests for quality assurance. Are we able to produce the same quality of product if I switch the fuel source? With the last 20 factories that I built, none of them had issues, and now I have to take a risk because we're designing something totally different.

That being said, I think that the human factors are more challenging than the technical factors. We want to get our staff engaged from early stages and say, "Well, we have a problem and we need your help. We want to hear your recommendations, viewpoints, and ideas on how we can achieve this." You can find some great ideas from the people who actually do the work day in and day out. We don't go in from the top down, we go in through an early stage partnership so that when we implement this type of project as a team, everyone feels like they have been part of the solution from day one. Getting the operational team's support and buy in from the beginning is what makes the difference between whether a project is successful or not successful.

What do you think is the most important thing for other companies to know before they start developing a target around renewable thermal?

Understanding your own manufacturing process is the key. If I'm running a brewery, I might have a different challenge than car manufacturers. Each industry or process is unique. Understanding your baseline, process, and critical obstacles that could prevent you from switching to other thermal technology is the first phase to start with.

Do you think there is interest from other peer companies like yours in using renewable thermal?

I'm sure there's interest from similar companies. I assume most companies have some kind of sustainability goal. As a food manufacturing company, most of our issues are probably similar. For us, we need heat to cook our wet pet food products. Similarly, canned food/soup companies, for example, need heat for their canned products. Can they do something similar to what we're doing? I think there's certainly a very high interest in other similar food manufacturing companies that are trying to achieve the same thing. The more we learn from each other, the more we can accelerate progress. Just like how we did it in renewable electricity by sharing ideas, options, and process.

ABOUT WINSTON CHEN

In addition to leading the Renewable Energy Program during the past five years, Winston Chen has been with Mars, Incorporated for more than 15 years, during which he has led procurement strategy for various infrastructure and energy efficiency related projects including co-generation, energy monitoring systems, waste and water treatment upgrades and helped achieve Mars' first LEED Gold certification process with the North America Chocolate Headquarter renovation project. He holds a B.S. in Business Administration and Marketing from Marquette University.

element
MARKETS

UTILIZATION OF BIOMETHANE TO REDUCE CARBON EMISSIONS: A CASE STUDY WITH ELEMENT MARKETS AND INTERFACE

GEORGIA, USA

OVERVIEW

Interface—the world's largest designer and maker of carpet tile—was seeking a renewable thermal solution for its manufacturing sites to meet its "Mission Zero" goals. Mission Zero is an ambitious goal set by the company in the mid-nineties to eliminate any negative impacts the company may have on the environment by 2020—included in this claim is a focus on waste, energy use, and emissions. Mission Zero requires innovation across all facets of the company's supply chain—including the company's natural gas supply. When on-site biomethane production proved infeasible in 2015, the company chose off-site biomethane off taking as a means of mitigating carbon emissions at its carpet manufacturing facilities in Georgia. Despite the high cost of biomethane in the U.S., the company—in partnership with Element Markets—was able to source biomethane environmental attributes and achieve zero emissions for its Scope 1 footprint.

PROJECT DESCRIPTION

Biomethane is made from organic material that breaks down from anaerobic digestion, such as material captured at a landfill or a farm. Biomethane is then injected into a common carrier pipeline. In the past, one of Interface's Georgia facilities was directly connected to a source of biomethane, but the local supply of biomethane was insufficient to meet the needs of the entire facility, leading Interface to consider pursuing other options. In 2016, Interface partnered with Element Markets to identify a single source of biomethane that was injected into the natural gas pipeline and the environmental attributes were then matched with natural gas usage at all of Interface's manufacturing facilities in Georgia—totaling 125,000 MMBtu per year. A third-party verifier is used to confirm the Scope 1 emissions on-site annually, and the environmental attributes are applied on a 1:1 basis to achieve a zero emissions report to CDP for the facilities.

COSTS AND FINANCING

Because achieving zero Scope 1 emissions was the company's main driver for the project, Interface did not require this project to achieve the same payback period necessary for other projects.

Table 1: Outcomes

GOALS	STRATEGIES	RESULTS
Use renewable energy at manufacturing facilities in Georgia—this stems from the Mission Zero goal to source 100% of energy needs from renewable sources by 2020. Apply biomethane to Scope 1 footprint to achieve zero emissions.	Collaborate with Element Markets to develop an innovative biomethane product with applications for landfill gas generation and industry.	100% achieved. Biomethane used as a source of renewable energy. Coupled 125,000 MMBtu per year in natural gas use with environmental attributes to mitigate Scope 1 emissions.

