

ENCYCLE



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SMARTER ENERGY

A BIOMIMICRY CASE STUDY

The commercialization story behind the
energy demand management technology
that mimics swarm behavior

Published by Synapse by Biomimicry 3.8

Written by Biomimicry Business Intelligence



Photo: Flickr.com | Rob Beirtholf

BIOLOGY

Swarm behavior exhibited by bees allows complex behaviors through simple rules



Photo © Encycle

DESIGN

Encycle mimics swarm behavior to automate complex energy management tasks

Forward

Biomimicry for Innovative Business Opportunities

Biomimicry is not itself a product but a process, drawing on strategies observed in natural organisms and practices in order to spark innovation.

*Biomimicry (from **bios**, meaning life, and **mimesis**, meaning to imitate) is a scientific design discipline that seeks sustainable solutions by emulating nature's time-tested patterns and strategies.*

The core idea of Biomimicry is that nature, after 3.8 billion years of research and development, has already developed solutions to many of the problems facing industry, government and agriculture. Such problems include packaging, transportation, energy production, non-toxic chemistry, carbon sequestration, and crop production.

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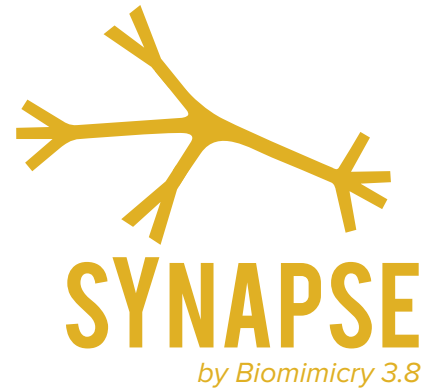
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At Synapse by Biomimicry 3.8, we are dedicated to providing biomimicry intelligence that informs, inspires, and empowers businesses to leverage nature's genius in solving their own innovation challenges.

By publishing biomimicry case studies that detail the commercialization stories experienced by biomimetic innovators, we hope to expose key insights and lessons learned about getting the most value out of the biomimicry approach as evidenced by real world projects so that others are better prepared to take advantage of nature's 3.8 billion years of research and development.

While these case studies are detailed, we have highlighted critical take aways throughout the document to provide at-a-glance learnings about market viability, the competitive landscape, the environmental issues, industry drivers, biomimetic insights, and more. Whether you are browsing or diving deep into the details, this case study will provide strategic insight for your next biomimicry project regardless of sector.



The ability to innovate is a key driver of productivity, competitiveness, and prosperity. Innovation requires entrepreneurs to rethink their strategies and adopt new approaches to their businesses, embracing new technologies and manufacturing opportunities that can be the difference between success and failure in the business world.

Biomimicry innovations are fertile hunting grounds for innovative business opportunities. Due to this immeasurable potential, corporate executives, investors, policymakers, and entrepreneurs across many industries look to this emerging field to drive sustainable growth.

But what are some powerful technology trends that can drive company success? What are the important factors that should be considered when trying to identify the next big trend? Biomimicry's inherent value lies in the answers it proposes to these questions.

BIOMIMICRY ADVISORY SERVICES

(BAS) is an independent financial market research and advisory organization that provides strategic advice and ongoing intelligence on emerging biomimicry technologies. BAS is a project initiative of Biomimicry Switzerland.

MISSION

BAS' mission is to help leaders in the commercial, public, and social sectors develop a deeper understanding of biomimicry innovations and to provide a fact base that contributes to financial decision making on these emerging technologies.



Executive Summary

Encycle Inc. is a Toronto based Energy Services provider that offers Peak Energy Demand reduction and intelligent Energy Demand Management solutions by applying the swarm logic that allows a beehive's drones to coordinate in order to execute complex tasks. Its patented Swarm Energy Management system uses a software algorithm and wirelessly communicating control units to mimic the swarm intelligence of a beehive in order to schedule attached loads, such as different rooftop mounted HVAC units, in the most efficient way.

SWARM TECHNOLOGY SOLUTION FOR ENERGY DEMAND MANAGEMENT

In mimicking nature’s genius, the Encycle system enables customers to shave off expensive and environmentally damaging peak demand, participate in utility demand response schemes and unlock valuable incentives, and realize energy savings through intelligently “smoothing out” energy demand.

Encycle is a young company that was founded in 2005 and the company currently focuses on re-investing its funds into a next generation platform. Presently, one of its principal locations is the California market that offers the most attractive Demand Response incentive programs in North America to date. Utility companies offer these programs because it allows

them to avoid having to service excessive peak loads during periods of spiking energy consumption, which otherwise would force them to operate expensive and often highly polluting “back-up” power plants in order to meet demand. The accrued savings from Demand Response programs addressing this issue are partly passed on to electricity consumers in

order to incentivize their responsiveness and finance enabling solutions, like Encycle. If applied effectively it is therefore a win-win situation for customers, utilities, and society as a whole through lower electricity bills and operating costs as well as reduced pollution and increased efficiency.



THE ENCYCLE BUSINESS MODEL

Encycle's current business model is focused on optimizing the coordination of rooftop-mounted air-conditioning units of small to mid-sized buildings in the commercial sector. It pursues a key-account based sales model of targeting building operators who manage portfolios of multiple locations and buildings. Examples include movie theater chains and retail stores, but also schools and manufacturing facilities. The system is

considered to provide effective savings for buildings with at least 4-6 rooftop mounted HVAC units, while the number of units for Encycle's average customers is approximately 15.

Over time, its sales model has evolved from a direct sales approach (one building at a time) to an account based strategy of targeting owners and operators of large building portfolios. To date, the company has installed

more than 6,000 of its control units and seeks to expand further into new markets with existing and new products. A highly interesting potential application of Encycle's swarm algorithm could lie in developments surrounding emerging "Smart Grid" solutions such as the intelligent IT-based coordination of Smart Metering or the charging of Electric Vehicles.

