



# Economic Opportunities of Sustainable Manufacturing

NIST Workshop on Sustainable Manufacturing

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*HARBEC* Plastics, Inc.

# Agenda

**“Being Green is nice but we can’t afford it”** ...Disproving a common misconception through eco-economic examples

Current Status- an update on implemented systems, equipment, and practices... What are the Eco-Economic results?

- Energy
  - Efficiency – through Combined Heat and Power
  - Pricing Predictability – through Renewable Wind
- Transportation
  - Green fleet
- Building Design
- Lighting Systems
- Industrial Efficiencies

Future Projects and Objectives

- What are the future opportunities for continued improvement?
- Using what we learn to develop future business opportunities

# Why and How

## The origin of Eco-economics at Harbec

The Harbec journey to eco-economic sustainability came about from the personal desire of its owner to be environmentally responsible. After a number of years of failure to make progress in funding projects due to the unspoken, but eventually obvious, opinions held by most contemporary business people and lending institutions, a new plan needed to be implemented. This new strategy would have to overcome the preconceived notion that environmentalists were 'tree-huggers' or 'burned-out Hippies', but not serious, competent business people.

In order to circumvent this stereotype, a plan was developed to redefine every thought, goal and resulting project idea, only from its economic value perspective. The other e word (environmental) while still the driving force, would not be mentioned again. This change was more than a decade ago, before we had any eco-economic successes to report and before sustainability and eco-economics were the topics of major institutional and business conferences.

# Current Status...

## Implemented systems, equipment, and practices



- CHP - Combined Heat and Power
- Sustainable building elements
- Renewable energy
- Manufacturing equipment choices
- Lighting System upgrade
- Vehicle fleet
- Water management alternative

# The *HARBEC* CHP Project



- 25 CNG fueled 30kW Microturbine Generators
  - 750 kW max potential provides:
    - 500 kW for Harbec's maximum electric load requirement
    - 250 kW redundancy for back-up and maintenance

# The *HARBEC* CHP Project



- 5 Heat exchangers
  - 1 unit per four microturbines
  - used to extract heat (thermal energy) from the exhaust gas and put it into water for heating and air-conditioning requirements



- 1 Absorptive Chiller
  - Converts 210° water to 44°-47° water for use in air-conditioning with no additional fuel cost