BARRIERS AND LESSONS LEARNED

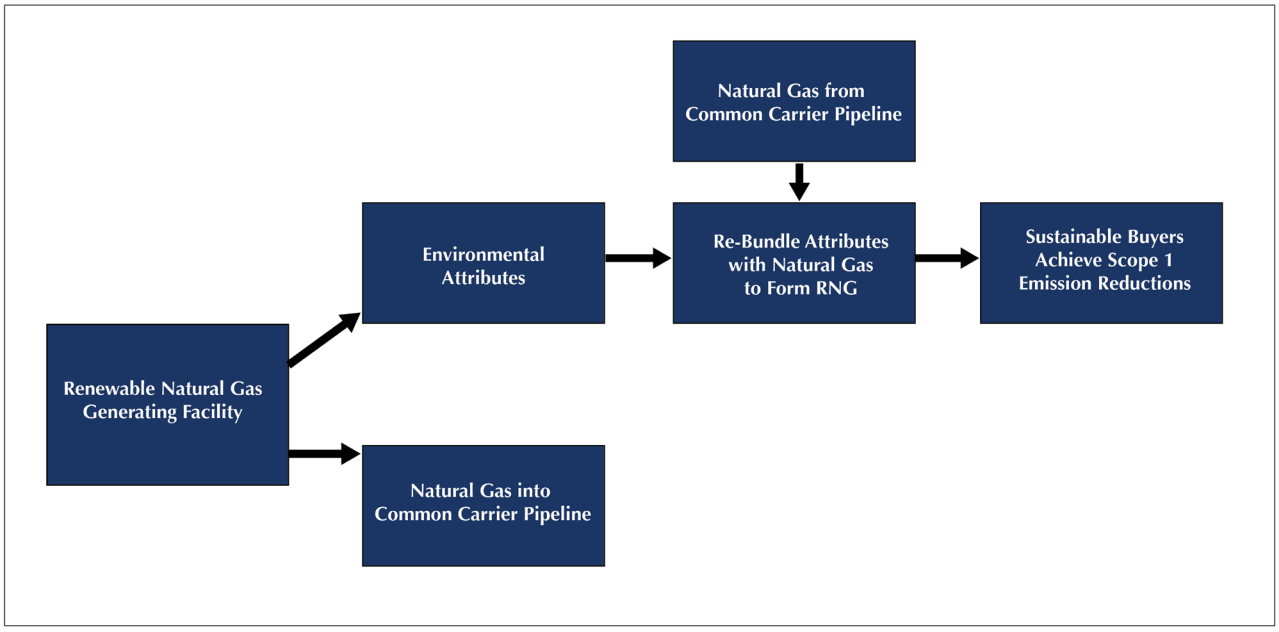
Ambitious sustainability goals require innovative solutions. By adopting a system that matches natural gas use with biomethane attributes on a 1:1 MMBtu basis, Interface is able to achieve Scope 1 emission reductions at its facilities without the costs and reliability issues associated with on-site generation. Annually, approximately 125,000 MMBtu of natural gas is mitigated through this process, and Interface's biomethane use is reported to stakeholders via CDP and the company's annual report. Interface continues to explore other innovative ways to reduce its impact to the environment from renewable energy.

ABOUT

Element Markets is an award-winning producer and marketer of renewable natural gas and environmental commodities. As the largest independent marketer of environmental commodities in the United States, Element Markets has completed more than $2.6 Billion in transactions with more than 800 counterparties since inception. The company is headquartered in Houston, Texas, and has satellite offices in Carlsbad, California; New York City; and Budapest, Hungary.

Interface, Inc. is a global commercial flooring company with an integrated collection of carpet tiles and resilient flooring, including luxury vinyl tile (LVT) and nora® rubber flooring. Our modular system helps customers create beautiful interior spaces which positively impact the people who use them and our planet. Our mission, Climate Take Back™, invites other companies to join us as we commit to running our business in a way that is restorative to the planet and creates a climate fit for life.

FIGURE 1: Lessons Learned from Utilization of Biomethane to Reduce Carbon Emissions



REDUCING CARBON EMISSIONS WITH A RENEWABLE NATURAL GAS TRIGENERATION PROJECT: A CASE STUDY WITH MAS ENERGY AND COCA-COLA

ATLANTA, GEORGIA, USA

OVERVIEW

Advancing the use of clean energy in order to reduce its carbon footprint is a key component of The Coca-Cola Company's sustainability strategy. As part of this strategy, Mas Energy, LLC, on behalf of Coca-Cola, developed a landfill gas and natural gas-fueled trigeneration project—the first of its kind to be operational in the United States. The system uses methane recovered from a nearby landfill to provide electricity, steam, and chilled water to Coca-Cola's Atlanta Syrup Branch (ASB), a production facility in Atlanta, Georgia that recently underwent a 125,000 square foot expansion project. The project achieved commercial operation on April 1, 2012.

The trigeneration project is designed to generate at least 48 million kilowatt-hours (kWh) of on-site renewable energy annually and reduce the ASB's carbon dioxide (CO_2) emissions by greater than 20,000 tons annually. It also reduces on-site fossil fuel consumption by greater than 56,000 MMBtu per year while providing economic benefits to Coca-Cola through lower energy spend, enhanced energy security, and levelized energy pricing.