FUNDING STRATEGY

During the early stages of its research and development process, the company managed to secure three consecutive sets of public research grants from the Canadian government supplemented by funds from angel investors. After having concluded two highly successful Series A and B funding rounds in 2011 and 2014 respectively, which together raised nearly \$15

million USD in funds, Encycle now has passed the startup stage and is looking to expand both its reach and scope even more rapidly in the future.

The combination of these two sources of funding was vital for the survivability of Encycle's nascent commercialization and the early stages of its development of a proof of concept. One of the key takeaways from its case therefore is the

importance of this kind of early stage backing, which seems to often be crucial in proofing the worth and viability of biometric concepts that could bring with them a sweeping and potentially disruptive innovation.



Industry Overview

In the energy services industry, two distinct but closely intertwined and often confused conceptual terms related to Energy Services Demand Response have emerged in recent years. One is **demand response** and the second is **holistic demand management**.

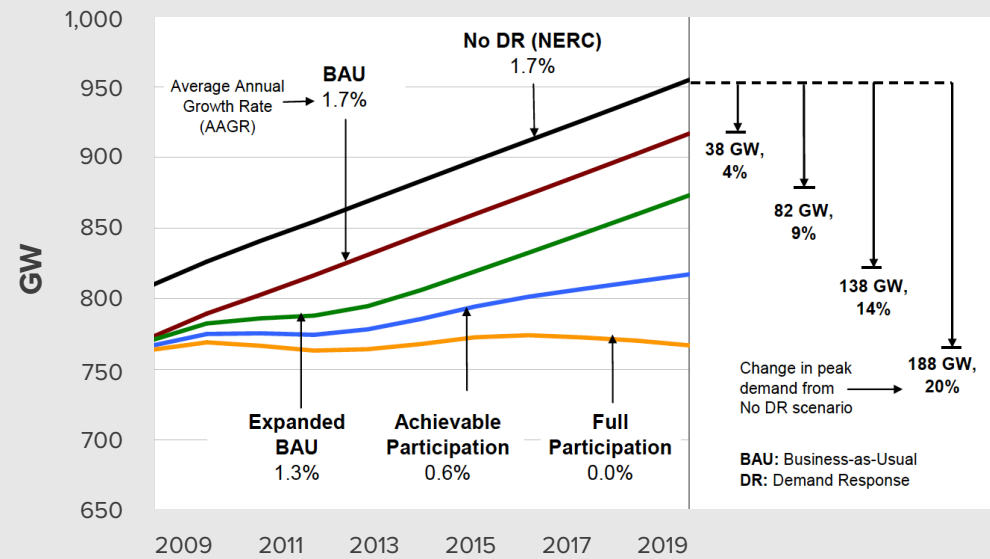
DEMAND RESPONSE

(Energy) Demand Response (DR), which is defined by the Federal Energy Regulatory Commission as: “[c]hanges in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time,

or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized”¹. In layman’s terms, demand response simply means a voluntary action by electricity consumers

¹ Murthy Balijepalli and Khaparde Pradhan (2011): Review of Demand Response under Smart Grid Paradigm. IEEE PES Innovative Smart Grid Technologies.

FERC US Peak Demand Forecast Scenarios



Icon © Encycle

DEMAND RESPONSE

(commercial or residential) in order to adjust their energy consumption in response to an economic signal, such as incentives provided their utility company. During times of peaking energy demand, utilities often have to fall back on expensive, and often highly polluting, back-up power plants in order to maintain the grid's integrity. Demand Response programs allow utility companies to avoid many of the associated direct and

indirect problems associated with higher operating costs and increased pollution—the benefit of which they can partly pass on to consumers in the form of incentives in order to motivate the necessary change of behavior.

The Federal Energy Regulatory Commission conducted a national assessment of demand response potential evaluating various levels of peak demand reductions

under different scenarios shown in the figure above.² The report also concludes that the potential reductions from demand response programs could be tremendous, but that they will also face certain regulatory, technological and other barriers.

² Federal Energy Regulatory Commission (2009): A National Assessment of Demand Response Potential. Staff Report June 2009

HOLISTIC DEMAND MANAGEMENT

A rather recent trend in the industry is an apparent shift from the established DR paradigm towards a trend of more holistic Demand Management.³ The main difference between these two concepts is that demand management seeks to not only curtail power consumption sporadically during peak demand events, but to smooth

it out on a consistent basis throughout the year. Naturally, there are potential synergies from combining the two approaches into one, truly holistic system. As we will see, this is precisely where one of Encycle's biggest advantages is rooted.

When analyzing the energy demand response/

management industry in its entirety, it is important to note that buildings can be responsible for up to 39% of the total energy use in the US.⁴ Especially during peak times, when large numbers of consumers draw power for their appliances at the same time, the costs of energy intensive activities such as air-conditioning can be

³ Michael Kanellos (2010): Demand Response? Try Demand Management, retrieved from: <http://www.greentechmedia.com/articles/read/demand-response-try-demand-management>

⁴ Terrapin Bright Green (2011): Innovative Paths to Energy Efficiency: ENCYCLE Case Study

tremendous. Typical times of peaking demand can vary by region and season but are usually associated with the early morning and/or evening hours of the day. Overall there is a huge potential market for companies in this industry. Colin McKerracher, an analyst at Bloomberg New Energy Finance (BNEF), estimates that Demand Response (DR) in the U.S. currently accounts for roughly 20 gigawatts (GW) or 2% of total installed capacity. In the EU, DR capacity currently amounts to only 5.4GW, but BNEF expects it to grow to 15.3GW by 2020.⁵

On a global scale, the world's smart demand response market was valued at \$5,041.4 million USD in 2013. By 2025, this number is expected to increase by a factor of 10, growing to more than \$50 billion USD. As of 2013, North America alone accounted for more than 80% of the global market.⁶ However, new markets such as China, Japan and South Korea are all starting to open to the idea of Demand Response and beginning to fuel the future growth of this industry. Although exhibiting promising potential in future growth, countries like China,

because of their electricity policies, do not yet have a mature business model in place. In Japan, Encycle has executed a licensing agreement with the Bamboo Congratulations Corporation in order to acquire customers in the Japanese market.