# The *HARBEC* CHP Project application features



- 17,000' of 1" Diameter tubing for radiant floor heating

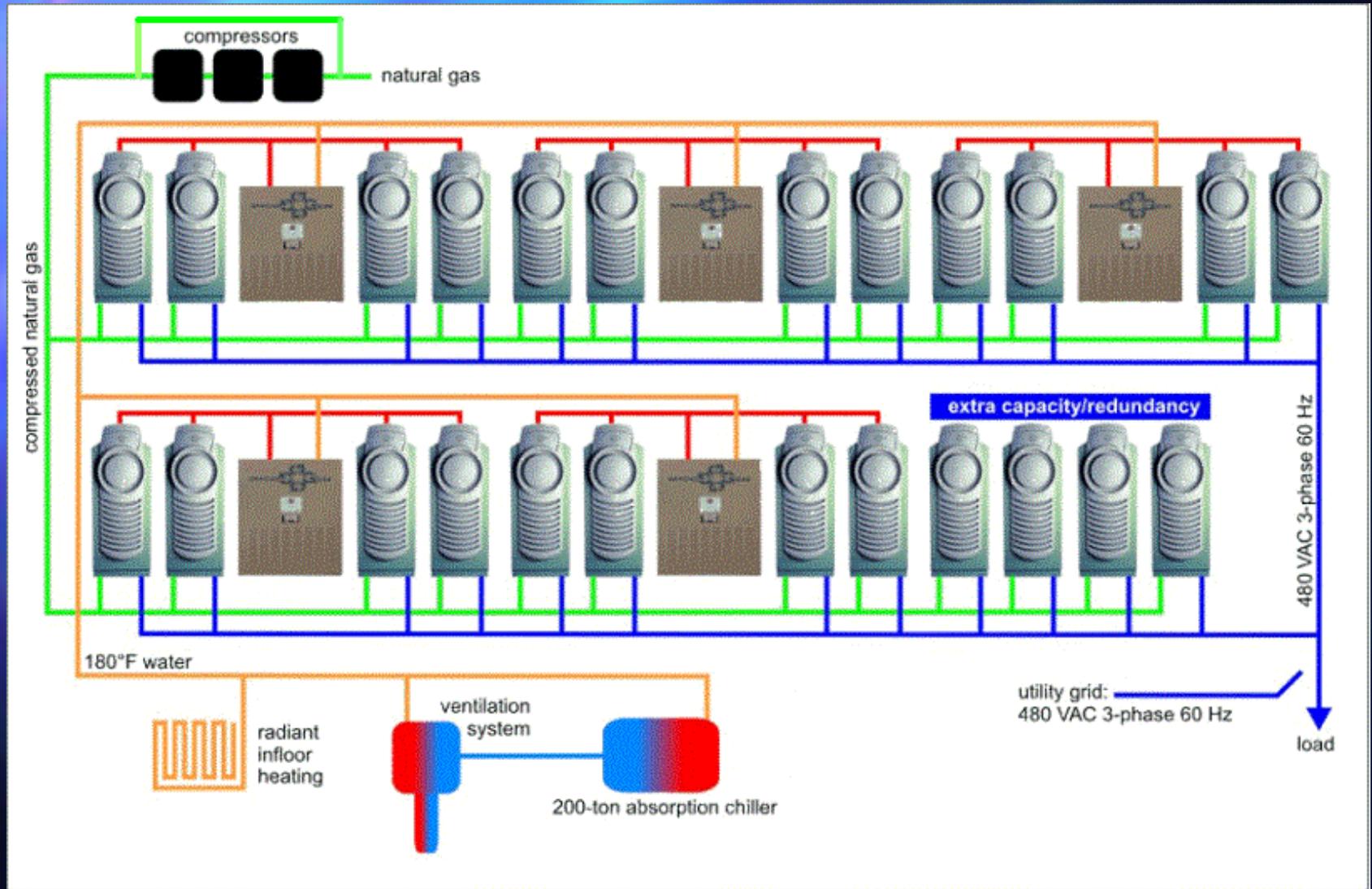


- Air-to-water heat exchanger delivers hot and cold water to the rest of the building's HVAC system and uses high efficiency Air Sox to deliver conditioned air.