PROJECT DESCRIPTION

The trigeneration—or combined cooling, heat and power—plant supplies electricity, steam, and chilled water to the ASB. It comprises three Jenbacher J616 reciprocating engine generators, each rated at 2,175 kilowatts (kW) for a rated gross output of 6,525 kW. The engines exhaust into individual heat recovery steam generators (HRSGs) that can each produce up to 3,500 pounds per hour (lbs./hr.) of steam at 125 pounds per square inch (psig), for a total rated steam output of 10,500 lbs./hr. The HRSGs have bypass dampers that enable full electrical output to be achieved even when thermal requirements of the ASB are relatively low. When in full steam-generation mode, steam from the HRSGs is dispatched to the ASB where it is primarily used to drive a 1,065-ton steam-turbine-driven York chiller.

Methane gas captured from a nearby landfill is the primary fuel source for the trigeneration plant. In addition to being the first operational trigeneration project fueled by landfill gas developed in the United States, the project is also unique in that it involves landfill gas treatment and combustion at two different sites. The collected landfill gas is first processed at the landfill via dehydration, compression, and siloxane removal equipment. Then it is transported via a dedicated, six-mile pipeline, where it is used to fuel the trigeneration plant. This project configuration added significant complexity to the scheme required to automate, monitor, and control all aspects of the system. Qualifying Facility status for the project as a "small power producer" was secured with the Federal Energy Regulatory Commission in early 2012.

COSTS AND FINANCING

A combination of debt and equity was used to fund construction of the project. The project also qualified for a Section 1603 grant, which was a payment in lieu of investment tax credits for domestic clean energy production under the American Recovery and Reinvestment Act of 2009 as administered by the U.S. Department of the Treasury. Project financing was provided via an investment-grade bond issuance through the Development Authority of Fulton County (Georgia). Bonds for the project were initially issued in March 2011 and structured to take advantage of Qualified Energy Conservation Bonds (QECB) allocated for private development by the State of Georgia. After the original bond issuance, the project applied for and received one hundred percent of the State of Georgia's allocation of QECBs for private activity (approximately $16.9 million). In May 2012, two new series of bonds were issued to take advantage of the QECB incentive.

OUTCOMES

- Generates 48 million kWh of on-site renewable energy annually—the equivalent of eliminating the CO_2 emissions of more than 3,300 passenger vehicles per year.
- Reduces the ASB's carbon footprint by greater than 20,000 tons of CO_2 annually while reducing on-site fossil fuel consumption by greater than 56,000 MMBtu per year.
- Provides economic benefits to Coca-Cola through lower energy spend, enhanced energy security, and levelized energy pricing.
- Integral to ASB's efforts in achieving LEED (Leadership in Energy and Environmental Design) Gold certification from the U.S. Green Building Council.
- Served as a key factor in Coca-Cola being recognized by the U.S. Environmental Protection Agency's Green Power Partnership as the third-largest on-site green power generator in the United States in 2012.
- Recognized by Power Magazine as one of six recipients of the 2012 Top Plant Award.
- Won U.S. EPA Landfill Methane Outreach Program 2012 Project of the Year Award—based on three equally weighted criteria: (i) innovation and creativity, (ii) success in promoting landfill gas energy projects locally, nationally or globally, and (iii) environmental and economic benefits achieved.

BARRIERS AND LESSONS LEARNED

- Renewable fuels can be used to economically provide multiple zero-carbon energy streams.
- It is possible to meet the emissions requirements in a non-attainment area using renewable fuel.
- Projects can incorporate directly-piped landfill gas over significant distances and still produce positive economics.
- For locations where direct piping of landfill gas is not feasible, the fuel can be processed to produce a natural gas "equivalent" (i.e. renewable natural gas) that can then be transported through existing distribution pipeline infrastructure to points of use.

ABOUT

Mas Energy is a fully integrated investment, development, and asset management organization that delivers creative and value-added resource solutions to utilities, companies, cooperatives, and municipalities. It develops, owns, and operates efficient, distributed clean energy generation systems that use combined heat and power, renewable natural gas, reciprocating engine simple cycle technology, and district energy systems.

The Coca-Cola Company is a total beverage company with more than 500 brands and 4,100 products in more than 200 countries and territories. Its 2020 sustainability goals include reducing the carbon footprint of its drink products by 25 percent, economically empowering 5 million women entrepreneurs worldwide, and improving water efficiency by 25 percent.

FIGURE 2: The Coca-Cola Company and Mas Energy's Renewable Natural Gas Trigeneration Project

ENDNOTES

1. Waking the Sleeping Giant, IEA-RETD, 2015, p. 1. Retrieved March 12, 2019, http://iea-retd.org/wp-content/uploads/2015/02/RES-H-NEXT.pdf.

2. International Energy Agency (IEA), 2014, "Heating without Global Warming." Retrieved March 12, 2019, https://bit.ly/2jj4mCy.

3. IEA, 2014, supra note ii.

4. IEA, Jan. 23, 2018, "Commentary: Clean and efficient heat for industry." Retrieved March 12, 2019, https://bit.ly/2DRrSm5.

The Center for Climate and Energy Solutions (C2ES) is an independent, nonpartisan, nonprofit organization working to forge practical solutions to climate change. We advance strong policy and action to reduce greenhouse gas emissions, promote clean energy, and strengthen resilience to climate impacts.

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