

SOLUTIONS AND PATHWAY TO HB 4297 SUCCESS

Key issues concerning SERE (Sol Electrica Renewable Energy Inc.) and added solutions to help pass HB 4297

- energy generated from waste; allow to qualify as renewable or advanced cleaner energy
- elimination of the energy optimization program

SERE's gas to electric generation systems will help utilize all of Michigan's solid waste opportunities from the largest to the smallest production facilities. The EnviroGEN series of gas to electric generators can be designed as small as 20 kW/h units and as large as 3 Megawatts. The systems are clean and very efficient in converting fuel to electric helping prove the fact that Michigan's biomass and waste gas recovery systems deserve to be classified as renewable. These systems are not in commercial use and are new technology which is being developed at Muskegon's Michigan Alternative and Renewable Energy Center (MAREC) in conjunction with GVSU. Phase I has been completed with great results.

The development goal of Phase II is to allow Michigan's natural gas, biomass, and waste gas to produce some of the cleanest, most cost effective long-term capital outlay and cheapest electric in the US.

- Energy Optimization Program (EOP)
56% less cost vs. commercial electric purchase through the use of EnviroGEN systems
- New technologies developed in Michigan will provide a replacement for EOP

With the elimination of the EOP what is the solution to Michigan's energy disparity? New technologies can provide the solution not through mandates, rebates, low interest loans or supplements but through direct consumer cost savings. Although SERE does not have a residential product in development it will. For now just commercial, industrial, institutional and governmental facilities will be able to enjoy 50% or more in electric cost saving by producing their own clean efficient electric using natural gas. In 22 months these systems will be available to Michigan's commercial consumers, immediately bringing down bottom line operational costs, fuel consumption and GHG emissions. Not only will Michigan's overall energy costs drop but increase interstate competitive advantages will result in more exports and more companies will wish to expand and relocate to the state with the lowest cost of electric.

Future discussions on net metering not meant for this hearing.

SERE would like to see the 295-2008-5 amended to include non-renewable clean energy electric production systems in net metering program if the following criteria are met:

- Systems produce less GHG emissions than Michigan's average current power plants

- Systems have a lower fuel to kW/h ratio than Michigan's average current power plants
- Systems produce kW/h at a low enough cost to provide the major power companies to purchase the excess electric at a rate which allows them to resell the power at a profit margin they are currently enjoying and still allows the systems owner to realize a profit

How SERE's EnviroGEN series affects **Energy Choice** in the Upper Peninsula (UP).

The small gas to electric generators that SERE will produce in Muskegon will solve the Energy Choice problem in the UP. Strategically placed EnviroGEN systems will provide very low cost power to the low population density areas in the UP. It is highly possible that a Michigan border municipal utility could provide electric to those areas in Wisconsin that are also in need of high electric cost issues.

