

## Tecogen Inc. (TGEN)

Company Report – April 13, 2019

**Tecogen Inc. designs, manufactures and sells industrial and commercial CHP (Combined Heat & Power), or cogeneration, systems that produce combinations of electricity, hot water, and air conditioning. It's a well-established Company that has already shipped over 3,000 units, some of which have been operating for more than 35 years.**

**With greater stress on power grids as the urban landscape in New York and across North America gets denser, demand for Tecogen's clean energy solutions will remain robust.**

**Moreover, the chiller segment has strong current and future growth potential driven by the indoor agricultural market as cannabis gains national acceptance.**

**As the stock price remains fairly steady, existing shareholders can view the fourth quarter financial statements as one step closer to Tecogen achieving its goal of consistently profitable revenue growth. This makes it a prime candidate for a major run towards our target price on positive news or demonstrated profitability. We believe that this is possible in 2019 as sales backlog transforms into more record revenue numbers and profitability on subsequent quarterly results.**

**We reiterate our buy recommendation for Tecogen Inc. with a target price of \$9.53, which is 140% above today's stock price.**



- In the United States, cannabis has been approved for sale on a state-by-state basis. Producers that want to participate in close proximity to their target market are often forced to establish growing centers in jurisdictions with high electricity rates.

Access to less-expensive, reliable and uninterrupted power is therefore essential for these growers.

Tecogen's gas-driven Tecochill line is an ideal solution for these greenhouses. The rapid growth of the cannabis sector is expected to continue and contribute to further sales of Tecochill units. In fact, just this week another sale of two Tecochill units to provide cooling for cannabis grow rooms was announced.



#### Market Data

Price	\$3.96
Sector	Technology
52-Week Price Range	\$2.86 - \$4.20
Shares Issued (m)	24.83
Market Cap (m)	\$98.32
Listings	TGEN (US) & 2T1 (Fra)
Website	<a href="http://www.tecogen.com">www.tecogen.com</a>

## THE COMPANY

Tecogen designs, manufactures and sells industrial and commercial cogeneration systems that produce combinations of electricity, hot water, and air conditioning using engines that have been specially adapted to run on natural gas. This technology is called cogeneration, or Combined Heat and Power (CHP).

Cogeneration systems are efficient because they drive compressors or electric generators, which reduce the amount of electricity purchased from the utility. They then use the engine's waste heat for water heating, space heating, and/or air conditioning at the customer's building, vastly improving fuel efficiency.

The main drivers for end users to opt for a CHP system are a significant reduction in energy costs, fuel efficiency, emissions reduction, the availability of government incentives, zero capital outlay options (see revenue sources), backup power generation and Microgrid capabilities that allow for participation in demand response and load shaving incentive programs.

Existing customers for CHP systems include hospitals and nursing homes, colleges and universities, health clubs and spas, hotels and motels, office and retail buildings, food and beverage processors, multi-unit residential buildings, commercial laundry facilities, ice rinks, swimming pools, factories, municipal buildings, and greenhouses.

**Tecogen is a well-established and respected Company in the industry. It has shipped over 3,000 units so far, some of which have been operating for almost 25 years.**

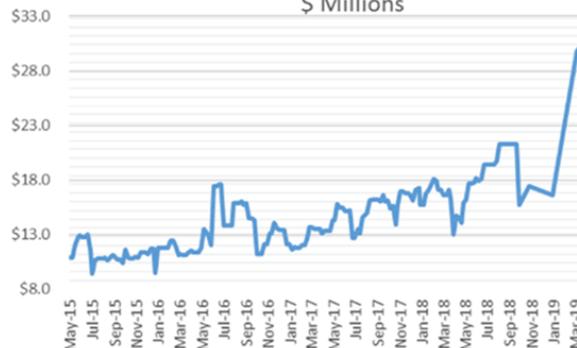
Tecogen announced revenues for the fourth quarter, ended December 31, 2018, of \$9,316,408, a decline of 9.3% from \$10,264,163 for the same period in 2017. Although Q4 saw a decrease, the Company still achieved record revenues of \$35,883,684 for the year ended December 31, 2018 compared to \$33,202,666 for the same period in 2017, an 8.1% increase. This growth was aided by having a full 12 months of American

DG Energy's operations, which was acquired in May 2017. Operations in 2018 have set the tone for further revenue growth in 2019, particularly after the impressive contracts announced so far this year (Also read Recent Events).

The main driver of non-acquisition revenue growth for Tecogen was chiller sales, which increased by \$2,352,039, or 49%, to \$7,157,771. Overall product revenue for the full year 2018 was \$12,624,867 compared to \$12,991,283 for the full year 2017, a decrease of 2.8%. Cogeneration sales declined by 33% in 2018, compared to 2017. Service revenue for 2018 was \$16,859,291, up 2.9% from \$16,377,443 in service-related revenue for the prior year. Long term service contracts represented 24% of total revenue. These service contracts help to stabilize and secure revenue going forward and steadily improve cash flow.

Mr. Benjamin Locke CEO of Tecogen commented, "2018 was a transformational year for the Company. We adjusted our product mix and sales strategy to maximize our opportunity with our exclusive natural gas engine cooling technology; substantially improved the profitability of the ADG fleet; and made significant progress developing our Ultra emissions technology for fork truck and automotive applications. Our recent transaction strengthened our balance sheet and puts us in an excellent position to achieve our 2019 goals."

Monthly Backlog - Product and Installation Services  
\$ Millions

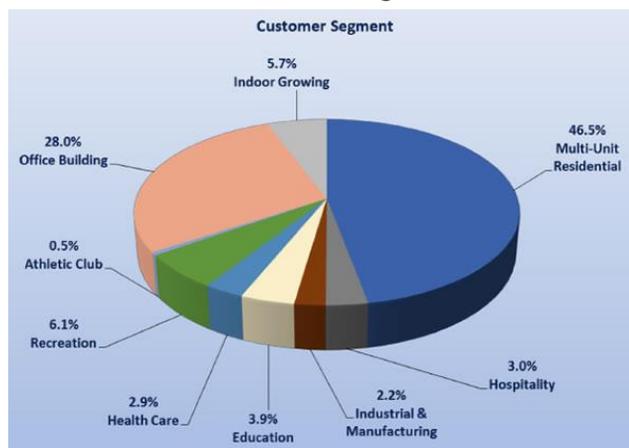


**Tecogen's spike in backlog is largely due to two of the most significant contracts the Company has signed to-date occurring over the last two months.**

Backlog of product and installation projects grew to \$16.6 million at year end 2018 compared to \$15.7 million at year end 2017

and at the end of the third quarter of 2018, but this does not tell the full story. Product and installation backlog has nearly doubled in the three months since then to \$29.9 million as of March 25, 2019, with product related backlog at \$15.4 million and installation backlog at \$14.5 million. The chart below from Tecogen’s corporate presentation puts a visual on backlog growth which has steadily grown from 2015 and spiked since the start of 2019.