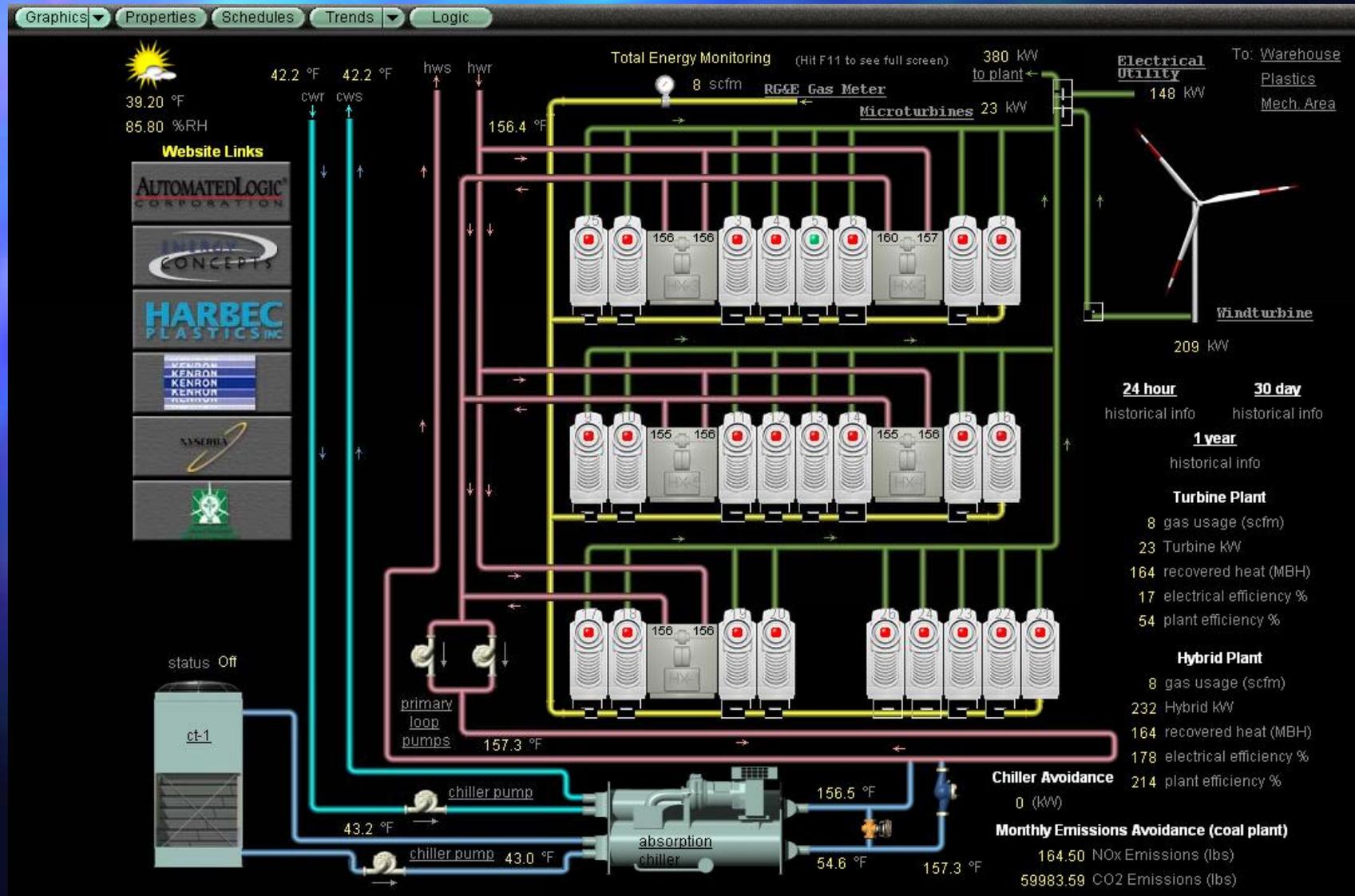
- Computer controlled sensing and delivery system

# The *HARBEC* CHP Project Schematic



# The HARBEC CHP Project

www.northerndevelopment.com



# The *HARBEC* CHP Project

## Results

Since July 9, 2001, microturbines have been capable of generating 100% of *HARBEC* power requirements and have provided air conditioning and heat for an injection molding facility, while grid was maintained for back-up. Most recently *HARBEC* has had to modify this due to gas prices

### *Economic*

- BTU efficiency electrical generating ~28% with thermal value for HVAC > 70%
- Utility Electricity costs 2008 with new tariffs = \$ .135 kWh
- Cost to Microturbine generate electricity = \$.095 w/ thermal and up to .016/ kWh w/o thermal in 2008 gas prices >\$10.00 to \$11.00 / decatherm
- **CHP System flexibility allowed us to analyze and develop thermal load priority model and save money**

### *Environmental*

- Less consumption of fossil fuels by increasing efficiency
- CO2 emissions reduced by >90%
- Significant reduction of SOX and NOX emissions
- No additional energy consumed to produce HVAC for plant
  - Improved employee working conditions and improved production quality year round

# The *HARBEC* CHP Project

## Secondary Results

Air-conditioning is provided by Absorption Chiller to turn exhaust gas waste heat into free air conditioning

### *Economic*

- Air-conditioning is provided to *injection molding* plant at **no** additional energy cost.
- Humidity level is controlled at no additional cost. This is important due to the hygroscopic nature of the plastic materials used.
- Employee comfort and safety is enhanced at no additional cost.