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ENVIROGENTM

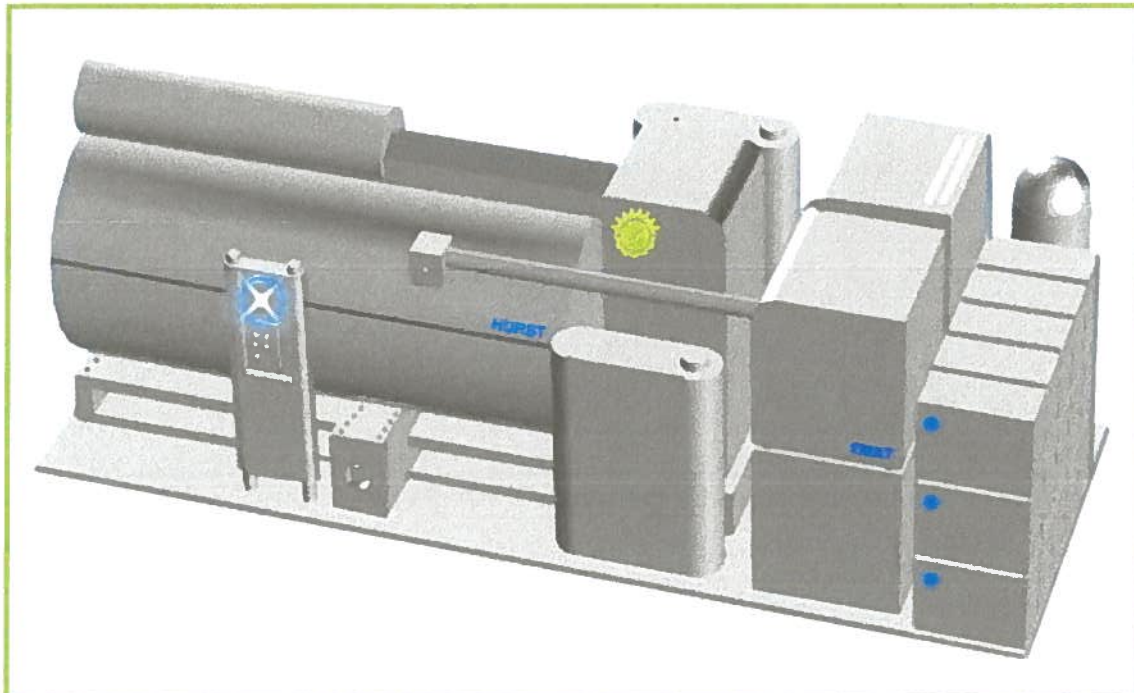
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ENVIROGENTM – Gas TMAT Electric Generator

The ENVIROGEN is a unique solution for greenhouse gas (GHG) reductions and low cost efficient electricity generation. The ENVIROGEN uses Sol Electrica's thermal molecular adhesion turbine (TMAT) and will provide as options, recently patented metal-air supercapacitor long-life battery array and GHG abatement combustion technology. The ENVIROGEN can be quickly installed at any school, hospital, retail, commercial, industrial or government facility which has natural gas access. The elimination of GHG emissions of over 50% and the greatly reduced cost to produce electricity on-site makes the ENVIROGEN a viable alternative to purchasing electricity from centralized regional coal powered electric companies.

For information concerning return on investment (ROI), regional system cost rebates, carbon credits and retail natural gas (NG) pricing see appendix A. For cogeneration efficiency and effect on ROI using worst-case scenario for retail fuel costs see appendix B.

Internal System Configuration View



Model Number: ENVIROGEN 700 / 750kW/h Gas TMAT Generator

Internal System Part Description:

- High Efficiency Industrial Saturated Steam Hurst Boiler (200 BHP)
- Hurst Internal Stack Economizer-SE (9% reduction in fuel usage)
- Negative Vacuum Condenser Closed-loop Water Flow System
- Low Maintenance Permanent Magnet 700-750kW/h, 480VAC Alt/Gen Unit
- TMAT (thermal molecular adhesion turbine) – 'Plug & Perform' Easy Upgrade Design
- System Control Interfaces – Solid State EMP Hardened Electronics
- Anodized Aluminum Housing With Triple-coat UV Electrostatic Paint with Long Term Corrosion and Weather Resistant Protection
- Dual Side Natural Gas Access Ports
- System Control Panels Locking Access Door
- Removable Skid Mount Hoist Connector Option
- Electric Junction Box, Grounding Link & grid-tie

Future Options (Commercialized in Phase II)

- Dual Combustion Catalyst Chambers – CO2 & NOx Reduction System
- Dual Side Combustion Catalyst Maintenance Panels
- Long life Metal-air & Supercapacitor Battery Surge Array
- Adsorption Chiller for commercial cold air production (CHP)
- Heat Exchanger for commercial heated air production (CHP)
- Ease of Replacement TMAT – As the TMAT improves in efficiency it can be upgraded for improved cost of electric production

ENVIROGEN 700 Specifications

Height – 110"

Width – 96"

Length – 26'

Weight (empty) – 22,765 lbs.

Weight (operational) – 32,156 lbs.