⁵ Boyden global executive research (2014): The ever-surging demand-response industry, retrieved from: http://www.boyden.com/media/8518/13562/the_ever-surging_demandre/index.html

Company Overview

ENCYCLE INC. IS A TORONTO BASED ENERGY SERVICES PROVIDER THAT OFFERS ITS CUSTOMERS A UNIQUE AND INTEGRATED ENERGY DEMAND MANAGEMENT AND DEMAND RESPONSE MANAGEMENT SYSTEM. ITS PATENTED SWARM ENERGY MANAGEMENT SYSTEM USES WIRELESS ENABLED CONTROL UNITS, CLOUD COMPUTING, AND A SOFTWARE ALGORITHM THAT MIMICS THE SWARM COMMUNICATION OF A BEEHIVE.

The methodology was conceived by Roman Kulyk and Mark Kerbel, with the first U.S. patent filed in 2009 (application # 20090287359). Newer patent applications have further developed and refined this “Method and Apparatus for Managing an Energy Consuming Load” – application numbers

20110172845, 20110172846, 20130245853, 20130268137, and 20130317663. The idea is that the control units communicate directly with each other via a wireless network in order to collectively figure out the optimal way of operating their attached loads. Utilizing this swarm

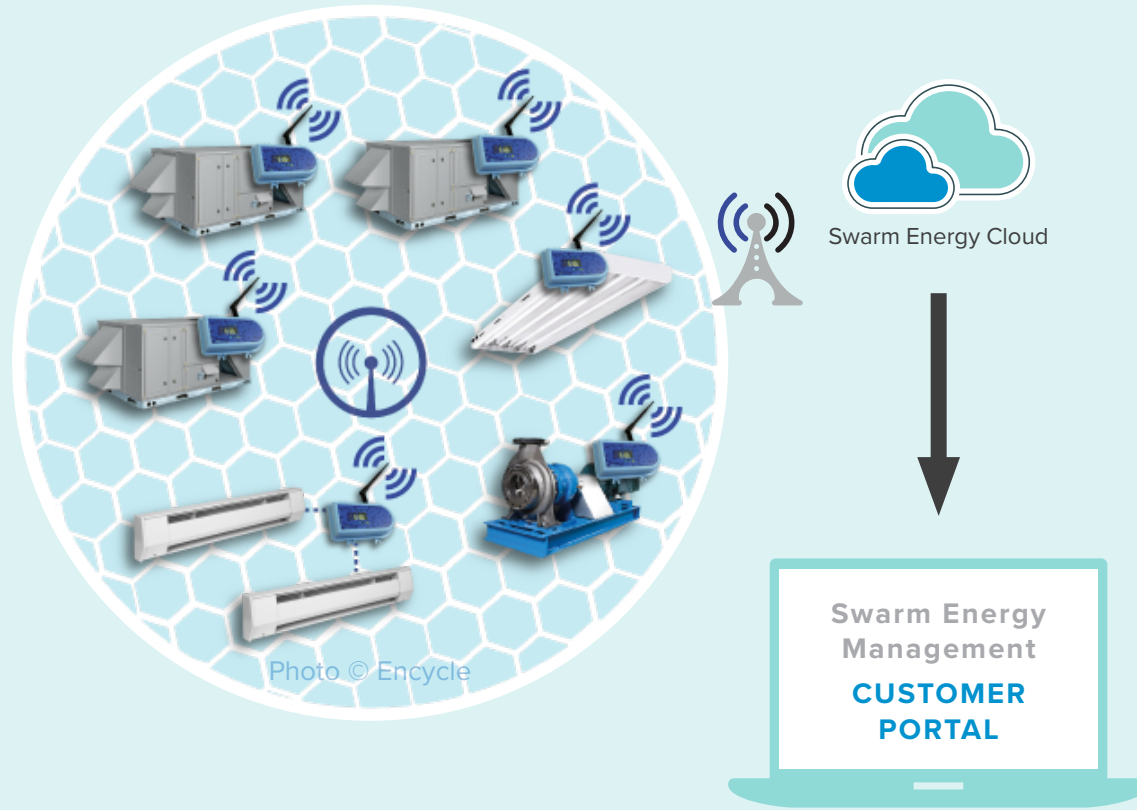
logic, the individually relatively simple hardware units can manage such complex tasks like Demand Management and Demand Response, using Encycle’s patented beehive algorithm and thereby harnessing the power of swarm logic.

Using a ZigBee network, controllers allow electrical loads to “talk to each other” in a swarm.

Controllers broadcast power readings to each other every 30 seconds.

Each controller makes a decision every few minutes to ensure the most efficient use of energy

A Gateway provides 2-way Internet communications without the need to access the site’s IP network. Power readings and controller decisions are uploaded to the Server every 5 minutes.