### *Environmental*

- No additional fuel consumed to produce HVAC for plant
- CO<sub>2</sub> emissions reduced by 100%
- Elimination of SO<sub>x</sub> and NO<sub>x</sub> emissions

# Sustainable Building Elements

## Following the lead of LEED

Leadership in Energy and Environmental Design

U.S. Green Building Council



- **Daylight Gathering:** using natural light resources to replace electric lighting during daylight hours



- **In-floor Radiant Heating:** Using hot water for the most efficient space heating method



- **Double Insulated walls and roof (R-value = 2X):** Silicone sealed, self supporting wall panels to minimize heat and cooling loss

# The *HARBEC* Sustainable Building Results

## *Economic*

- By designing facility for sustainability, the energy consumption is reduced.

## *Environmental*

- LEED practices provide guide for reduction of waste, minimization of environmental impact
- Less consumption of non-renewable fuels by increasing efficiency
- CO2 emissions reduced by 100%
- Elimination of SOX and NOX emissions

# *HARBEC* Renewable Energy



- Installation of 250 kW wind generator to accomplish wind/microturbine hybrid
- Better than Class 3 wind site
- Projected energy production is 300,000 to 350,000 kWh per year, or about 20 % of the total *HARBEC* annual energy requirements.

# HARBEC Renewable Energy

## Results

### *Economic*

- Displaces retail value electricity, which is \$.135 per kWh
- Electric savings provides \$40,000/year revenue stream
- 8-10 year ROI on project if utility costs remain the same
- Shorter ROI if electric costs rise
- Allows us to predict 10-15% of our energy costs 25 to 30 years into the future

### *Environmental*

- Zero Green House Gases are emitted
- No non-renewable fuels are consumed

HARBEC now purchases 100% of its grid power as 'green' energy

# HARBEC Manufacturing Equipment Choices



- Over seven year time span, replaced all standard hydraulic type equipment with all-electric injection molding machines
- Electric machines do not use power when they are in static state, which is a significant portion of the time.
- Capable of doing the same or better job than the hydraulic machine, using as much as 50% less energy

# *HARBEC* Manufacturing Equipment Choices

## Results

### *Economic*

- Although Electric molding machines cost up to 50% more initially, typically the energy savings pays back the difference in about 3 years.
- Eliminating heat caused by hydraulic systems reduces waste heat and moisture in molding plant environment.
- Reduces energy and material waste due to shortened change-over / startup times

### *Environmental*

- Up to 50% less Green House Gas emitted into the atmosphere
- Up to 50% less non-renewable energy is consumed.
- Employee safety and comfort are increased due to lower noise level and lack of hydraulic leak potentials.
- Amount of waste plastic sent to the landfill is reduced.

# HARBEC Manufacturing Equipment Choices



- Use of waste heat for absorption A/C means reduction of moisture in plant air which reduces the need for use of electric material dryers by as much as 75%.
- Use of inverter drives and soft starts on all motors 10 hp. and greater saves energy due to more efficient motor starting.
- Replacing standard screw-type air compressor with variable speed unit greatly increases efficiency and reliability.

# *HARBEC* Manufacturing Equipment Choices

## Results

### *Economic*

- Reduced electrical consumption due to increased efficiency reduces energy costs.
- Maintenance requirements and costs are reduced due to lower operating stress and temperatures.

### *Environmental*

- Reduction of energy consumption reduces amount of Green House Gases.
- Amount of non-renewable limited resources being consumed is reduced significantly.