The increase in the office building segment (see chart below) is driven by the largest order in the Company’s history, the \$8.3 million deal involving a charge generation system for a data center located in Manhattan office building. The contract announced three weeks ago is responsible for a large portion of the multi-unit residential segment.



**This pie chart gives investors an insight into backlog by customer segment.**

The most compelling part of this chart however, is the indoor growing sector, which represents only 5.7% of all backlog but Mr. Locke decided to lead with this segment when discussing backlog. He stated on the call, “We are continuing to aggressively promote our chillers for indoor growing facilities with crops such as fruit, vegetables or cannabis in some states. Our chillers are ideally suited to these facilities because of the low operating cost of the Tecochill chillers compared to electric chillers and utilizing the waste heat from our chillers for heating and/or dehumidification of the growth states. Our systems have become the design basis for several large growers who are planning additional facilities. I expect more orders for our equipment in this space in the coming months.”

Note that the backlog does not include recurring service contract revenues, nor does it include ADG’s estimated undiscounted future energy production revenue, which exceeds \$50 million, stretching over the next 15 years. It also does not include any sales of the Company’s Tecofrost product that will be re-launched this year.

The Company’s products are sold directly to end-users by its own sales team and by established sales agents and representatives, who are compensated by commissions. Various agreements are in place with distributors and outside sales representatives for certain territories and product lines.

Tecogen is supported by an established network of engineering, sales, and service personnel across the United States.

As of year-end 2018, Tecogen had 92 full-time employees and 5 part-time employees, including 8 sales and marketing personnel and 43 service personnel.

## Revenue Sources

Tecogen manufactures, sells, installs, and maintains the following types of products:

- ❑ Combined Heat and Power (CHP) units that supply electricity and hot water;
- ❑ Chillers that provide air-conditioning and hot water;
- ❑ Tecofrost units that provide refrigeration with a natural gas driven engine;
- ❑ High-efficiency water heaters; and
- ❑ Ultera, a muffler-like kit that dramatically reduces a natural gas powered engine’s harmful emissions such as NOx, CO, and hydrocarbons.

Moreover, in 2017, Tecogen added another important revenue source, as the Company acquired American DG Energy, which distributes, owns and operates natural gas powered cogeneration systems that produce electricity, hot water, heat and cooling. ADGE’s business model is to own the equipment that it installs at customers’ facilities and to sell the energy produced by these systems to the customer under long-term contracts at prices guaranteed to the customer to be below conventional utility rates.

Consequently, bringing American DG under the Tecogen umbrella allowed the latter to offer a cost-free-installation option to customers without access to financing, sufficient capital on hand, or for those who may not be interested in owning and maintaining the equipment.

It is noteworthy that since the acquisition of ADG, approximately half of Tecogen's annual revenue is being derived from stable, long-term contracted sources. This revenue base provides a reliable funding source for both operating expense and growth initiatives, while also making Tecogen's revenue profile more predictable, as the revenue volatility caused by somewhat cyclical equipment sales and installations is reduced.

The transaction has created a vertically integrated clean technology company with 84 installed energy systems that are able to offer equipment design, manufacturing, installation, financing, and long-term maintenance service (Also read Balance Sheet).

### Case Study – Toren Tower

The Company's business model, and its benefits for all parties involved, will become perfectly clear on the basis of a case study.

Toren is an iconic skyscraper that forever changed downtown Brooklyn. The 37 story building offers 240 condominium homes with breathtaking floor-to-ceiling views of the Manhattan skyline and New York Harbor as well as the opportunity to live in the most environmentally advanced high-rise residential building in New York, perhaps even in the U.S.

Toren uses five Tecogen InVerde 100kW cogeneration modules, located on-site, to meet much of the building's energy needs.

The cogen modules provide electricity, while the waste heat they produce is recovered and used to heat interior spaces, provide domestic hot water, heat the pool and even run the air conditioning.

That way, the remarkably efficient cogeneration system reduces Toren's carbon

footprint by more than 2000 tons of CO<sub>2</sub> each year while providing annual cost savings of \$540,000.

Toren's CHP plant is designed to automatically follow the building's electric demand. As demand for electricity increases and decreases within the building, the electrical output from each of the five CHP modules will also increase and decrease.

Thanks to highly sophisticated load control software built into each unit, the amount of electricity being purchased from Consolidated Edison, the electric utility in Brooklyn, can be held to less than 20kW.

Another innovative and very desirable feature of Toren's cogen system is that it is a "Microgrid" with the ability to run independent from the grid in "Island Mode", providing power for the building if New York City should ever experience a blackout like the one in 2003.

### Government Regulations

Several kinds of government regulations affect the Company's current and future business, such as:

- Air pollution regulations, which govern the emissions allowed in engine exhaust;
- State and federal incentives for CHP technology; and
- Electric utility pricing and related regulations.

Strict regulations that control **air quality and greenhouse gases** increasingly favor Tecogen's low-emission products. In some states that have strict emissions regulations, such as California, the pollution from natural gas engines presents a challenge.

However, the development of the Ultra low-emissions technology has addressed this issue. In January 2013, a state-certified source test at a customer's site verified that emissions levels of a CHP unit equipped with the Ultra technology, were well below the new permitting requirements.

In addition, there are currently 23 states that recognize CHP as part of their Renewable

Portfolio Standards. New York and New Jersey, for example, have **incentive programs** that rebate a significant portion of the CHP project cost.

Similar incentive programs also exist in Massachusetts, Rhode Island, and Maryland albeit with different structures and terms. Massachusetts has an additional CHP incentive in the form of an annual rebate proportional to the carbon savings versus conventional technology.

