

15 Year Pursuit of Sustainable Manufacturing  
The Eco-Economic Opportunities and Advantages

ESW Annual Conference 2015  
Rochester Institute of Technology



By: Bob Bechtold

*HARBEC, Inc.*

# HARBEC Energy Management Strategy

- Combined Heat and Power (CHP) = reduced energy co\$t through efficiency (by using the other 65% to 75%)
- Renewable on sight generation = fixed energy co\$t for 25 years (no constantly escalating fuel cost)
- Green power from utility = free energy storage, low co\$t energy insurance, co\$t effective renewable energy credits

## Why Bother?

Energy in our type of manufacturing =  
4 to 6% cost of doing business

# Eco-Economic Opportunities

## Moving in a Sustainable Direction

- “Being **Green** is nice but we can’t afford it”  
...Disproving a common misconception through eco-economic examples
- Is Carbon Responsibility in the U.S. Manufacturer’s future?...with or without the Government...**ISO 50001/SEP**
- Because the most important part of Corporate Social Responsibility (CSR) is the “Corporation”

# Why ISO 50001/SEP ?



Says Who???

...Greenwashing

Requires third party audit/validation

- “European Commodities market predicts that carbon will be the largest traded commodity by 2020”
- “Asia claims they will beat Europe to carbon economy”
- **Walmart Sustainability Index... by 2015**

**WALMART SUSTAINABILITY INDEX**  
**KEY INITIATIVES**

**Recycled UPSWING**  
More than 29 million tons of valuable plastics end up in landfills in the U.S. every year. We're working with cities to reclaim plastic and with our suppliers to use more recycled content and make packaging more recyclable.

**Clean & GREEN**  
Sustainable chemistry has come a long way. We're asking suppliers to transition to greener substitutes for priority chemicals in household cleaning, personal care, beauty and cosmetic products.

**Fertilizer ENERGIZER**  
We're working with suppliers who use corn, wheat and soy in their products to use fertilizer more efficiently. We have the potential to reduce fertilizer use on as many as 14 million acres of U.S. farmland by 2020!

**Go GLOBAL**  
We're using the Sustainability Index to improve products around the world. Having previously launched the Index in China, we're now seeing it adopted by our business in South Africa and we are expanding the Index to Walmart Chile and Walmart Mexico next year.

**POWER to the People**  
By selling 500,000 of our private label LED lightbulbs, we estimate that we can save our customers more than \$67 million dollars over the lifetime of those bulbs, which last about twice as long as a CFL and 20 times longer than a traditional lightbulb.

Join the conversation on Twitter with hashtag #WMTgreen and by following @WalmartGreen. To learn more about sustainability at Walmart, visit [walmartgreenroom.com](http://walmartgreenroom.com).

Walmart

# Sustainability = Economic Opportunities

- *HARBEC* marketing strategy is to provide carbon neutral precision, metal and plastic components parts at no additional cost
- Carbon Market vs. Carbon Taxes assign true carbon value to goods
- \$7-10k vs. \$40-50k to purchase carbon offsets

# What a Difference Fifteen Years Makes

## Problems initially...

- 1998-2000 Problem solving, concept developing, engineering search,....Bank Rejections (wrong reasons... no models)

## Opportunities eventually...

- 2000-2001 Banked and Built CHP/Wind hybrid... but alas, no wind
- 2002/3 250 kW wind turbine installed
- 2007 Lighting upgrade
- 2008 CHP project - paid off
- 2009 Barrel insulation installed
- 2010 Wind turbine project - paid off
- 2012/13 850 kW Wind Turbine installed
- 2014/15 CHP Upgrade Project
- 2015 LED Lighting Upgrade Project

Future Opportunities...2016...2017...Biofuels to Blueflame...500kW  
Solar...Rankine Cycle...WISP...

also...Energy Saving Manufacturing Alternatives, Processes and  
Sustainable Bio-origin Materials