ORGANIZATIONAL STRUCTURE

Mark Kerbel currently serves as the company’s CTO and Founder and Robert Chiste serves as Chairman and CEO. Encycle’s headquarters, administration, finance, and its main R&D arm are split between Toronto, Canada, where the company was originally founded by Mark Kerbel and Roman Kulyk, and the UK office. Its sales and operations are conveniently based in San Marcos, California, due to the fact that the Golden State currently offers the most

favorable incentive structure for energy demand and demand response management systems. Encycle’s third major location is situated in the UK, where the company added a group of software developers to its payroll in order to further expand its R&D activities. Encycle currently maintains a total of 50 employees across all of its three locations.



MARK KERBEL
CTO & Founder

ENCYCLE’S PATENTED SWARM ENERGY MANAGEMENT SYSTEM

The Swarm Energy Management system has demonstrated itself capable of smoothing out demand and significantly reducing peak demand. The stated ROI of Encycle’s system is between 1 and 3 years on average and typically no more than approximately 1 year for the company’s main geographical target market of California. This remarkable indicator shows the attractiveness of the Californian market to Encycle, due to its current highly attractive incentive schemes, but also that while favorable incentives greatly boost the company’s value proposition, they are not to be considered an absolute necessity. Encycle also offers a financial structure of an ongoing service model, which has proven attractive to its customers.

CALIFORNIA INCENTIVES

All but one of Encycle's account representatives are currently based in California. Demand response has been given a high priority in California's "Loading Order for Electricity Resources and Energy Action Plan", ahead even of conventional power plants and renewables. In September 2014, SB 1414 was approved by the governor, which encourages and incentivizes more households and businesses to voluntarily deploy DR technology. From 2011 to 2013, the California Public Utilities Commission has approved \$1

billion in ratepayer funds to allocate to demand response. Despite these sizeable efforts, California has not yet met its policy goals when it comes to DR. The California Public Utilities Commission set a goal of "meeting five percent of the system's annual peak-energy demand through demand response programs by 2007", which was met only by half in 2014. However, with so much importance attached to demand response programs, the market in California remains huge and prosperous.

7 Lauren Navarro (2014): EDF Is Calling For More Demand Response In California And Why You Should Too, retrieved from: <http://www.forbes.com/sites/edfenergyexchange/2014/08/18/edf-is-calling-for-more-demand-response-in-california-and-why-you-should-too>

8 California Senate Office of Research (2014): Delivering On The Promise Of California's Demand Response Programs: An Opportunity or the State to Maximize the Flexibility and Efficiency of Its Electrical Grid, June 2014, page 6.