NG CFH Usage (peak) – 8,400, 8.4 MCF

Output (peak) TMAT35 – 700+ kW/h

Output (peak) TMAT40 – 750+ kW/h

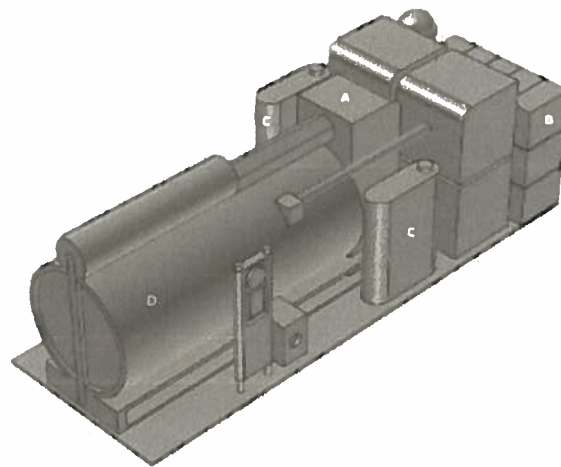
Options:

A – Adsorption Chiller (CHP)

B – Metal-air Battery Array (Surge 75kW)

C – Combustion Catalysts (GHG -50%)

D – Hurst Internal Stack Economizer



The above specifications and product description are very close to the actual system configuration and predicted functionality, which will be commercialized in Sol Electrica's Phase (I) development.

APPENDIX A

Additional Factors for Further Reduction of Return on Investment (ROI)

State, Federal and Regional Power Company Rebates – TBD
Carbon Credit Impact – TBD
System Classification (non-regulated power generation) – TBD
Natural Gas Retail Qualifications – TBD

ROI Comparison for Green & Renewable Energy Systems (significant Co-generation savings not included)

At 95% yearly operation the ENVIROGEN 700 (est. \$600,000 installed cost) will have an expected ROI of between 1.25 – 2.5 years based on retail price of NG vs. regional commercial price of electricity. [Assuming all electric produced is used by customer or can be sold back to grid at retail.](#)

Regional Specific Cost of Electricity

Using natural gas (NG), the currently most cost effective fuel source, there are several possible retail pricing tiers. If your company is paying commercial NG costs you can use the \$/MCF to estimate your electric production cost. Here is an example using California* as a test case:

May 2014 commercial average electric cost - \$0.1473 per kW/h
May 2014 commercial average NG cost - \$8.90 per MCF (thousand cubic feet)

At normal operation the ENVIROGEN 700 requires 8,400 CFH (-9% SE) or 7.64 MCF to produce 750 kW/h using the TMAT at (40%). Cost of fuel will be \$0.091 per kW/h or **38.2% less than purchased electric.**

The ENVIROGEN 700 should qualify as a non-regulated power production customer which would then enjoy a further reduction in NG costs:

May 2014 commercial average electric cost - \$0.1473 per kW/h
May 2014 'electric power' average NG cost - \$5.48 per MCF (thousand cubic feet)

Cost of fuel will be \$0.056 per kW/h or **62% less than purchased electric.**

Another method for further cost reductions over commercial costs would be qualifying for volume discounts using the NG providers 'Transport'** pricing. The ENVIROGEN 700, at normal operation, would require 736,000 Ccf/year. This volume would qualify most commercial customers to use the ST Transport Rate which will be lower than their current commercial rate. Each state's regions have varying volume parameters to qualify for these reduced rates and should be contacted directly for each areas requirement.