# Energy - CHP = Electricity and HVAC

## Combined Heat and Power CHP

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

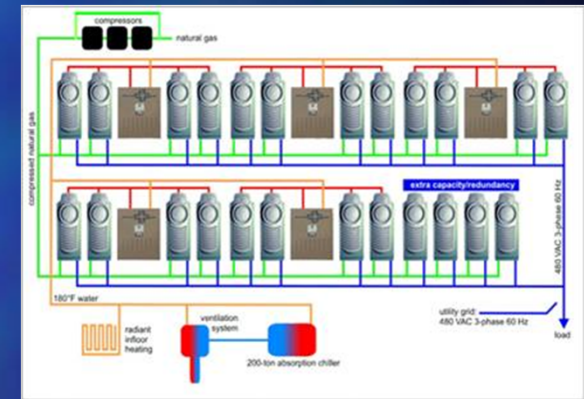


### Thermal Advantages

Heating and A/C almost energy (fuel) free

**No Magic**

We just use the 65 - 75% that Utilities throw away



\$\$\$ 7 Year ROI paid for with energy dollars not spent \$\$\$



# Energy – CHP – Upgrade in progress

## Combined Heat and Power CHP

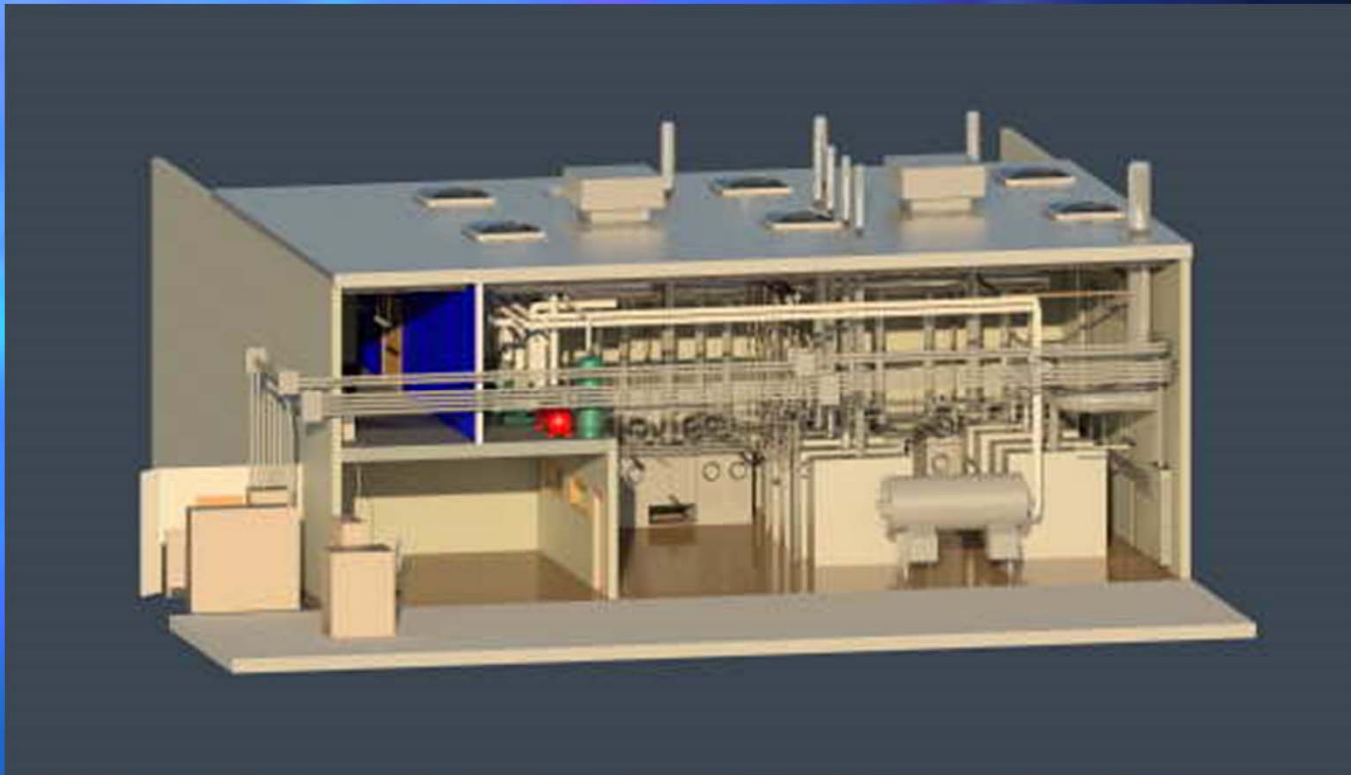
- 10- CNG fueled 30kW Microturbine Generators -Original
- 8- 65kW Microturbine Generators = 520 kW
- Increase to 820 kW max potential provides:
  - 500 kW for *HARBEC's* max electric load requirement
  - 320 kW redundancy for *WISP* and maintenance