9 Ibid, page 2.

Encycle installation site at Sage Hill School in Newport Beach, CA



Commercialization Process & Strategy

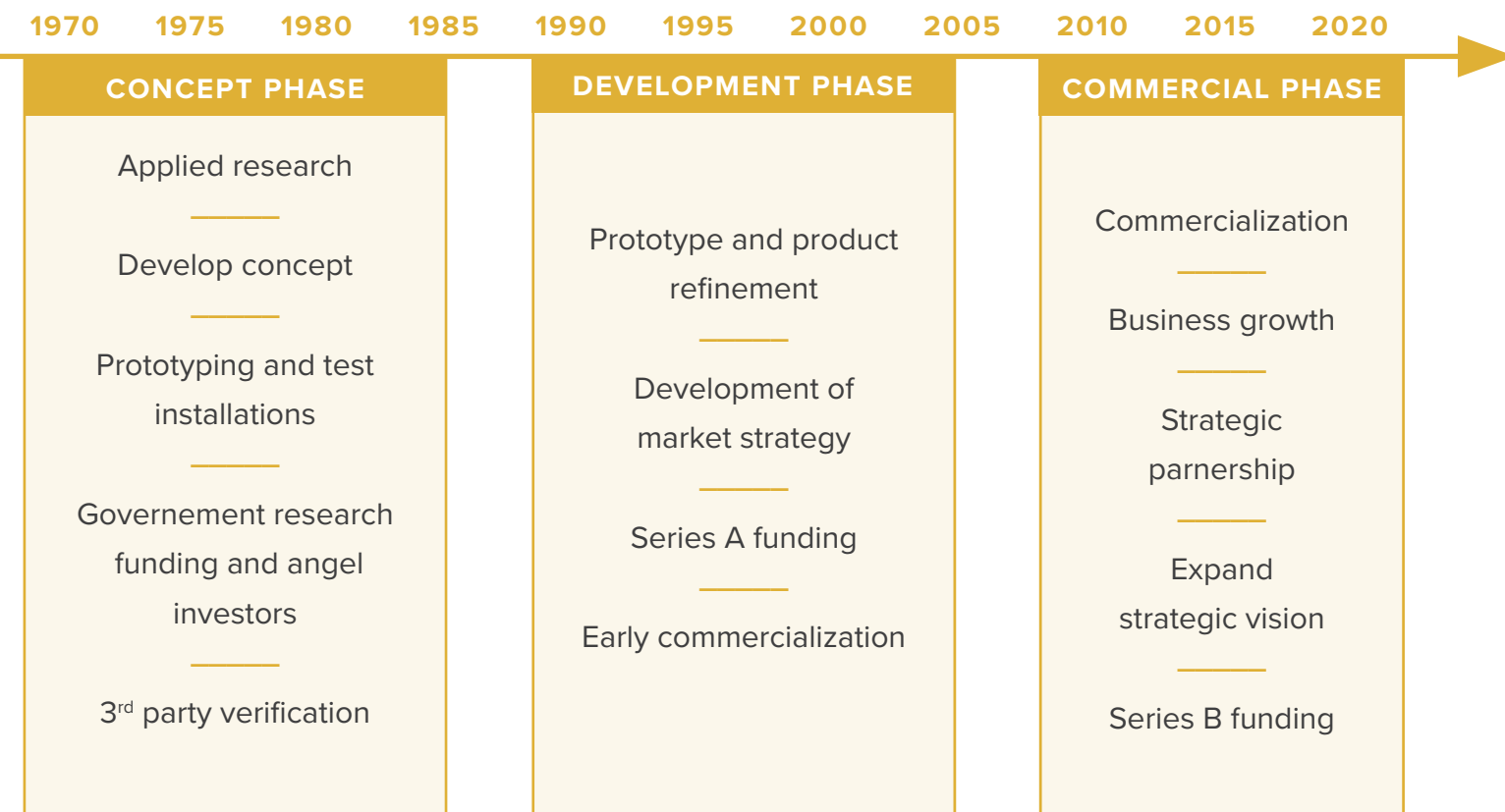
EARLY DEVELOPMENT

Starting in 2005, the company spent the first 2-2.5 years to develop the idea of using swarm logic in order to smooth out energy demand in buildings. It carried out traditional R&D work, both in the lab and in the field by testing prototypes, and began filing its first patents. During this early stage of the development process, Encycle's co-founders largely had to rely on their own private savings in order to develop their original idea into a viable concept. Hoping that their idea could later be successfully commercialized, they took a considerable risk by injecting well over \$100,000 USD of their own personal funds into the project.

In early 2007, the company received its first research funding from the Canadian government, which was worth the equivalent of roughly \$100,000 USD. This support was tied to the independent verification of Encycle's system by the Centennial College in Toronto. About one third of the funds were channeled to the Centennial Energy Institute, in order to produce a corresponding case study, which assessed and confirmed the ability of Encycle's control units to manage and achieve demand reductions of attached loads.¹⁰ These early prototype installations were not yet equipped with wireless technology and required a PC

on site in order to manually modify the control units, but they enabled Encycle to further refine and improve its system. The company was subsequently able to finalize development of its adaptive duty cycle mechanism, which allows its controllers to automatically determine when to allow their attached loads to run by communicating wirelessly.

It was at this point in the development process that the company experimented with different types of building applications, in order to identify the areas with the greatest potential for its system to reduce peak demand and achieve overall demand



¹⁰ Herbert Sinnock and Dave Clark (2007): Data Analysis – Maestro Pilot Installations and Energy Reduction Analysis. Centennial Energy Institute.

reductions. In the summer of 2007 for example, Encycle completed a pilot installation at the Toronto Hydro Energy Services Belfield facility, where it experimented with HVAC units, hot water tanks, and dimmable lighting circuits.¹¹ Eventually, the focus was put on rooftop-mounted HVAC units because the dispersed nature of these loads allows for the largest potential savings from Encycle’s intelligent swarm management system. Furthermore, Encycle’s system for many operators of medium-sized commercial facilities proved to be a very cost-effective solution to achieve demand reductions in this area. Market leaders in the

building controls industry at the time, such as the OEM vendor Johnson Controls, tended to focus on large commercial facilities (100,000 square feet or more) with full-scale building automation systems that smaller operators often could not or did not want to afford.

In order to finance its early development stage beyond the founders’ personal savings, government sponsored research funding was of great importance. However, these public funds were also supplemented by investments from angel investors, which according to Encycle Founder and CTO Mark Kerbel, was just as crucial. In our interview

he highlighted that the interaction between private and government funding is especially important in this early stage of development and should be mutually reinforcing. Especially for highly innovative and radical ideas such as biomimetic innovations, which crucially require a convincing proof of concept in order to receive funding, this mutual reassurance for investors in form of government/private backing for projects such as this is highly beneficial.

¹¹ Encycle (2007): Case Study of Demand Management / Demand Response At Toronto Hydro Energy Services Belfield Facility.

TARGET MARKETS

Encycle focuses its business on operators of medium-sized commercial and industrial buildings. Full-blown building automation systems often require prohibitively expensive upfront installation costs for these customers while Encycle’s system comes with relatively little upfront costs because it is based on a recurring service model. It poses an efficient and relatively inexpensive alternative to smooth out energy demand and to participate in demand response programs offered by utility companies for these customers.

The Swarm Energy Management system is

currently tailored to rooftop mounted HVAC units, which allow for the greatest potential improvements in this sector. Naturally, centralized heating or cooling systems would allow for little improvement through a swarm logic based system. Encycle’s system makes most sense for buildings with at least 4-6 rooftop mounted HVAC units, and the average number of units for Encycle customers is approximately 15.

Interestingly, when the company first launched its product, its main focus was on the reduction overall peak demand. It was not until much later that it realized the potential for demand response



INDUSTRIAL



SCHOOL



THEATER

management, especially in markets with highly appealing incentive structures. It turned out that Encycle’s system would be as valuable if not more valuable in managing automated demand response as it is in reducing peak demand.