Finally, the Company is targeting customers in states with **high electricity rates** in the commercial sector, such as California, Connecticut, Massachusetts, New Hampshire, New Jersey, and New York. These regions also have high peak demand rates, which favor utilization of modular units in groups so as to assure redundancy and peak demand savings.

### Nationwide Factory Service

Besides selling machines, which in many cases are one-off deals, Tecogen generates substantial revenue through service contracts. This is a reliable and growing part of the Company's total sales. In fact, more than half of Tecogen's installed units have a service contract.

Most of the service revenue is in the form of annual service contracts. Customers are invoiced based on equipment run-time hours without unforeseen add-ons for such items as unscheduled repairs or engine replacements.

Tecogen offers service support on all its CHP products nationwide through a network of ten service centers spread all over the United States. These centers are staffed by full-time Tecogen technicians and have been an essential part of Tecogen's growth and success through the years, as good factory support from Tecogen allows its customers to focus on their core missions and businesses.

In September 2018, the Company opened its 10<sup>th</sup> service center in Tampa, Florida, which will provide service for Tecogen's growing fleet of equipment and installations in the Southeast portion of the United States.

### Competition

Tecogen's products fall into the broad market category of distributed generation systems that produce electric power on-site to mitigate the drawbacks of traditional central power and the low efficiency of conventional heating processes.

The Company's CHP products use reciprocating engines originally designed for gasoline fuel that are modified to run on natural gas. Although gas-fueled CHP units are relatively common, Tecogen is confident that no other company has developed a product that competes with its inverter-based InVerde e+ CHP, which is highly efficient, facilitates battery or solar array integration, and is compliant with the NFPA 110 standard for emergency and standby power systems.

If competitors wanted to develop a similar product, development time and costs would be significant. In addition, certain Tecogen patents and licenses for microgrid software would prevent others from offering certain important functions.

### Strengthening Patent Portfolio

Tecogen holds several patents that protect both its technology and specific methods of use. More importantly, the Company's patent portfolio continues to expand rapidly.

In June of 2018, for example, the Company obtained patent protection for its Ultera system in Japan. And in May of this year, Tecogen was notified that the European Patent Office intends to grant a patent for the Company's Ultera emissions technology. This patent will give Tecogen exclusive control over the Ultera technology in Europe when it files for national protection in countries such as the United Kingdom, Ireland, France, and Germany.

Next to Europe, Tecogen has also filed for, or been granted, patents for this technology in Australia, Brazil, Canada, China, Costa Rica, Dominican Republic, India, Japan, Mexico, New Zealand, Republic of Korea, Singapore, and South Africa.

## TECHNOLOGY

Combined Heat & Power (CHP) is truly a way to get “two for the price of one”. It produces the electricity or cooling power that a customer needs, and it captures much of the thermal energy that is normally lost during the energy conversion into power.

With CHP, the “waste” thermal energy gets captured and put to good use on site, for heating water or building spaces.

Following is an overview of the three types of CHP systems that Tecogen offers. Also, the highly efficient Ultra system that makes CHPs meet the most stringent emissions standards is described in more detail below.

### Combined Heat and Power

Tecogen’s premier cogeneration product is the InVerde e+ CHP system. The revolutionary unit combines the best technologies in the field and features a unique set of proprietary innovations.

The InVerde incorporates an inverter, which converts direct current, or DC, electricity to alternating current, or AC. With an inverter, the engine and generator can run at variable speeds, which maximizes efficiency at varying loads. The inverter then converts the generator’s variable output to the constant-frequency power required by customers (50 or 60 Hertz).

Thanks to the cutting-edge inverter technology, an innovative power control, and a new and improved engine, the InVerde e+ reaches an electrical efficiency of 33%, while its nearest competitor achieves efficiencies between 27 and 29 percent.

Note that this efficiency only refers to the produced electricity and does not take into account the harvested heat to produce thermal energy. With heat recovery a Tecogen CHP system can achieve an overall efficiency of 80 to 90 percent.

The DC input capability, facilitating battery or solar array integration, is another huge innovation. It allows for a seamless transfer of

energy between the CHP unit, other energy generators, such solar panels, windmills, and backup batteries, eliminating the need for costly converters.

#### **NFPA 110**

The NFPA 110 standard covers performance requirements for emergency and standby power systems providing an alternate source of electrical power in buildings and facilities in the event that the normal electrical power source fails. Amongst these requirements is that the backup equipment needs to supply electrical power within 10 seconds of the blackout in order for it to qualify.

Moreover, the InVerde e+ automatically starts up within 10 seconds in the event of a full blackout of the grid, making the CHP compliant with the new strict Type 110 standard for emergency and standby power systems by the National Fire Protection Association (NFPA). This is yet another innovation that very few competitors offer.

This is also the first engine-driven product to carry full UL 1741 Certification for “utility-safe” interconnection. As a result, it does not require any additional permitting for interconnecting to the electric grid, speeding the installation process.

### Ilios High-Efficiency Water Heaters

The Ilios high-efficiency water heater operates like an electric heat pump but uses a natural gas engine instead of an electric motor to power the system.

The water heater, uses a heat pump, which captures warmth from outdoor air even if it is moderately cool outside. Heat pumps work somewhat like a refrigerator, but in reverse. Refrigerators extract heat from inside the refrigerator and move it outside the refrigerator. Heat pumps extract heat from outside and move it indoors.

In both cases, fluids move the heat around by flowing through heat exchangers. At various points the fluids are compressed or expanded, which absorbs or releases heat. The gas

engine's waste heat is recovered and used in the process, unlike its electric counterpart, which runs on power that has already lost its waste heat.

The net effect is that the efficiency of an Ilios' heat pump far surpasses that of conventional boilers for water heating. This translates directly to lower fuel consumption and, for heavy use customers, significantly lower operating costs. Gas engine heat pumps can deliver efficiencies in excess of 200%.

The Ilios market continues to expand both geographically and into different end-market segments. The high-efficiency water heater is ideal for locations with a gas demand of at least 4000 Therms/month, such as water parks, swimming pools, hotels, hospitals, apartment buildings and recreation centers.

The Ilios system also attracts customers that consistently have the simultaneous need for heating and cooling, such as manufacturing and R&D type facilities.