By using the thermal energy from exhaust, we heat and air condition 9000 sq.ft. molding area with 25 injection molding machines and a 17,000 sq.ft. manufacturing/warehouse space and soon 14,000 sq.ft. of shop and office





# CHP Upgrade - 2014



Capstone C30 times x10  
Refurbished

Plus...

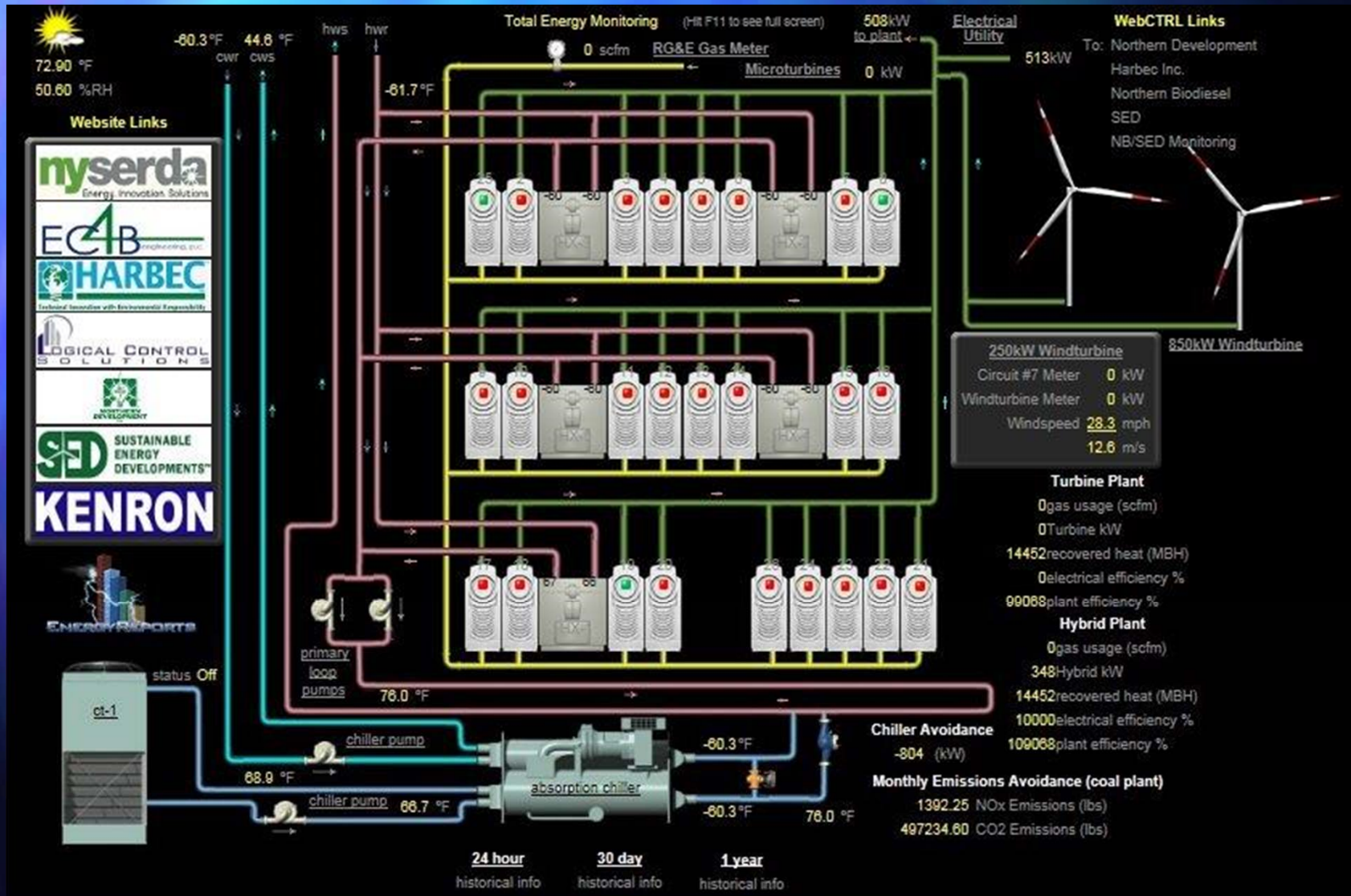
Capstone C65 times x8  
New

- Improved performance
- Improved efficiency
- additional CHP plant capacity...750 kW to 820 kW



# The HARBEC CHP Project

www.northerndevelopment.com



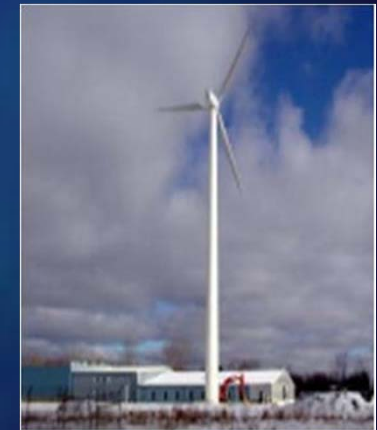
# Energy – Renewable Wind Electricity - I

- Installation of 250 kW wind generator to accomplish wind/microturbine hybrid
- Slightly better than Class 3 wind site
- Projected energy production is 300,000 kWh +/- 10% per year, or about 10 to 15 % of the total *HARBEC* annual energy requirements.



- Displaces retail value electricity, which is ~\$0.15 per kWh
- Electric savings provides >\$45,000/year revenue stream
- 8-10 year ROI on \$400k project originally
- ROI is shortened as electric costs rise (< 8 yrs.)