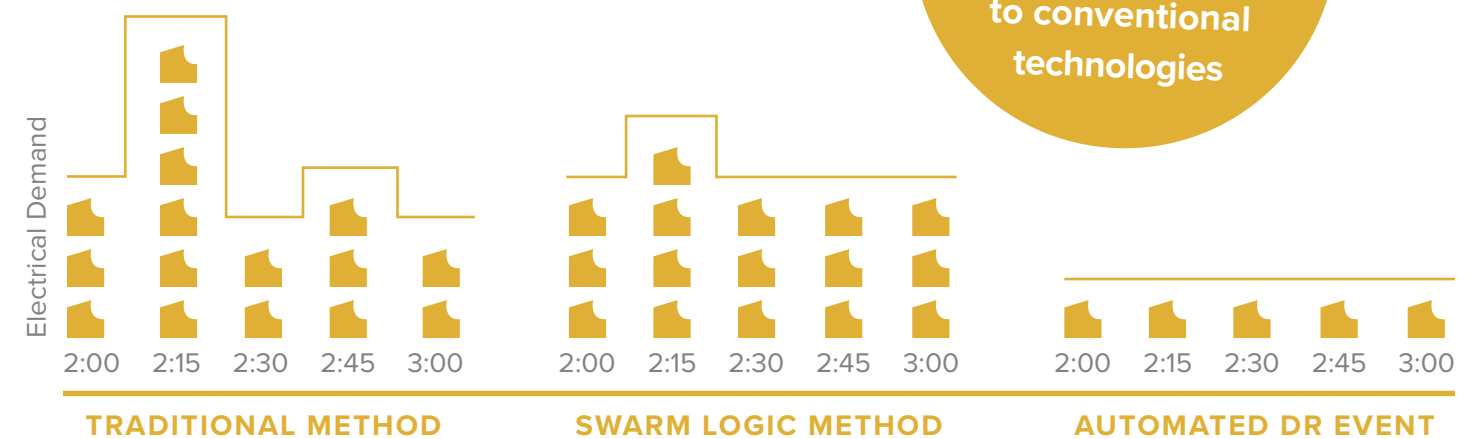
California is therefore currently the company’s main geographical target market, not only because of its warm weather and consequently high need for air-conditioning, but primarily because of its highly generous utility incentive and reward programs. Encycle’s next most important target markets in terms of the incentive structures provided by utilities there are New York State, New England, and Texas.

According to the Federal Energy Regulatory Commission, based on its “Achievable Participation Scenario”, California, Florida, and Texas are forecast to have the highest demand response potentials in 2019, with 7 GW, 9 GW, and almost 12 GW respectively. As a fraction of peak demand, Connecticut (23%), Maryland (21%), and Maine (19%) will have the highest demand response potential by 2019.¹²

¹² Federal Energy Regulatory Commission, page 42.

ADVANTAGES OF ENCYCLE SWARM TECHNOLOGY

Demand reductions from Encycle’s systems compared to conventional technologies



Low Upfront Cost

One of the Encycle product’s key unique selling propositions is that it comes with relatively little upfront installation costs, compared to full-scale building automation systems, but can yield equal if not better results in terms of energy demand management and automated demand response.

Peak Demand Management

The relatively simple Encycle controllers are installed directly at each rooftop HVAC unit and directly regulate the attached loads. Each controller is capable of managing the respective duty cycle of the load under its control. They are usually set to not to interfere with the overall level of these duty cycles, so that the overall occupancy comfort in terms of temperature and humidity

inside the building will not be affected. Instead the controllers wirelessly communicate with each other in order to collectively schedule the timing for each HVAC unit’s “natural” duty cycle. This way, peak demand can be smoothed out, by avoiding the unnecessary and excessive simultaneous operation of multiple loads during peak times, when electricity prices are highest.

CUSTOMER	PORTFOLIO	EXISTING SYSTEM	PEAK REDUCTION	ENERGY SAVINGS	DOLLAR SAVINGS
Engineering & Manufacturing Company in Rancho Santa Margarita, CA <i>Completed 2012</i>	1 facility 27 HVAC units	Manual demand response	11 kW avg. monthly peak reduction	16,181 kWh avg. monthly savings	\$22,232 avg. annual portfolio savings **
Sage High School in Newport Coast, CA <i>Completed 2012</i>	1 facility 26 HVAC units	Energy demand management system with manual DR	55 kW avg. monthly peak reduction	11,620 kWh avg. monthly savings *	\$24,451 total annual savings 2013
Movie theater chain in New Mexico <i>Completed 2011</i>	Initially 3, later 11 theaters across New Mexico	Centralized building automation system in 3 of 11 sites	26 kW avg. monthly peak reduction	4,418 kWh avg. monthly savings per site *	\$54,810 [†] average annual portfolio savings *
Big box discount retailer*** <i>Completed 2010</i>	6 stores across California, New Mexico, and Texas	Building automation system	31 kW avg. monthly peak reduction	3,934 kWh avg. monthly savings per site *	\$30,385 average annual portfolio savings *

* Author's calculations based on annual figures provided by Encycle

** Author's calculations based on total portfolio savings since project completion provided by Encycle

*** Retailer has since expanded to over 200 locations and benefited from \$1M in savings from Encycle solution

[†] These annual savings refer to the initial 3 locations alone

Operating Costs Savings

Based on a number of case studies issued by Encycle, the company's Swarm Energy Management system can save its customers real money. Usually uncontrolled

air-conditioning units will run each according to their own schedule, which very often results in many or even all of them running at the same time, a practice that causes expensive spikes in peak

demand. When demand management is employed, such spikes can be avoided by smoothing out demand through the intelligent scheduling and coordination of different loads.

Unlocking Incentives

The control units curb their loads in order to alleviate the utility's stress from currently spiking overall energy demand, which generates rewards in the form of monetary incentives. It is interesting to note that the largest annual dollar savings coincide with the second lowest energy savings. Incentives seem to be a prime source of customer savings, rather than mere bottom-line demand reductions. The collaboration and maintenance of a favorable professional relationship with the utilities, in order to unlock the full potential of their DR award and incentive programs, is therefore of great importance for Encycle. These incentives constitute a large proportion of accrued customer savings and therefore also weigh heavily on the ROI.

Rebound Optimization

Another advantage of Encycle's patented Swarm Energy Management system is that in the case of a Demand Response (DR) event, occupancy comfort can still be maintained to a large degree and the typical DR-rebound is avoided. This rebound usually occurs when a building's air-conditioning units all switch back on simultaneously after having been curbed during a DR event in order to make up for increased temperature and humidity inside the building leading to a sudden spike in demand and defeating the entire point of conducting demand response in the first place. Encycle's system avoids this pitfall by smoothing in and out of the DR event using its swarm logic.