US Fuel and Electric Cost Source Information

* [EIA GOV Natural Gas Pricing US](#)

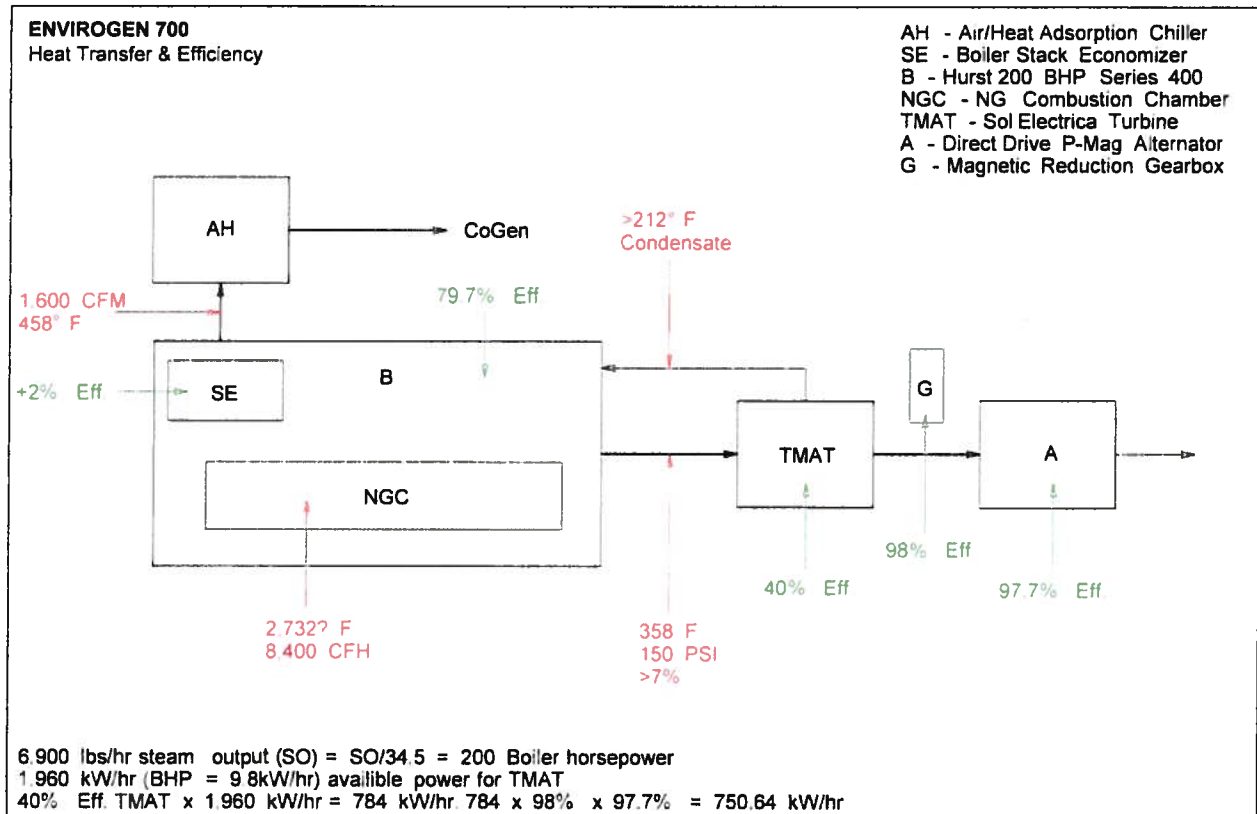
* [EIA GOV Electricity Pricing US](#)

** [DTE MI Natural Gas Retail Pricing Structure](#)

APPENDIX B

ENVIROGEN Technical Data & System Block Diagram

Below is a block diagram of the ENVIROGEN 700 (gas TMAT generator) with efficiency gains and losses shown in green. Also, heat transport flow through the system is shown in red. Calculations are based on standard thermodynamics conversion formulas.



"Internal heat transfer will be discussed that the end of the document"***

The calculations show that for every 8,400 CF/hr 750kW/hr is produced.

Input firing rate (NG) 8,400 CFH – 8,400,000 BTU (+ Eff. 2% not factored) – 8,400 CFH
 Steam output (150 PSI) 6,900 LBS/HR
 Stack exhaust 1,600 CFM @ 458°F

Boiler horsepower (BHP) is measured in lb/hr steam production.