- **Allows us to predict 10% of our energy costs 20 to 25 years into the future \$\$\$\$\$**



# Energy – Renewable Wind Electricity- II

- Installation of **850 kW** wind generator to accomplish wind/microturbine hybrid
- Slightly better than **Class 3** wind site
- Projected energy production is **1,500,000 kWh** +/- 10% per year, or about 50% of the total **HARBEC** annual energy requirements.
- $300\text{k- kWh} + 1.5\text{MM kWh} = 1,800,000 \text{ kWh}$
- **6 – 7 year ROI on \$2.1M project originally**
- ROI is shortened as electric costs rise

**Allows us to predict ~ 50% of our energy costs 20 to 25 years into the future \$\$\$\$**

**Total energy from Renewable is ~ 60%**



# Transportation - Green Fleet

\$\$\$ Improved efficiency reduces consumption, saves money on fuel

\$\$\$ Reduced maintenance costs due to cleaner more efficient operation

- 100% of Company Vehicles are considered 'Green' due to alternative fuels or efficiency:
  - 1 Chevy Volt electric plug-in hybrid
  - 2 Toyota Prius Hybrid Electric/Gas cars
  - 1 Biodiesel delivery Sprinter window van
  - 1 Bio-diesel fueled International diesel/electric hybrid delivery truck