# Lighting Systems – High efficiency: fixtures, ballasts, and sensors

Complete lighting upgrade was installed the end of 2007

Replaced every fixture and ballast plus high bay sodium with new T-8 type fluorescent bulbs and reflectors

- Quality of light was improved by using fuller spectrum bulbs
- Lighting energy consumed was reduced by **48%** on average company wide
- Bulbs have longer life & reduce replacement cost



# *HARBEC* Lighting System Upgrade

## Results

### *Economic*

- Total cost \$65,000
- Total annual electric savings \$38,000
- NYSERDA Grant \$16,000
- Direct Federal Tax credit \$8,000
- Contractor secured financing package

\$\$\$ ROI 1.5 years \$\$\$

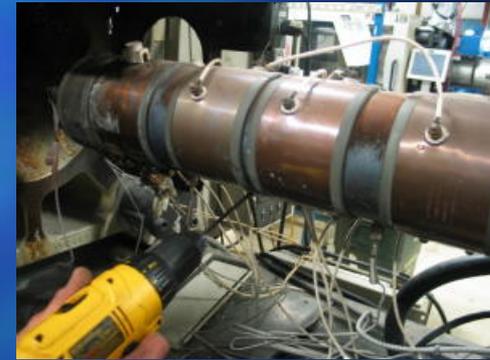
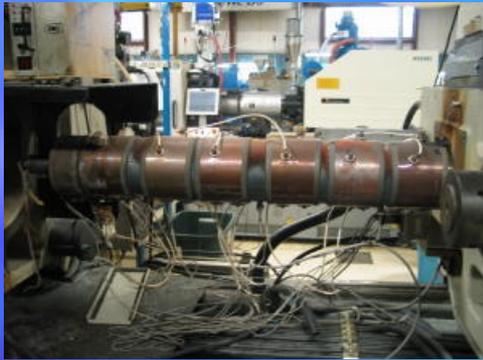
### *Environmental*

- Energy consumption reduced by 48% company wide average annually
- 280,000 kWh per year saved:
- $1.5 \times 280,000 = 420,000$  lb. of CO<sub>2</sub> = 210 tons of CO<sub>2</sub>
- Significant GHG reduction including NO<sub>x</sub> and SO<sub>x</sub>

# HARBEC Manufacturing Equipment Modifications

## Molding Machine Barrel Heater Insulation Project:

- Replace heater bands and install insulation covers



- Install metal cover to contain and protect insulation



# HARBEC Manufacturing Equipment Modification

## Results

### *Economic*

- Reduced electrical consumption of molding machines by 40% per year (324,000kWH) due to increased efficiency of barrel heaters so reduces energy costs by \$44,000.
- Containing heat reduces amount of excess heat in room which lowers the load on the A/C system by 12 Tons per hour. (or ~12 kWh per hour of operation)

### *Environmental*

- Reduction of electricity consumption reduces amount of Green House Gases by 243 tons of CO<sub>2</sub>. (324k kWh x 1.5)
- Significant GHG reduction including NO<sub>x</sub> and SO<sub>x</sub>
- Reduction of demand on A/C system energy saving
- Amount of non-renewable limited resources being consumed is reduced significantly.

# Eco-Economic Results of Cumulative Energy Efficiency Measures

- From 2005 to 2008 *HARBEC* increased sales and profits  
...YET...
- EPA Green Power Partnership Yearly Report:
  - 2005 total electric consumed= 3,627,000 kWh
  - 2008 total electric consumed= 2,402,000 kWh
  - Reduction of total electricity = 1,225,000 kWh
    - Electric consumption reduced by 35%
    - @ .13 = \$159,250
    - \* 1.5lb. = 1,837,500 lb. = 919 tons GHG



Lesson Learned: If you want to make an environmental impact, and save money, use energy efficiency!

# The Dream of Rankine Cycle... becomes a reality at *HARBEC*



Thanks to the invention of:

**Ener-G-Rotors, Inc.**

*Converting Low Temperature Heat to Electricity*

112 Erie Blvd.

Schenectady, NY 12305

518-372-2608



- 2 Turbine @ 24 kW each
- Water set point @ 225 F
- Hot water flow=62 GPM @ 218 to 227 F
- Cold water flow= 25 GPM @ 67 to 88 F
- Exhaust gas temp to stack = 223 F (vs. 350)

Produces 5 kW electric power

Next year 50 kW to be continued...