1 BHP = 34.5lb/hr 6,900 ÷ 34.5 = 200 BHP

BHP can be converted into BTUs. 1 BHP/hr = 33,475 BTU/hr

200 BHP = 6,695,000 BTUs (steam output to TMAT)

Steam output ÷ 8,400 CFH = 79.7% Boiler efficiency

Stack exhaust ~ 1,705,200 BTUs (CO/GEN output)

BTU/hr can be converted into kW/hr. 3,415.8 BTUs = 1 kW

Total kW input to TMAT 6,695,000 ÷ 3,415.8 = 1,960 kW/hr

Magnetic Gearbox reduction – 98% Eff.

Direct Drive P-Mag Alt reduction – 97.7%

TMAT at 40% efficiency will produce 750 kW/hr at normal operation

Cost to Produce Electricity in Michigan (TMAT 40% EFF.)

First, it would be good for our customers if the ENVIROGEN 700 could qualify for the lowest rate, which is the 'electric power' price. By definition 'electric power' price is the price of gas used by electricity generators (regulated utilities and non-regulated power producers) whose purpose is the generation of power.

Customers operating the ENVIROGEN 700 at a 95% rate per year will qualify for the ST transportation rate.

But since the above cannot be easily calculated or expected we will use straight commercial electric to natural gas pricing which will be the worst-case scenario. Instead of a monthly price rate for both we would rather use a yearly average since DTE's lower end large commercial price has not fluctuated and the NG price is highest in the summer. Customers will be using year costs to determine their overall ROI.

2014 commercial electric cost – \$0.1182 per kW/hr*
2014 commercial natural gas cost – \$8.515 per MCF** (DTE gas rate may be lower)
2014 electric power price - \$4.48 per MCF***

The cost of NG (MCF) to produce 750kW/hr ~ $8.40 \times \$8.515 = \71.53 or \$0.095 / kWh

The cost of electricity to produce 1kW/hr = \$0.1182

The end user or customer is able to generate their own electricity at 19.63% less than commercial electric prices

Electric cost savings per year - \$152,441

ROI (with expected five year maintenance costs built in) - $\$600,000/152,441 = 3.9$ years

AS ELECTRIC POWER PRODUCER!!

The cost of NG (MCF) to produce 750kW/hr ~ $8.40 \times 4.48 = \$37.63$ or \$0.0501 / kWh

The cost of electricity to produce 1kW/hr = \$0.1182

The end user or customer is able to generate their own electricity at 57.54% less than commercial electric prices

Electric cost savings per year - \$447,417

ROI (with expected five year maintenance costs built in) - $\$600,000/447,417 = 1.34$ years

Note: ROI does not include cogeneration savings; this will be calculated and added below (1.8 year ROI with COGEN included at minimum)

Cogeneration Cost Savings (Stack exhaust ~ 1,705,200 BTU/hr)

In order to estimate the cost saving for an individual customer one would have to know what type of heating and cooling equipment they are currently using. The efficiency, type of fuel used, hours of operation and how energy efficient their facility has been designed. We will show how many BTUs can be contributed to both heating and cooling and estimate, on the low end, how many hours they would need both types of energy consuming requirements for their interior climate control. Below is our expected contribution to our customers heating and cooling energy needs.

Heat Exchanger (exhaust to heated air) – 80% for counter current exchange / MVHR (+90 AFUE for costly systems) = 1,364,160 BTU/hr

Adsorption Chiller single-effect (exhaust to conditioned air) - coefficient of performance (COP) 70% (0.6-0.8 range) = 1,193,640 BTU/hr

3,412.15 BTU/h = 1 kW/h Thermodynamics conversion

For heating we will use 8 hours at 175 days for the Michigan region for cooling we use 8 hours at 80 days, again please use your own numbers to more accurately estimate the total cost saving for your region.