# Building Design - 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 code reqs) Silicone sealed, self supporting wall panels to minimize heat and cooling loss

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



Conservation is the first rule of Sustainability

# Lighting Systems Upgrade - 2007

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
  - Total cost \$65,000
- Quality of light was improved by using fuller spectrum bulbs
- Lighting energy consumed was decreased by 48% on average company wide
- Bulbs have longer life which reduces replacement cost
  - Total annual electric savings \$38,000...+...+
  - NYSERDA Grant \$16,000
  - Direct Federal Tax credit \$8,000
  - Contractor secured financing package

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





# Lighting Systems Upgrade – 2014/15

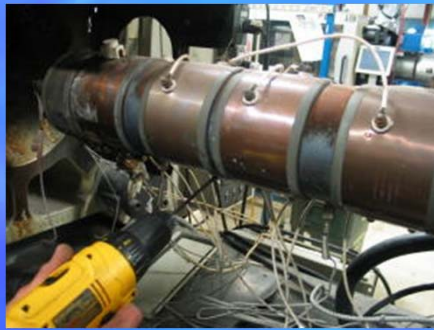
## LED – Direct Replacement / Ballast Compatible Bulbs

- New LED tubes that are magnetic or electronic ballast compatible means:
  - No rewiring of fixtures to avoid ballast
  - No fixture replacement cost
  - 50k hour bulb life
  - 45% Lighting energy reduction (from 32w to 18w)
- Complete Facility (1280) bulb replacement project:
  - \$32,000 total cost
  - 50% RG&E grant = \$16k
  - Lease option for no upfront cost
  - < One year payback w/grant...< Two year payback no grant
  - \$22k annual savings

# 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



- 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)
- Exploring screw designs for additional energy efficiency potentials
- 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 Sox
- Reduction of demand on A/C system energy saving
- Amount of non-renewable limited resources being consumed is reduced significantly.

# Industrial Efficiencies

## Eco-Economic equipment and systems purchase decisions

- 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**
- Use of exhaust 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.



# More Industrial Efficiencies

## Eco-Economic Equipment and Systems Purchasing Decisions

- Replacing standard screw-type air compressor with variable speed unit greatly increases efficiency and reliability.

\$\$\$\$ **Reduced electrical consumption** due to increased efficiency, lowers energy costs. (<3 yr. payback)

- Maintenance requirements and costs are reduced due to lower operating stress and temperatures. \$\$\$\$\$



## Eco-economic conclusions about \$ustainable Manufacturing Opportunities

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

# Eco-Economic Results of Cumulative Energy Efficiency Measures

- From 2005 to 2008, each year *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%
    - @ .145/ kWh = \$177,625
    - 1.5 lb/kWh = 1,837,500 lb. = 919 tons GHG



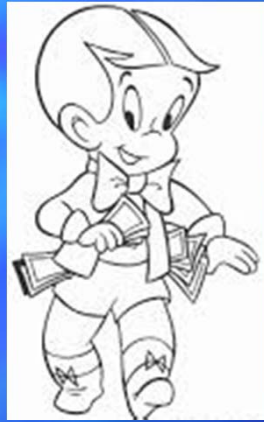
Lesson Learned: If you want to make an environmental impact, and save money, use energy efficiency!

## Another Way to put into perspective the opportunity for positive impact to bottom line...

- Energy = 5% cost of doing business for manufacturing
- Example Mfg. Company is \$10MM sales ~ \$500K annual energy cost
- 35% energy cost reduction = \$175k/year to bottom line
- .....
- If (5% to 10% is average profit) = \$700k
- \$175k is 30% of \$700k
- Would require 30% (of \$10MM) ~\$2MM to \$3MM additional sales for equal impact on overall annual profitability
- .....
- **Would any normal manufacturing company not pursue an opportunity to increase sales by 30% ??**

# ROI

Good business practice demands ROI be limited to...