## Chillers

TECOCHILL natural gas engine-driven chillers provide building owners with a reliable, proven, efficient, and cost-effective alternative to conventional electric motor-powered chillers. It's the only natural gas engine-driven chiller on the North American market in its size range.

The engine drives a compressor that makes chilled water; while the engine's free waste heat can be recovered to satisfy the building's needs for hot water or heating. This process is sometimes referred to as "mechanical" cogeneration, as it generates no electrical power, and the equipment does not have to be connected to the utility grid.

A TECOCHILL's benefits are significant. It cuts a building's cooling costs in half, by eliminating most of the electrical demand (kW) associated with providing cooling. In addition, it offers optional "waste" heat that is always available at the same time. This high-quality heat source (up to 230°F hot water) literally comes for free, whenever the chiller is running.

The TECOCHILL chillers are available in capacities ranging from 25 to 400 tons, with the smaller units air-cooled and the larger ones water-cooled. They are ideal in facilities where new chilling capacity is desired, as replacements for aging electric chilling equipment, where the local electric utility's kW demand charges are high, or where the site's electrical capacity is limited.

Basically, they make sense wherever large chillers are needed, including hospitals, colleges, schools, office buildings, aquariums, government buildings, large residential facilities, industrial facilities, hotels, and ice rinks.

## Tecofrost

Tecogen has recently relaunched its Tecofrost chiller. Unlike Tecochill, the Tecofrost product is meant for industrial ammonia refrigeration systems typically found in manufacturing facilities, such as dairy operations, meatpacking, bottling facilities, food processing and cold storage facilities.



**Tecofrost is perfect for a wide range of applications, including cold food storage, ice production, food processors, breweries, etc. Note that the above image is from an old Tecofrost.**

The Tecochill product, which circulates chilled water or directly chilled air, is not an ideal fit for these applications, as ammonia is much more efficient. On the other hand, a Tecofrost unit can't be used in hotels, schools, or commercial buildings, as ammonia posed a safety hazard.

Refrigeration plants have extremely large electrical demand and usage loads. In many applications this load peaks in the daytime and summer, the same periods when electricity is the most expensive and natural gas supply is the most abundant. By reducing the refrigeration plant's electric demand and usage during these periods, owners can save significantly in their total energy costs through the entire year.

The original Tecofrost product line was discontinued in the early 2000s due to high gas prices, but the resurgence in gas availability, combined with continued electric grid escalation, particularly on the demand component of electric grids, makes Tecofrost an excellent product to reintroduce given the strong market pull. In fact, in many regions, the total cost of meeting refrigeration load by natural gas is substantially less than the cost of using electricity.

An important aspect to this product reboot is Tecogen's ability to work with its previous compressor manufacturing partner Vilter Manufacturing to jointly bring the products to market. The major advantage of again working together with Vilter Manufacturing is that all the product engineering, manufacturing data, testing, operation and maintenance are already in place. This minimizes cost and the timeframe to re-launch the product.

Maximum savings can be realized by utilizing the heat generated by the engine jacket and exhaust gas. Recovered heat can be used for space heating, domestic hot water, boiler feed water preheating, or process applications. Nearly one-half of the engine's fuel consumption can be recovered through this waste heat and is available up to 225°F.

## Ultera

In 2008 there was a dramatic change in the air quality regulations for distributed electricity generation in Southern California. At that time no technology could enable engine-driven generators to meet the new, stricter, emission standards. In reaction to the new regulations, Tecogen developed the Ultera technology.

Tecogen decided to look at the chemistry of emissions instead of the mechanical controls of the engine to simultaneously get rid of NOx compounds, CO and hydrocarbons. They broke the catalyst process into two steps and ran each step at a different temperature.

By controlling the temperature in the first stage, the system could achieve very low NOx emissions. In a second stage process the remaining pollutants were oxidized by injecting some air between the first and second stages and altering the process conditions.

In 2012, a 75 kW CHP unit equipped with the Ultera system became the first unit to obtain a conditional air permit in Southern California since the strict regulations went into place in 2009. A state-certified source test, administered in January 2013, verified that the emissions levels of the system were well below the new permitting requirements, and the final permit version was approved in August 2013.

**The Ultera retrofit kits deliver simple, cost-effective and robust solutions for meeting even the most stringent emissions standards. The patented system provides peace of mind to its customers by lowering NOx and CO to near-zero levels without the need for complex additional controls or frequent maintenance.**

## GROWTH DRIVERS

### Ultera Applications With Tremendous Potential

Tecogen's current success is in part based on its exceptional emissions control technology called Ultera. This is a muffler-like kit that dramatically reduces a **natural gas powered engine's** harmful emissions such as NOx, CO, and hydrocarbons. Since 2012, the Ultera technology has been installed on hundreds of cogeneration systems and functions impeccably.

Following that achievement, Tecogen has been developing a number of applications for

its Ultera technology with tremendous blue-sky potential.

In December 2015, following the outbreak of the Volkswagen emissions scandal, Tecogen initiated a program to adapt the Ultera technology to **gasoline fueled automotive engines**. The prospect of vehicle engines realizing fuel cell like emissions is tremendously compelling from a policy and market standpoint.

Two phases of testing conducted since at the world-renowned AVL California Technical, showed that Ultera was highly successful in reducing emissions of carbon monoxide (CO) and non-methane hydrocarbons (NMOG).

Subsequently, Tecogen entered into an agreement with a leading not-for-profit research and development organization with globally recognized expertise in vehicle powertrain development, including emissions after-treatment processes. The goal of this first phase is to optimize the chemistry and design of the second stage of the Ultera two-stage catalyst system.

The organization is performing the first phase of a three-phase program that will ultimately lead to Tecogen's goal of creating a working prototype of the Ultera system that is fully integrated into a vehicle.

This will enable potential partners in the automobile industry to have confidence in their evaluation, especially regarding cost, space and reliability. Tecogen is funding this initial phase. For the following phases, which will focus on component development, followed by completion and testing of the refined prototype, Tecogen may seek external financiers.

Additionally, in the first quarter of 2017, Tecogen began a research program, funded by the Propane Education and Research Council (PERC), to demonstrate the effectiveness of the Ultera emissions systems on **propane fueled fork trucks**.