For heating we use the number of BTUs available from the GTG700 which is 1,364,160
 $1,364,160 / 3,412.15 = 399.75 \text{ kW/h}$ $399.75 \text{ kW} \times 0.1182 = \47.25 per hour
 $8 \times 175 \times 47.25 = \$66,150 \text{ savings per year for heating}$

For cooling we use the number of BTUs available from the GTG700 which is 1,193,640
 $1,193,640 / 3,412.15 = 349.82 \text{ kW/h}$ $350 \text{ kW} \times 0.1182 = \41.37 per hour
 $8 \times 80 \times 41.37 = \$26,477 \text{ savings per year for heating}$

Combined heating and cooling saving per year = \$92,627

Electric cost savings plus COGEN (heat + cool kW/h) per year - \$152,441+ \$92,627
ROI (with expected five year maintenance costs built in) - \$600,000/337,695 = 1.8 years

AT ELECTRIC POWER PRICE

ROI (with expected five year maintenance costs built in) - \$600,000/540,089 = 1.11 years

Note: the price of capital acquisition does not include the cost to the customer to retrofit their heating and cooling system for use with the GTG700 COGEN output.

As the ENVIROGEN 700 will be continuously providing heated or conditioned air, to a 50 – 100,000+ square foot facility, the facilities heating and air equipment will not be required to be operational for the difference between ENVIROGEN 700 input and facility requirements. Hence an average yearly saving could be much higher than the above low average. Again a reduction in fossil fuel use and GHG abatement will occur.

* <http://www.dleg.state.mi.us/mpsc/electric/download/rates1.pdf>

** <http://www.eia.gov/dnav/ng/hist/n3020mi3m.htm>

*** http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_SMI_m.htm

*** Internal Heat Transfer

Combustion only occurs in the boiler and 79.7% of the BTUs produced are used to continuously heat 1,126 gallons of purified water to 358° F at 150 PSI. The remaining BTUs are exhausted through the boiler stack to produce COGEN energy.

The TMAT will only see 358° F at any given time and because there is very little friction inside the TMAT this internal temperature will not rise significantly. The TMAT uses the temperature drop of 146° F to convert this energy into power. The majority of the TMAT power comes from the mass of the working fluid moving at a specific velocity and providing adhesion and viscosity power to the internal flat disc array which is then transferred to the main rotor shaft. Hopefully you can see from the block diagram where all the heat is being generated and transferred throughout the system.

HOUSE BILL AMENDMENTS / BUSINESS STABILITY,
COMMERCIAL COMPETITIVE ADVANTAGE & JOB GROWTH

The main goal of Sol Electrica Renewable Energy Inc. (SERE) is to help Michigan become a decentralized utility provider, highly energy efficient and emission reduced electric power state. SERE is developing an advanced cleaner energy system, **ENVIROSEN™** (see product sheet in handout), at the MAREC/GVSU facility in Muskegon. This near future product will provide a solution to the above mentioned goals. In order to accomplish these milestones certain aspects of the current bill need to be addressed.

- Energy efficiency added back into HB 4297 section 1(2)
- An additional section covering energy efficient non-renewable electric production systems HB 4297 section, 3b (or new numeric designator)
- Net Metering for high efficiency non-renewable electric producers: HB 4297 section 13,

Currently only renewable energy sources can enjoy this option (section 13), but we believe that more can be done to promote lowering the amount of fossil fuel consumption and GHG emissions to produce the same amount of electric output. By combining the ‘advanced cleaner energy systems’ with ‘technologies not in commercial operation’* you will have a new class of efficient electric production systems. The goal is to achieve increased fuel to electric conversion at a much higher efficiency than the current systems. Again these new technology systems must be more efficient than current Michigan power plants, reduce GHG emissions below today’s standards and possibly be made in Michigan. All of the renewable energy solar panels and wind turbines are made outside the state of Michigan. It is time to provide the needed support for Michigan’s own development of high-tech renewable and advanced cleaner/efficient energy systems.