## ENERGY PROJECT ROI

If the dollars you use to pay for an energy project come from the **Energy Bill (tax bill) Pocket** you had to spend them anyway...

If you choose to buy an **asset** that generates an electron with the same dollars, at the end of the payments you have a continuing Revenue potential instead of **spent electrons**.

# What's next...2014...2015...2020..?

## 500 kW Solar Farm

3 Acre area prepared  
under wind turbine II



## RENEWABLE ENERGY FOR GAS TURBINES

Cleanest use of Renewable Fuels

- Fuel Flexibility with Lowest Emissions Possible
  - Carbon Neutral (“net” zero)
  - Generate Carbon Credits
- Generate Renewable Energy Credits
  - Over 1000 hours and 14 fuels
  - 2012/13





LPP working pre-production  
prototype = 1k hours ++



# 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



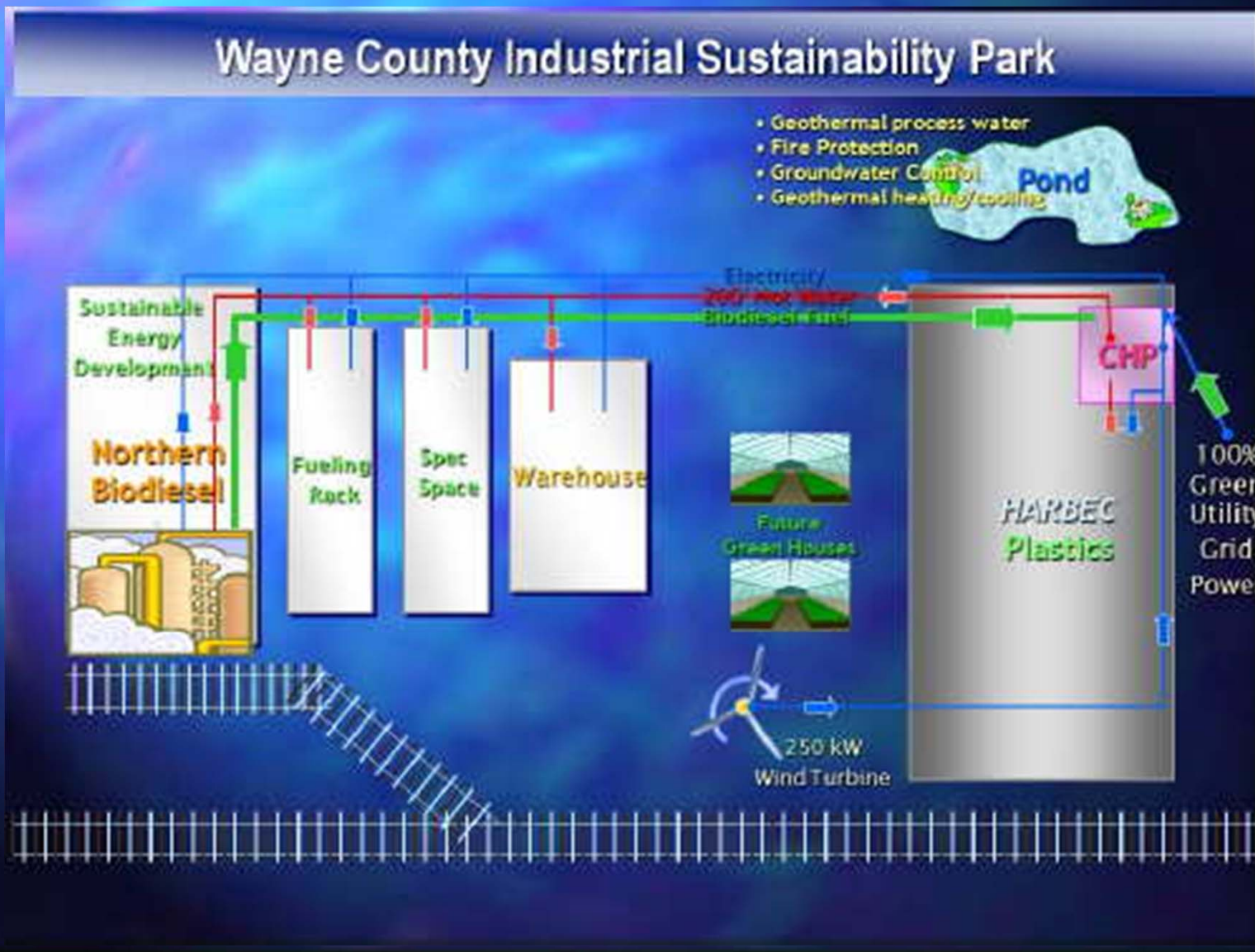
- 2 Turbine @ 24 kW each
- Water set point @ 225 F
- Hot water flow=62 GPM @ 218 to 227 F
- Cold water flow= 25 GPM @ 67 to 88 F
- Exhaust gas temp to stack = 223 F (vs. 350)
- Ran successfully for 6 months demo period