The project had significant potential for the industry, as these vehicles generally operate indoors, where health concerns are magnified. In recent years, the market share for propane

fork trucks has been eroded, while battery-operated versions have taken over, mainly because of this issue.

Given these regulatory market drivers, the Company secured a commitment from Mitsubishi Caterpillar, a major fork truck company, to support the Tecogen engineering team and to supply a fork truck for testing. The initial results from these tests were superb.

During a heavy lift test, the truck was subjected to 20 repeated lifts in a 12-minute period. This was a strenuous duty cycle as the weight, 4,300 pounds, was close to the 5,000 pound rating of the truck. Both Tecogen and a third party lab conducted this test with comparable results.

As shown in the table, the Ultera reduced Carbon monoxide (CO) emissions with 99% and 91% respectively. Total hydrocarbons (THC) emissions were reduced by over 52% according to the third-party, while Tecogen instrumentation wasn't able to measure this pollutant. The Ultera also improved nitrogen oxides (NOx) emissions by 24% and 29% as measured by Tecogen instruments and that of the third party, respectively. This proves again that the Ultera technology is flexible and adaptable.

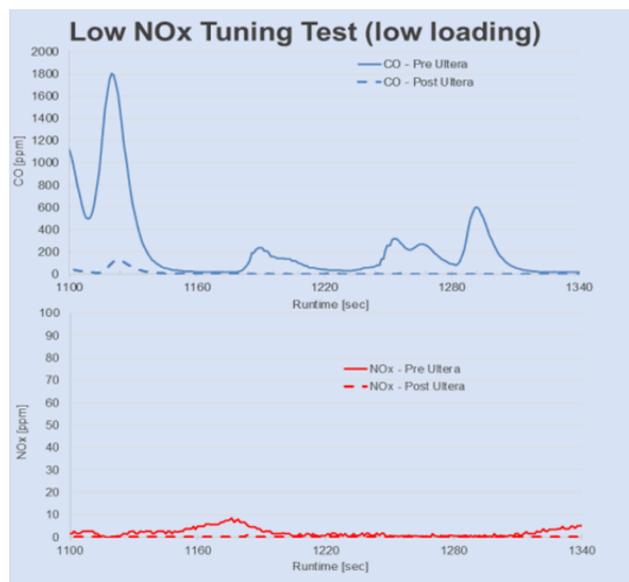
	<b>Tecogen</b>	<b>Third Party</b>
CO	98.8%	91.0%
THC	N/A	52.1%
NOx	24.3%	29.2%
<b>Emission reductions achieved during heavy lift tests were confirmed by an independent third party.</b>		

On the following page is a graph that shows the results of a test, which was completed at low load. For this test, the engine tuning was somewhat altered, which resulted in quite low NOx concentrations (solid red line). The detrimental side effect of this tuning however, is that the factory system was less effective in treating CO (solid blue line). With the Ultera added to the fork truck, both CO and NOx emissions were eliminated.

Mitsubishi Caterpillar has meanwhile informed Tecogen that it wants to proceed with the program. The fork truck manufacturer's

engineers in Japan are currently optimizing the software for the fork trucks with the goal to ultimately achieve near zero emissions.

This may then result in a small fleet of fork trucks being upgraded with an Ultera to further demonstrate its benefits over a longer period of time as the fork trucks go through their daily activities.



Finally, in 2018, the South Coast Air Quality Management District (SCAQMD) reset its Best Available Control Technology (BACT) Guideline for **stationary non-emergency electrical generators** powered by a spark-ignition internal combustion engine to be consistent with its Rule 1110.2 emissions standard.

SCAQMD covers the Los Angeles Basin, extends eastward to within a few miles of the Arizona border, and represents almost half of the state's population. To date, Ultera is the only known technology that enables rich-burn engines to comply with the rule.

In 2017, Tecogen supplied a customer with Ultera kits for a group of natural gas generators in Southern California that required permitting for general use well beyond the 200-hour annual exemption given to emergency generators today.

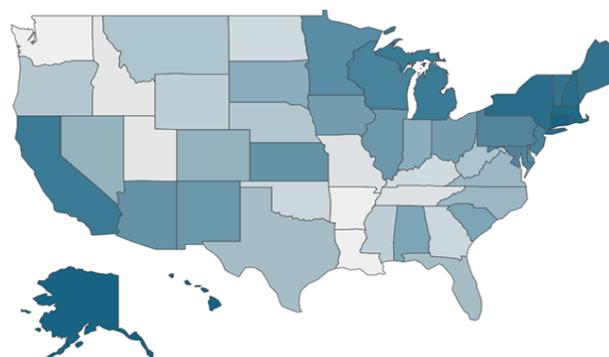
So far, all but one of the units, have been successfully tested by a third-party to confirm compliance. This official test is the final step

in the approval process. The final unit is expected to receive approval in the coming weeks.

This again presents a vast opportunity for Tecogen. Customers could equip their – almost idle - backup generators with an Ultera and run them during certain times of the year and certain times of the day when electricity rates peak. This would be tremendous cost saver for thousands of potential customers.

### Cannabis Becomes Key Industry for Tecogen

In recent quarters, Tecogen has emerged as a premier supplier to the cannabis market due to the comprehensive natural gas powered chiller systems the Company has developed which provide cooling while also achieving superb energy efficiency, reduced pollution output, high reliability, and certified performance.



**States where cannabis is legalized with a large population and high electricity rates are ideal for Tecogen's Tecochill chillers. States with some of the highest electricity rates are: Hawaii, Alaska, Connecticut, Rhode Island, Massachusetts, New Hampshire, and New York (dark blue on the map).**

The Tecochill product not only delivers substantial energy savings over electric cooling systems, but also accomplishes significant greenhouse gas (GHG) savings compared to traditional forms of heating and cooling similar facilities which typically use grid-powered electric chillers and boilers. At one facility, where two Tecochill DTx 400-ton units were installed, the chillers are expected to reduce GHG emissions by upwards of 1,000 tons of CO<sub>2</sub>/year.

This excellent performance is contributing to rapid growth for the Company, and a new

sales record was achieved in 2018 for Tecochill products with more than half of that growth driven by demand from the indoor cannabis cultivation subsector. The successful trend continues into 2019, as the Company has announced several more sales in the indoor growing area.