# HARBEC Vehicle Fleet



- 100% of Company Vehicles are considered 'Green' cars:
  - 2 Toyota Prius Hybrid Electric/Gas cars
  - 1 total electric Ford EV Ranger
  - 1 CNG delivery Ford window van
  - 1 Bio-diesel fueled Ford box van type delivery truck

## Results

### *Economic*

- Improved efficiency reduces consumption, saves money on fuel
- Reduced maintenance costs due to cleaner more efficient operation

### *Environmental*

- Lower Green House Gas emissions
- Reduced consumption of non-renewable fuels

# HARBEC Alternative Water Management



Bi-metallic water treatment plant requires no chemicals

## Results:

- Eliminates thousands of dollars per year of chemical costs, and eliminates need for people to handle them
- 850,000 gallon pond to provide water capacity sufficient for sprinkler system and to provide cooling and make-up water to compliment process water loop thanks to help from NY ESD



## Results

- Reduction in cost of Fire Insurance. Dollars are used to pay for hard assets like pond, pump house, fire protection sprinkler system, etc.
- Opportunity to provide attractive area for employee recreation and enjoyment

# HARBEC Alternative Water Management

Process water tempering system, provides thermal transfer to remove excess heat from process water which uses pond as a heat sink. This reduces the amount of work that the evaporative chillers need to do, which saves over 900,000 gallons of city water annually.



# Eco-economic Sustainability in the *HARBEC* future

## Solid Waste Reduction:

### The result of ISO 14000 Certification

- Developing Co-mingled Molding technology method for processing mixed material wastes from normal plastics processing which usually is sent to landfill.
- Market analysis and potential being evaluated in conjunction with RIT – CIMS
- Our goal is to implement a solution that will help to reduce the amount of non-recyclable plastic that is currently being sent to landfills.



# Eco-economic Sustainability in the *HARBEC* future

Additional future potentials being considered or implemented include Biodiesel fuel production, Aquaponics, wood or crop drying, ice and snow management, community heating etc. as added opportunities for using additional thermal resources that are currently being wasted. Through resourcefulness and proper prioritizing we hope these and others not yet realized will help us continue to grow our business while reducing our environmental foot print.



In an attempt to move beyond the lack of common understanding of what being Green means from one company to another, *HARBEC* is currently assessing its Carbon Foot Print in order to become a

**Carbon Neutral** manufacturing company

# Final conclusions about Eco-economic \$ustainable Manufacturing

## Results

### *Economic*

- Control operating costs
- Improve competitive pricing
- Insure power reliability ~ No Blackouts
- Reduce dependence on foreign countries
- Provide fixed energy costs decades into the future
- Improved operating efficiency through thermal utilization

### *Environmental*

- Reduce or eliminate negative environmental impact
- Reduce amount of non-renewable resources being consumed
- Opportunity to take control and responsibility for carbon footprint

# *HARBEC* conviction to Eco-economic Sustainable Manufacturing

*HARBEC* regards Eco-economic Sustainability as absolutely critical to the future of our business, and we believe that our success in the pursuit of it, will improve our competitive advantage by insuring our efficiency.



...Striving to be a  
Carbon Neutral  
manufacturing company...