**Produced 5 kW electric power**

- in 2013 tested new 30 kW unit
  - Ran for over 500 hours
- Produced up to 19 kW (due to less available hot water)

# Beyond HARBEC ...

*What will we do with all this energy?*

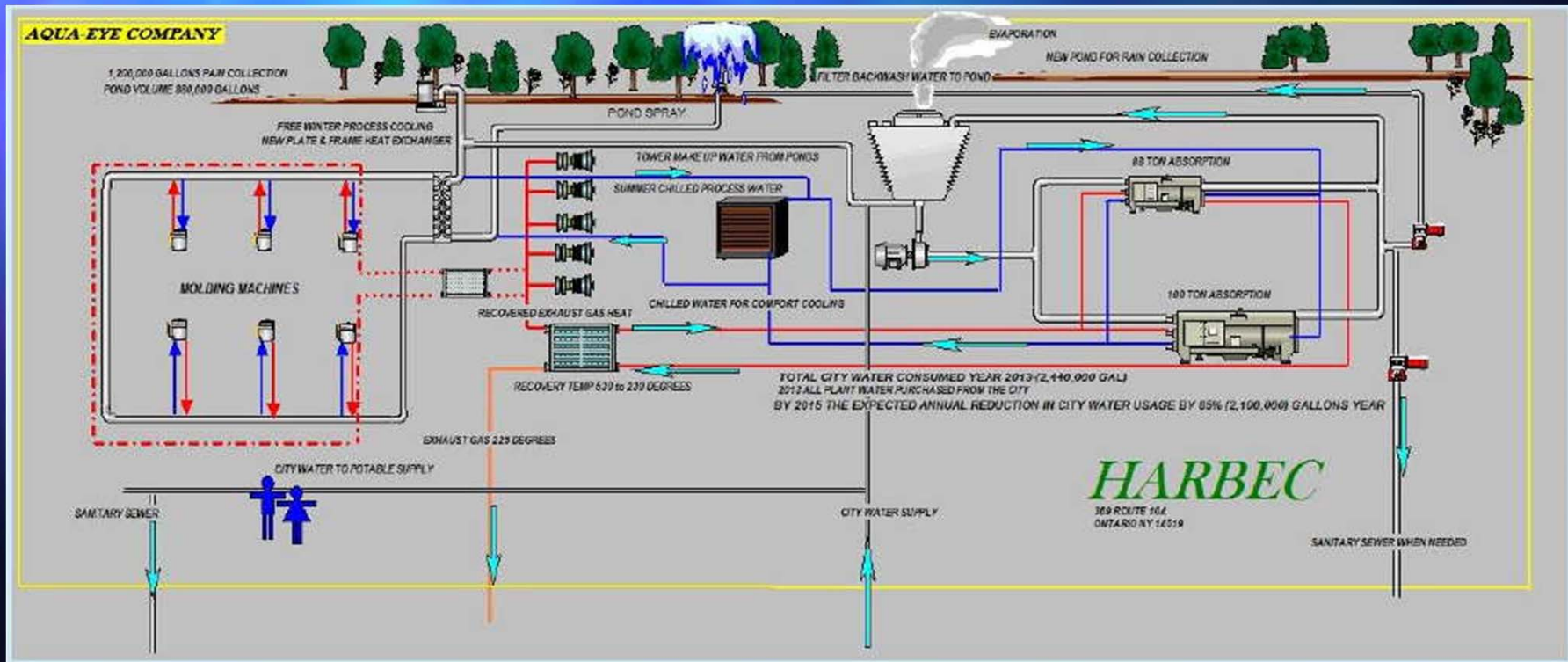
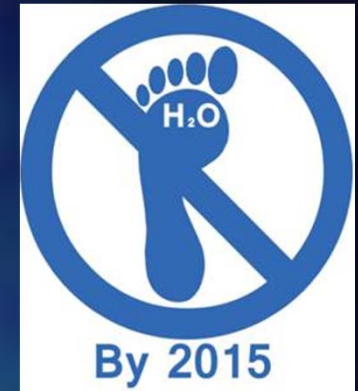