Allowing non-renewable energy systems to participate in the net metering program will positively affect the following:

- ❖ Reduction in fossil fuels needed for electric production
- ❖ Reduction in GHG emissions
- ❖ Decentralized State’s electric power distribution
- ❖ Provide greater energy security by using Michigan’s Natural Gas resources
- ❖ Encourage private investment in advanced efficient clean energy systems
- ❖ Allow new municipal utilities creation with the purpose of providing lower cost electric to their residential customers
- ❖ Allow commercial and industrial entities to begin producing their own lower cost electric, sell excess back into the grid and lower emissions

* From 2008 PA 295 (iv) An electric generating facility or system that uses technologies not in commercial operation on the effective date of this act.

Renewable energy systems require large federal rebates and state incentives to even approach viability. Even with this outside help the return on investment (ROI) is over ten years for these current technologies. SERE's **ENVIROSEN™** series of gas to electric generators will provide customers with less than 4 years ROI and as low as 1.2 years when 'electric power price' natural gas retail rates are enjoyed along with onsite cogeneration adaptation. Also, the overall installed cost and capital outlay for these systems is 23% less per kW than current coal or gas fired power plants cost for the same kW.

Additions to HB 4297 that would decrease fuel usage, reduce electric cost to consumers and abate GHG emissions are:

- ❖ A sub tier of renewable energy credits aimed at non-renewable clean energy efficient electric production systems. As an example, a 10% increase in system efficiency should result in a 10% energy credit
- ❖ Ability to redeem excess electric production credits or sell them on the open market
- ❖ No limits on capacity buy back (net metering), currently 1% of nameplate capacity
- ❖ Systems meeting electric production criteria will enjoy 'electric power price' retail natural gas end-user costs

Using the city of Muskegon as an example, we will demonstrate how these small changes and additions to HB 4297 can effect a dramatic and positive change in Michigan's current electric power environment:

Muskegon decides to put an **ENVIROSEN™** 700 series gas electric generator (750kW/hr) at one of their government complexes to provide electric power. The unit is delivered as a plug-n-play complete micro power plant with only electrical and natural gas (NG) hookups needed onsite. If the commercial NG line cannot provide at least 8.4 MCF/hr service, then DTE will have to negotiate with the city a main line extension to the operational NG hub for this unit. Once the NG line is furnished and a facility/grid tie is complete then the unit will provide power at +50% less than the city can purchase commercial electric from Consumer Energy. Let us assume that the facility has a peak power usage of 750kW/hr but a low of 600kW/hr during certain daily cycles. This would mean that they could sell the excess 150kW/hr back to Consumer Energy. Because the **ENVIROSEN™** is more efficient than the power company, the city of Muskegon can sell back excess electric production at below retail rates to the grid and still offer lower electric cost to the consumer. Avoided-costs needed for the power company to remain profitable can be met with an amiable resolution agree by both entities.

In this scenario both the power company receives low cost energy back for sale into the grid; Muskegon reduces their electric costs by over 50% and still receives funds from the sale of excess electricity. Furthermore, less fuel is used to produce the same amount of power needed, fewer GHG emissions are produced and the city can allocate the saved costs to other needed resources locally.

The above example also works for commercial, institutional and industrial facilities that have access to commercial NG. Reducing operational costs in the above sectors will promote job growth, interstate competitive cost of goods sold, company reinvestment and business stabilization.

In conclusion, when these small changes and additions are implemented into law and SERE's **ENVIROSEN™** product meets expected performance, there should be no need for Michigan to build any new power plants to replace the losses from the decommissioning of coal fired systems. Various carbon capture systems are being looked at for the already low GHG emissions from the **ENVIROSEN™**. This technology will make our system's emissions less than the current power plant standards.

We look forward to the opportunity to discuss these issues and opportunities further. Please contact the below corporate officers for past test results on turbine technology, future renewable energy products and additional information concerning Michigan's energy bills.

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Please ask about our future renewable energy system by SERE Inc. – Modular Solar Power Plant (MSPP)

- Non-Solar Cell Technology (PV) – collection/concentration
- High efficiency – +35% solar to electric conversion
- 3 times peak operational time vs. static solar cell panels
- 1/3rd less weight and footprint size than current solar panels systems
- Direct AC output with grid tie