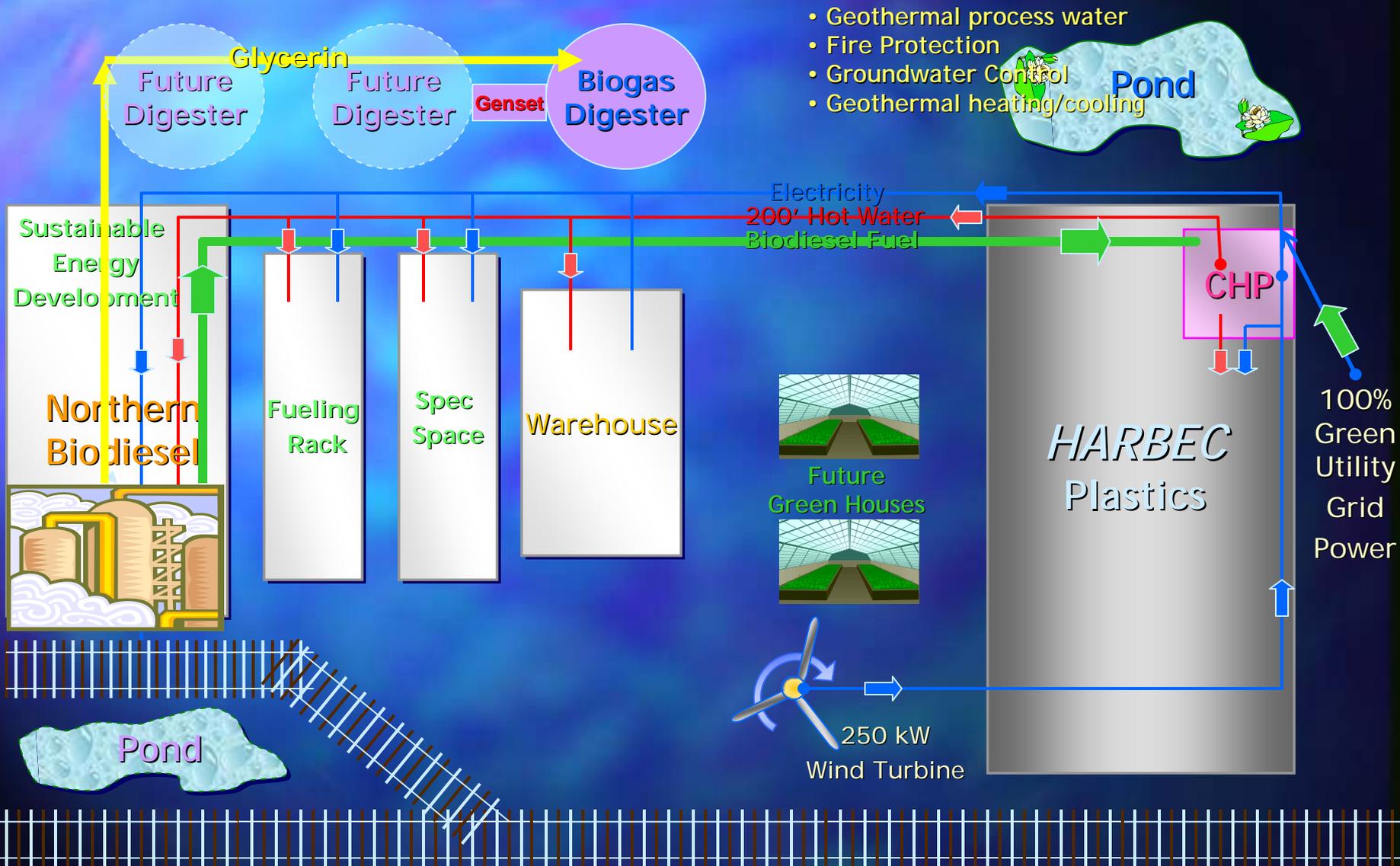
...If it works so well for one company...  
what could it do for an industrial park?

## Wayne County Industrial Sustainability Park

- The number one reason for businesses leaving NY State is the cost of energy (3<sup>rd</sup> highest average in the US)
- If we build it they will come...as long as it's cheaper
- Lower energy cost means less energy used - less emissions produced.
- Energy efficiency reduces cost of doing business.
- Renewable energy locks in energy cost for years into the future.