# HARBEC Alternative Water Management



## Water Neutral by 2015

### HARBEC Sustainable Water Management



# Sustainable Polymer Alternatives

## Bio-origin vs. Bio-degradable

The screenshot shows the HARBEC website's "BIOPOLYMER INFORMATION CENTER". The header includes the HARBEC logo with the tagline "Technical Innovation with Environmental Responsibility" and a "CONTACT US" button. A navigation menu contains links for HOME, ABOUT US, INSIDE HARBEC, CAPABILITIES, YOUR FOCUS, and SUSTAINABILITY. Below the menu is a search bar labeled "Search HARBEC".

The main content area features a blue banner with the text "BIOPOLYMER INFORMATION CENTER". Below this, there is a paragraph of text:

Plastic, by its very nature, is recyclable. We regrind and reuse or resell our waste plastic so it doesn't ever see a landfill. There are new technologies that make plastic even more environmentally friendly called **biopolymers or bioplastics**. HARBEC, is very interested in utilizing bioplastics for your next injection molding project. We are currently exploring various samples to understand the functionality and best applications for our customers needs.

We are always looking for new biomaterials to try, so if you have a material you would like to see injection molded, or if you are a manufacturer or supplier interested in how your material performs, please feel free to contact us. We would love to work with you!

On the right side, there is a blue-tinted image of plastic granules with a "DID YOU KNOW?" banner. Below the image, it says "You can contact us to request a specific resin." and a "MORE >" link.

At the bottom, there are three links with "READ" buttons:

- What is Bioplastic? Terms and Definitions
- Types of Bioplastic
- Bioplastics In Our Repertoire

# Xeriscaping / Sustainable Sweetness



# HARBEC conviction to Eco-economic Sustainable Manufacturing

At *HARBEC* we regard 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.



A Carbon Neutral manufacturing company

-----Striving to be-----

Water Neutral by 2015



By 2013



By 2015



ISO 50001/SEP Platinum Nov. 2013  
DOE - Better Plants – Challenge Jan. 2014

*HARBEC*, Inc.  
585-265-0010

**Thank You**

Ontario, NY  
[www.harbec.com](http://www.harbec.com)

## Question

Which story will you tell your Grandchildren ??

“even though the scientist and economists told us that we were on an unsustainable path we ignored them and maintained status quo”

or

“I was part of the generation that listened to the experts and cared enough to change for the sake of a better, sustainable civilization”



Dad! Mom!  
Pleeease...  
Save some for us?

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