Performance Data

Accessibility

The use of cloud computing together with Encycle's specialized software further offers important benefits to building operators and facility managers. It allows them to access building data, monitor important indicators, and even modify the control units and their schedules from wherever they are. They are able to change temperature thresholds, adjust load-schedules, or monitor and adjust demand-response events remotely from their laptops or even smartphones, as long as there is Internet access. This provides them with an efficient and convenient way to employ demand management and demand response across even a large portfolio of buildings, regardless of where they oversee it from.

SERVICE SUBSCRIPTION PRICING MODEL

Due to commonly available incentives from utility companies and the simplicity of Encycle's control units, their upfront installation costs are relatively inexpensive and often even negligible. While the main source of revenue is currently generated through the fees for purchasing these controllers, the company is shifting towards a recurring service charge model in which annual fees are projected to become a more sizable portion of revenues.

This includes the service charge for Encycle's cloud computing software, which is necessary to set and monitor the control units, but also to participate in Automated Demand Response (ADR). The fee however also covers the warranty for the controllers, as well as software and firmware updates provided by Encycle. The company's pricing strategy thus constitutes a typical recurring service model with little upfront costs.

SALES STRATEGY & LIMITS

Encycle's sales model has evolved from a direct sales approach of one building at a time, to an account based approach that mainly targets property owners of a large portfolio of buildings. The first stage in the typical procedure for this customer acquisition strategy is the initial demonstration of the product's capabilities at only one or just a few locations among the customer's portfolio. This first step is then usually followed by a massive rollout across the customer's entire portfolio,

after the system's performance has been demonstrated. One caveat to this approach is that, since the company's service is currently primarily air-conditioning based, the demonstration of the product's capabilities naturally has to occur during the summer. Such a narrow annual time frame for convincing large portfolio customers of the viability of the product for a portfolio wide adoption therefore puts a cap on the company's possible growth rate.

In Southern California, Encycle recently reintroduced a direct sale model approach, because there the incremental revenue derived from these sales warrants the effort. However, portfolio operator focused sales continue to dominate the company's overall sales approach, because they have proven to be more cost effective than a direct sales model at the end of the day.

DISTRIBUTION & COLLABORATIVE REVENUE GENERATION

For installing the Encycle controllers, the company collaborates with a small number (4-5) of large regional or national installers. The company's sales-by-account approach also helps to leverage the scale of its projects for contracting installation companies. By assigning them an entire block of buildings rather than one at a time, their crews can be provided continuous work for weeks, which helps them to cut idle time and costs, heavily impacting their bottom line. A good working relationship with these companies is an important asset for Encycle's business model.

In taking the distribution and

reach of its product one step further, Encycle has formed an important strategic partnership with the cooling giant Carrier. Having signed a distribution deal, Carrier markets and sells Encycle's product under its own Energy Demand System (EDS) brand. Subsequently, customers are forwarded to enroll in Encycle's cloud service, without which the control units themselves are of little actual value. Thus the main revenue stream flowing from its recurring service model remains intact for Encycle, while Carrier can leverage its strong distribution arm in order to get large numbers of control units out to the market.

Closely monitoring

developments in the OEM sector and trying to form strategic partnerships and distribution deals with large players such as Carrier for existing and new products will be an interesting and promising strategy for Encycle in the future.

GROWTH & CONSTRAINTS

Encycle's patented Swarm Energy Management system has come a long way since the early prototypes were installed and tested at commercial buildings around Toronto, to become the sophisticated system and nicely branded controllers the company offers today. At the time of writing, more than 6,000 Encycle controllers have been installed at approximately 600 building sites.

Encycle's CTO and Founder, Mark Kerbel, hopes to see the company approximately double its existing customer base over the course of the next 12-36 months. Of course more growth would always be desirable,

but is usually constrained by different factors. In most cases capital constraints pose the greatest inhibitor to faster growth. In Encycle's case however, other factors seem to be more important and pose almost natural growth constraints to the company's business model.

One of them has to do with the fact that its service is primarily air-conditioning based. This prescribes a natural geographical type of core markets such as the U.S. Southwest, at the same time rendering colder regions less attractive. Additionally, the focus on air-conditioning means that when proving the

effectiveness of the product to new customers through installations at test-sites, this can often only occur during the summer months—unless a warm climate such as that in Southern California, where high temperatures can hit or exceed 80F even during the fall and spring, allows for effective demonstrations year-round.

Yet, as Encycle's CTO and Founder Mark Kerbel points out, markets with electrical cooling and heating needs offer potentially even better savings that warm climates alone, hence the company's interest in expanding into Japan, where buildings use the same rooftop units for

both purposes. According to Mr. Kerbel, Encycle's next generation platform will allow the company to integrate seamlessly with certain styles of building control systems in regions even in the U.S. where electrical heating is common, further helping mitigate the seasonal sales element of its existing business.

Encycle is still at a relatively early stage of its expected life cycle. Therefore, its ingenious innovation mimicking the swarm logic of a beehive still must be proven to potential new customers. This is a common problem for all innovations, but it is especially for the most disruptive ones

such as those inspired by biomimicry. As the company grows and accumulates reputation and brand recognition, this issue will however likely be alleviated. Encycle is beyond the stage of proving the basic viability and technical feasibility of its product, now it has to work on gradually removing the need for demonstrating the product's effectiveness to customers by building reputation and brand awareness.

Another cap on Encycle's growth however, is a sheer manageability issue, which comes with increasing scale in any growing business.