The energy savings and infrastructure simplification of using the Tecochill product is becoming standard practice when engineering cannabis or other high value indoor growing crops. Tecogen's nationwide service presence and cloud-based remote monitoring capabilities ensure rapid response to critical process cooling customers such as indoor agriculture facilities.

## RECENT EVENTS

### Tecogen Signs Its Largest Contract To-Date

In February 2019, Tecogen signed an \$8.4 million contract for Turnkey Engineering, Procurement, and Construction Services to install a one MW trigeneration plant at a data center in New York City.

This agreement is the largest contract the Company has procured to-date and it calls for Tecogen to install, commission and provide operations and maintenance services for multiple InVerde Combined Heat and Power (CHP) systems and an absorption chilling plant to be installed at the data center. The system will also provide backup power to the complex in the event of a grid outage.

We have previously spoken about Tecogen's business developments in the cannabis industry, where efficient power and climate control are imperative for maximizing crop yields. The data center business is yet another burgeoning industry experiencing heavy growth for which temperature control is vital to operations. This contract is important not only as the largest one to-date but it also gives Tecogen a chance to showcase its technology to this high-growth industry. CEO Benjamin Locke even referred to this contract as a "showcase project". If Tecogen's technology is proven successful in saving on

utility costs for this one data center, this could lead to more contracts globally.



**In today's digital economy, data centers must operate with hyperscale capabilities to meet demand, stay competitive, and provide new digital services. Tecogen can help achieve that high standard service with its second to none technology.**

Another note to take away from this sale is the tremendous interest the Company is seeing for its products in dense, space-limited areas like Manhattan. Due to population booms in cities, a premium on space and demand for clean and reliable power will be intimately linked. Tecogen has built on its reputation of good quality, efficient clean energy systems for years, and now it is finally paying off as the demand for these products has never been stronger, but will only grow with time.

### Tecogen Secures Another Large Contract in New York City

A couple of weeks after Tecogen procured the largest single contract in its history, it quickly followed up that deal with the announcement of Multiple Turnkey Contracts with a Luxury Apartment Building Owner in New York. Tecogen will install, commission and provide complete maintenance services for seven InVerde CHP systems to be installed in three of the owner's properties. The systems will also provide backup power to the complex in the event of a grid outage. While no revenue numbers were disclosed, it's important to note that the contract includes five years of maintenance on the seven CHP units.

Tecogen operates three service centers in proximity to NYC. This ensures availability of technicians to maintain and service equipment, plus rapid access to parts. The

service support on hand for this large urban center is a contributing factor to the large client base in the area.



**Building owners and developers are continuing to invest heavily in improvements to their buildings. Tecogen's CHP systems reduce operating expenses, improve resiliency and increase the value of these properties.**

Dense, space-limited urban areas like New York have high demand for clean and reliable power, especially as energy costs are on the rise. The flexibility of Tecogen's modular approach to its CHP solutions was imperative when procuring this new contract and will continue to be for any future business in the city.

While Tecogen units can only be sold to buildings that can handle the vast amount of energy produced, the most important aspect of Tecogen's sales pitch to landlords is the significant energy cost savings that can be generated, with a secondary benefit of being able to provide reliable power through outages, which improves service to the tenants.

The seven units are projected to exceed \$500,000 in annual savings with a 5-6-year payback for the property owner, based on the analysis of an independent engineering company. These savings, along with State incentive programs that rebate a portion of the CHP project cost, continue to be the driving forces behind Tecogen's success in New York City.

### **Advanced Tecogen InVerde e+ Systems Chosen to Power Large Urban Housing Complex**

Late December 2018, the Company announced it had secured the sale of a large microgrid system for a housing complex operator in the New York City area. The sale involved a total of 12 InVerde e+ units that

are going to be installed to power a multi-unit housing project comprising six buildings in Manhattan. Each building will have two units operating to provide electricity and heating, along with standby power for lighting, elevators, water pumps and back-up electrical systems in a grid-down event. These CHP systems will also include the advanced Ultra emissions control technology that reduces pollution output to near-zero levels.

With the combined power generating capacity of 1.5 MW, this deal represents one of the largest contracts in the history of Tecogen and a milestone in the overall advancement of CHP technology serving residential complexes within urban centers. The complete microgrid system will be installed and phased in throughout 2019. A five year maintenance agreement is also part of the contract.



**One of the biggest orders in Tecogen's history for 12 InVerde e+ units will be installed in 6 buildings that are part of a large low income housing complex in Manhattan.**

In addition to the high value of this sales contract, the transaction is also notable in that Tecogen worked closely with the project managers for a long period of time to design an effective system that addressed all of the operating requirements for this large complex, while also delivering cost savings and long term reliability. A prominent engineer involved in the process determined that technical superiority of the Tecogen InVerde e+ system provided the best solution compared to alternative product options that were considered.

The system will qualify for financial rebates offered under the NYSERDA program operated

by New York State, implemented to encourage the installation of CHP systems for high value projects as a means to offset conventional electrical demand on the grid. The combination of financial incentives and cost benefits WILL ultimately amount to more than the capital investment to purchase and install the units, so in effect these systems pay for themselves.

## FINANCIALS

Product revenues in the fourth quarter of 2018 were \$3,702,610 compared to \$4,642,124 for the same period in 2017, a decrease of 20.2%. Service revenues in the fourth quarter of 2018 were \$3,964,852 compared to \$4,118,406 for the same period in 2017, a decrease of 3.7%. Energy production revenues in the fourth quarter of 2018 were \$1,648,946, compared to \$1,503,633 for the same period in 2017, an increase of 9.7%. Energy production revenue represents energy revenues earned during the quarter by the American DG Energy sites.

Consolidated gross profit for the fourth quarter of 2018 was \$3,711,367 compared to \$3,795,081 in the fourth quarter of 2017, a decrease of 2.2% in overall gross profit year over year. When compared to the decline in revenue for the quarter, this result is actually quite good and is driven by an increase in overall gross margin for the fourth quarter of 2018 to 39.8% from 37% for the same period in the prior year.

Services and energy production margin both increased substantially over the fourth quarter of 2017. Service margin increased from 33.5% to 38.7% and energy production margin increased from 34.8% to 41%. Product gross margin stayed about flat for the quarter: 40.5% in Q4 2018 versus 40.7% in Q4 2017.