# Wayne County Industrial Sustainability Park





317 Rt.104 Ontario, NY 14519

585-507-8338

[www.northernbiodiesel.com](http://www.northernbiodiesel.com)

- Able to produce ASTM 6751 certified Biodiesel.
- Our facility will have the capacity to blend biodiesel to any percentage with petroleum diesel:
  - B100 = 100% Biodiesel
  - B50 = 50 % Biodiesel, 50% Petroleum
  - B20 = 20% Biodiesel, 80% Petroleum... Etc.
- On Road...This fuel available for all users is subject to local, State and Federal taxes
- Off Road...This fuel is available for most construction vehicles, farm vehicles and other approved users
- Home Heating Oil...Biodiesel is also used for home heating oil and is most often used as a 100% blend
- Multiple feed stocks include Soybean, rapeseed/Canola, yellow grease
- Hybrid batch/flow processing technology



## Distributed Wind Power Generation

- Power Your Home, Farm, Business, School or Municipality

## Utility Scale Wind Farm Consulting

- Resource Assessment, Data Services, Site Analysis, Development Consulting

SED works to promote the development of quality, well developed wind farms and to establish the distributed use of wind turbines for electric generation. SED strives to make wind a large, integral part of America's energy generating portfolio with the widest possible population receiving electricity, environmental benefits, and economic savings from wind turbines.

## Contact Information

317 Rt. 104

Ontario, New York 14519

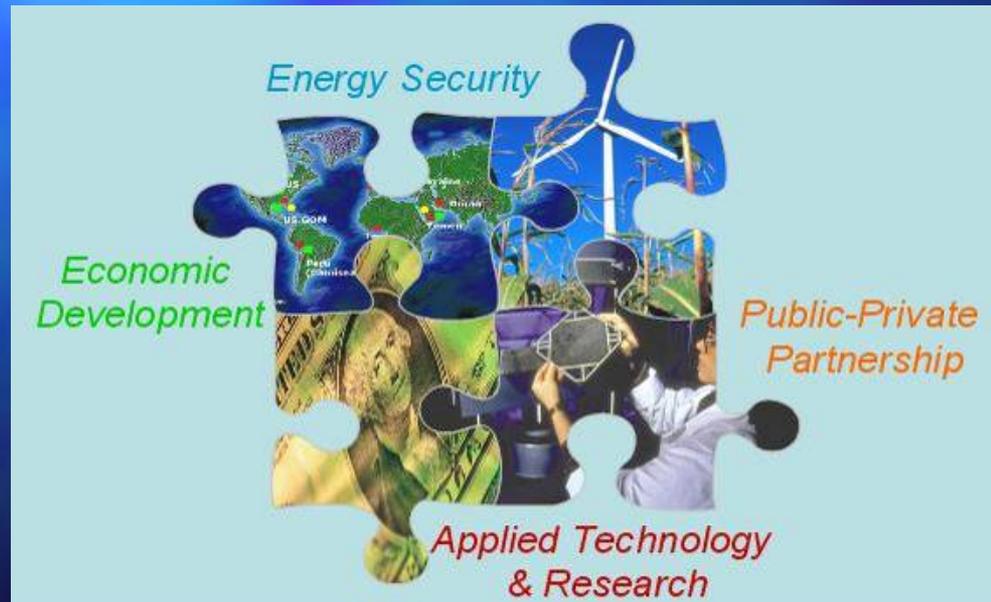
E-mail: [info@sed-net.com](mailto:info@sed-net.com)

Phone: 1.877.WindNRG

# Wayne County Industrial Sustainability Park

## ■ The Opportunities and Benefits

- + Tax revenues
- + Increased employment
- + Energy security from blackouts
- + Energy independence from foreign sources
- + Energy cost controls decades into the future
- + Lower energy costs than competing communities
- + Uniqueness in demonstrating positive solutions for the future ...  
... leading edge vs. trailing edge...



**\$ustainability** can be a cost effective opportunity for business today...which insures a viable and comparable world to live in for future generations.



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