Encycle's recurring service model not only generates a continuous revenue stream, which is good for finances, but also necessitates a continuous effort to manage an ever increasing customer base and portfolio of control units, which puts natural strains on management. This is why Mr. Kerbel emphasizes an organic growth trajectory in his vision for the company's future, in order to avoid overstretching and deteriorating service quality due to excessively rapid growth. A further push for the company's growth may however come from a different direction, as the R&D teams in both the UK and Toronto have been working on

applying the Encycle concept to web-enabled devices in order to unlock the potential of the "swarm in the cloud". For this purpose, Encycle has partnered up with the IOT firm Ayla Networks and Carrier, in order to translate the benefits of swarm logic communication to customers with e.g. web-enabled thermostats. This new platform could open up new sizeable markets for the company to tap and should constitute its next major wave of growth after 2017. Encycle has also recently launched the Swarm Service which integrates with building automation systems, starting with energy management solutions provider Zen Ecosystems.

Although the software-based recurring service model provides customers with significant additional value by keeping the system up to date with continuous software and firmware updates, the hardware itself is difficult to substantially improve based on current technology offerings. Yet Encycle's R&D teams are working on a next generation controller and cloud platform that is designed not only to provide better information, but also more computational power on site, in order to dramatically reduce the operational efforts needed to manage these sites. Furthermore, the company instead seeks entirely new frontiers to apply its patented swarm algorithm. In addition

to tapping the web-enabled device market noted above, it has long eyed the EV market to apply its technology in order to help utility companies coordinate peaking demands for EVs plugging into the grid. A recently concluded, highly successful Series B round of funding may provide what is needed for exciting new developments from Encycle.

Financial Strategy

SINCE THE COMPANY'S ESTABLISHMENT IN 2005, ENCYCLE HAS UNDERGONE THE THREE CLASSICAL PHASES OF THE STARTUP FORMATION PROCESS—STARTUP FUNDING, SERIES A, AND SERIES B.

Private savings of founders

Three consecutive rounds of government funding and angel investment

Series A funding (\$7.5 million)

Series B funding (\$7 million)



In order to finance its early prototype installation and evaluation projects in and around Toronto, the company accrued research funding from the Canadian government, similar to the SBIR/STTR (Small Business Innovation Research / Small Business Technology Transfer) government funds in

the United States. These funds were partly channeled to the Centennial Energy Institute in Toronto in order to conduct independent third party verification of Encycle's prototypes and were supplemented by private angel investment. Both government funding and private investors are needed

because the existence of each tends to reassure the other in a mutually reinforcing process. About 2/3 to 3/4 of funding in the company's early years came from private investors, while government funding primarily took the shape of a convertible loan.

Encycle's Series A round of funding in 2011 raised \$7.5 million USD in total, which sparked the conversion of its government loan. In the process, the company took on two venture capital partners, BDC Capital and NGEN Partners, whose total of \$5.5 million USD contribution was

topped up by existing private shareholders. These funds enabled the company to move its operations to the US, with a new base in San Marcos, in order to tap the promising California market.

Series B funding closed in 2014, and raised close to \$7 million USD from EnerTech Capital, Export Development Canada (EDC), and a major US utility company. The existing shareholders BDC Capital and NGEN Partners topped up these funds to a total of over \$12 million USD.¹³

¹³ Deal Feed (2014): Series B Financing (USD12m): Export Development Canada/EncycleEncycle Inc., retrieved from: <http://www.dealfeed-intl.com/series-b-financing-usd12m-export-development-canada-ENCYCLE-energy-inc->

Conclusion

THE ROAD AHEAD

The recently completed and highly successful Series B round of funding will open up a range of new opportunities for the company to expand its reach and/or scope in exciting new ways before anyone at Encycle is likely to think of exit strategy. The company could, for example, use these funds to step into the vast and still largely uncharted territories of Smart Grid technologies or apply its swarm algorithm to the intelligent demand management of web-enabled thermostats or even electric vehicles. The opening of such new frontiers would not only enable Encycle to tap potentially huge future growth markets, but also significantly diversify risk in times of heightened regulatory uncertainty in the DR industry amid a legal battle between load aggregators and traditional power generators.

POTENTIAL EXIT STRATEGIES

For the future of Encycle in terms of a possible exit strategy, there are two basic options on the table: IPO or acquisition. While acquisition, for which large utilities or companies like Siemens, GE, or CISCO would appear to be likely candidates, seems to be the most viable scenario for the company's exit strategy, the current business model seems to be reasonably sound and stable enough for Encycle to be able to continue to operate and grow for many years to come, without having to worry too much about securing a potential buy-out.

Lessons Learned

DIVERSE FUNDING SOURCES GENERATES INVESTOR CONFIDENCE

For young startup companies proposing innovative and potentially disruptive but also unproven technologies like Encycle, the mutually reinforcing assurance that the presence of both public and private funding provides is critical, especially in the early stages of the commercialization process.

DON'T UNDERESTIMATE FUNDING EFFORT

The successful completion of the startup funding process is the perhaps most critical strain on a young company's management. Even once the initial critical barrier of proofing the concept is overcome however, the time and effort required to attract and secure new investors remains substantial.

SEASONAL CONDITIONS CAN BE INHIBITOR TO GROWTH

Contrary to conventional wisdom, Encycle's case shows that a lack of funding does not always have to be the most important inhibitor to faster growth—sometimes there also exist certain “natural” growth constraints peculiar to the business model.

PROOF OF CONCEPT IS CRITICAL AT ALL STAGES OF DEVELOPMENT

A convincing proof of concept is vital for these biomimetic innovators – this is especially true during the early stages of the commercialization process, but seems to hold well into the more mature phases of the business cycle:

- First independent third-party verification was crucial for Encycle's securing of government funding;
- The company's ability to show a convincing proof of concept remains vital in terms of customer acquisition.

For more information about Encycle
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