Tecogen's net income for the fourth quarter of 2018, exclusive of goodwill impairment, was \$18,686 compared to an income of \$268,981 for Q4 2017, a decrease of \$250,295. Operating expenses excluding the goodwill impairment rose 7% with much of the increase being due to legal fees in connection with the acquisition of American DG Energy Inc, as well as selling expenses incurred from

an increased focus on chiller sales. R&D expenses increased 3% for the quarter. Non-GAAP EBITDA, which excludes non-recurring merger related costs, goodwill impairment, mark to market adjustments and stock compensation expense, was \$502,160 for Q4 2018, down 5.8% from \$532,160 in Q4 2017.

Amounts in \$000's	12/31/18	12/31/17
Product Revenue	3,703	4,642
Service Revenue	3,965	4,118
Energy Revenue	1,649	1,504
<b>Total Revenue</b>	<b>9,316</b>	<b>10,264</b>
Cost of Product Sales	2,201	2,751
Cost of Services Sales	2,431	2,738
Cost of Energy Sales	973	981
Total Cost of Sales	5,605	6,469
<b>Gross Profit</b>	<b>3,711</b>	<b>3,795</b>
Operating Expenses	8,122	3,487
<b>Income (Loss) from Operations</b>	<b>(4,411)</b>	<b>308</b>
Total Other Expenses	123	33
<b>Net Income (Loss)</b>	<b>(4,533)</b>	<b>274</b>
Diluted EPS	(0.18)	0.01
Diluted Shares Outs.	24,822	23,343
<b>Selected income statement data for the quarters ending December 31, 2018 and December 31, 2017. Source: Company Filing</b>		

Product revenues for 2018 were \$12,624,867 compared to \$12,991,283 in 2017, a decrease of 2.8%. Service revenues for 2018 were \$16,859,291, compared to \$16,377,443 in 2017, an increase 2.9%. Energy production revenues for 2018 were \$6,399,526, compared to \$3,833,940 for the same period in 2017. Note though that the 2017 energy production revenue only represents revenues earned after May 19, 2017, the day after the acquisition of American DG Energy through the end of the year.

Operating expenses (excluding the goodwill charge) increased to \$14,739,581 for 2018 compared to \$12,729,252 in 2017, an increase of 15.8%. This is largely driven by the acquisition of American DG Energy Inc. R&D expenses increased 38.5% for the year. Tecogen recorded a net loss of \$5,708,532 (\$1,317,942 excluding the goodwill charge) for 2018 compared to income of \$47,436 for 2017. Adjusted EBITDA declined to \$217,454 in 2018 from \$1,102,780 in 2017.

## Balance Sheet as of September 30, 2018

Current assets at year-end of \$26,368,572 were double the current liabilities of \$13,198,320. Current liabilities as of December 31, 2018 included \$2,009,435 of short-term debt on the Company's revolving line of credit.

Amounts in \$000's	12/31/18	12/31/17
Cash and Cash Eq.	273	1,673
Accounts Receivable	14,176	9,537
Inventory	6,695	5,131
<b>Total Current Assets</b>	<b>26,369</b>	<b>21,661</b>
Property & equipment	11,273	12,266
Intangible Assets	2,894	2,896
Goodwill	8,975	13,366
<b>Total Assets</b>	<b>49,904</b>	<b>50,671</b>
Accounts Payable	7,153	5,095
Accrued Expenses	1,528	1,417
<b>Total Current Liabilities</b>	<b>13,198</b>	<b>8,708</b>
Unfavorable Contract Liability	6,293	7,730
<b>Total Liabilities</b>	<b>21,867</b>	<b>16,976</b>
Total Stockholder Equity	27,783	33,240
<b>Selected balance sheet data for December 31, 2018 and December 31, 2017. Source: Company Filing</b>		

In March 2019, Tecogen announced that it strengthened its balance sheet with approximately \$7 million thanks to the sale of eight projects that it obtained when it acquired American DG Energy Inc (ADGE) in May 2017.

The assets were sold to a company managed by the New York office of Sustainable Development Capital, an investment firm with a proven track record of investment in energy efficiency and decentralized generation projects.

At the time when ADGE was acquired, it had 92 installed energy systems, including various models of Tecogen cogeneration units, Tecochill water chillers, and conventional air-conditioning systems. The acquisition was a stock-for-stock transaction, which valued American DG Energy at approximately \$18.8 million.

Tecogen will continue to maintain the equipment and perform invoicing for the energy supplied by the equipment for the duration of the power purchase agreements. These agreements include performance incentives split evenly by both parties for energy savings collections exceeding the minimum collection guarantees in the agreements.

The Company will use the cash generated by the sale to eliminate debt, support growth in strategic product areas, and strengthen the balance sheet.

## OUTLOOK & VALUATION

The fourth quarter financials were a mixed bag for Tecogen, although most of the "bad" is backwards looking with the "good" expected to come. While revenue and EBITDA declined, it is obvious that Tecogen is laying the groundwork for an excellent 2019 due to record contracts and tremendous increase to backlog along with an increase to gross margins in Q4.

Tecogen now has more than 250 separate microgrid enabled CHP systems online in the US. This amounts to a combined power output of 25MW. Just within the New York City area, several housing complexes already depend on large-scale CHP services provided by Tecogen equipment, and the potential for further expansion is at hand as many other projects are scheduled for refurbishment and renovations in the years ahead. The established benefits and reliability of the InVerde systems will factor into additional sales growth in this city and across the US.

The major contract announcements the past months also validated the advanced technology of the product line that created specific advantages for each client. The Tecogen systems provide operational flexibility, in addition to reliability and lower pollution emissions. All these factors contributed to the choice for each new client to upgrade to Tecogen products, instead of other options that were considered.

The exponential demand growth for cannabis, and the unique regulatory framework that

requires cultivation of the plants within each state where the sales are completed, has led to a rapid increase in the construction of new indoor cultivation centers for cannabis plants. The specific requirements necessary for optimal plant yields and the high energy costs associated with many of the states where these facilities are located, has encouraged cannabis growers to purchase integrated systems developed by Tecogen as the ideal solution for their needs.

A new sales record for Tecochill chillers was achieved during 2018 as a result of the expansion for cannabis cultivation facilities. Considering the expectation for additional capacity to be added to supply these markets, plus the anticipation that cannabis legalization will be approved in several other states, even stronger sales growth lies ahead for Tecogen.

As the sales volume increases for equipment, the Company is also securing long term service contracts that will also contribute to increased recurring revenues. Combined with a network of service centers strategically located in many of the largest market centers in the United States, the growth plan for Tecogen is gaining traction on multiple levels. This steady trend of sales growth will continue to support a rising share price for the stock.

## Valuation

Given the still emerging nature of Tecogen's earnings, a multiple-based valuation is challenging. Instead, we apply a Discounted Cash Flow (DCF) model.

Based on our estimate of 26.1 million diluted shares outstanding, the intrinsic value of Tecogen's shares derived from our model is \$9.53.

**We reiterate our buy recommendation for Tecogen Inc. with a target price of \$9.53, which is 140% above today's stock price.**

## SHARE DATA & OWNERSHIP

As of March 31, 2019, Tecogen had 24,829,746 common shares outstanding. In addition, the Company had 1,292,589 stock options outstanding with a weighted average

exercise price of \$3.52. Each stock option entitles its holder to purchase one common share of the Company.

The principal owners of the Company's common stock are George Hatsopoulos (11.1%), Monovoukas Yiannis (10.5%), John Hatsopoulos (9.3%), Joseph Comeau (9.1%), and Tryfon Natsis (6.5%).

## MANAGEMENT

### ▣ BENJAMIN LOCKE – CHIEF EXECUTIVE OFFICER

Mr. Locke was named Co-Chief Executive Officer in October, 2014 and sole Chief Executive Officer in March, 2018. He joined Tecogen in June, 2013 as the Director of Corporate Strategy and was promoted to General Manager prior to his appointment as Co-CEO. Previously Mr. Locke was the Director of Business Development and Government Affairs at Metabolix, responsible for developing and executing plans for partnerships, joint ventures, acquisitions, and other strategic arrangements for commercializing profitable clean energy technologies. Mr. Locke has a B.S. in Physics from the University of Massachusetts, an M.S. in Electrical Engineering from Tufts University, and an MBA in Corporate Finance from Boston University.

### ▣ ROBERT PANORA – CHIEF OPERATIONS OFFICER

Mr. Panora has served as President of Tecogen since 2000. He had been General Manager of Tecogen's Product Group since 1990 and Manager of Product Development, Engineering Manager, and Operations Manager of the Company since 1984. Over his 27-year tenure with Tecogen, he has been responsible for sales and marketing, engineering, service, and manufacturing. Mr. Panora contributed to the development of Tecogen's first product, the CM-60 cogeneration module, and was Program Manager for the cogeneration and chiller projects that followed. Mr. Panora has B.S. and M.S. degrees in Chemical Engineering from Tufts University.

### ▣ BONNIE BROWN – CHIEF ACCOUNTING OFFICER

Ms. Brown served as ADGE's Chief Financial Officer, Treasurer and Secretary since September 2015. From September 2015 to January 2017, Ms. Brown served as Chief Financial Officer, Treasurer, and Secretary of EuroSite Power Inc. Ms. Brown was a Financial Advisor at Barker Financial Group, a strategic wealth management advisement company, from July 2014 to September 2015. From 2009 to December 2014, Ms. Brown served as the Chief Financial Officer of Ilios Inc. She joined Tecogen as its Controller in 2005 and became the Chief Financial Officer in 2007 and remained in that position until December 2014. Prior to 2005, Ms. Brown was a partner at Sullivan Bille PC, a regional accounting firm, for 15 years where she provided financial, accounting, audit, tax, and business consulting services for mid-sized companies.

**▣ DR. JOHN N. HATSOPOULOS –  
CHAIRMAN EMERITUS, DIRECTOR**

Dr. Hatsopoulos was the Chief Executive Officer of the Company since the organization of Tecogen in 2000. Later, he became the co-CEO of the Company next to Benjamin Locke. On March 29, 2018, Mr. John Hatsopoulos resigned as Co-Chief Executive Officer of the Company, making Mr. Locke the sole Chief Executive Officer. Mr. Hatsopoulos will continue to serve as a Director of the Company through the end of his current term. Mr. Hatsopoulos is a co-founder of Thermo Electron Corporation, which is now Thermo Fisher Scientific (NYSE: TMO), and the retired President and Vice Chairman of the Board of Directors of that company. Mr. Hatsopoulos graduated from Athens College in Greece, and holds a bachelor's degree in history and mathematics from Northeastern University, as well as honorary doctorates in business administration from Boston College and Northeastern University.

## ANNUAL INCOME STATEMENT FY 2015 – FY 2018

All numbers in thousands

PERIOD ENDING	FY 2015	FY 2016	FY 2017	FY 2018
<b>Total Revenue</b>	<b>21,443</b>	<b>24,490</b>	<b>33,203</b>	<b>38,884</b>
Cost of Revenue	13,809	15,190	20,248	22,292
<b>Gross Profit or (Loss)</b>	<b>7,633</b>	<b>9,301</b>	<b>12,954</b>	<b>13,592</b>
<b>Operating Expenses</b>				
General & Administrative	7,998	7,994	9,520	10,791
Selling	1,687	1,637	2,272	2,651
R&D	592	667	937	1,298
Goodwill Impairment	-	-	-	4,391
Total Operating Expenses	10,277	10,289	12,729	19,130
<b>Operating Income or (Loss)</b>	<b>(2,643)</b>	<b>(997)</b>	<b>225</b>	<b>(5,538)</b>
<b>Other Income or (Expense)</b>				
Interest Expense	(172)	(176)	(155)	(120)
Unrealized Gain (Loss) on Investment Securities	-	-	-	(118)
Provision for State Income Taxes	-	-	-	(33)
Income or (Loss) attributable to the non-controlling interest	74	65	50	(93)
<b>Net Income (Loss) attributable to Tecogen</b>	<b>(2,727)</b>	<b>(1,096)</b>	<b>47</b>	<b>(5,709)</b>

Annual Income Statement FY 2015 – FY 2018. Source: Company Filings



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**Frankfurt: 2T1**

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