
Hydro
Genyse
A WTE Industrial Ecosystem

About This Project

This project analyzes the economic, social and climate effect of a vertically integrated industrial commercial ecosystem that is connected directly to the output of a high efficiency waste to energy power plant.

97,199,134 KWh
Sustainable reliable electric

144,000
Metric Tons Of CO_2 Saved

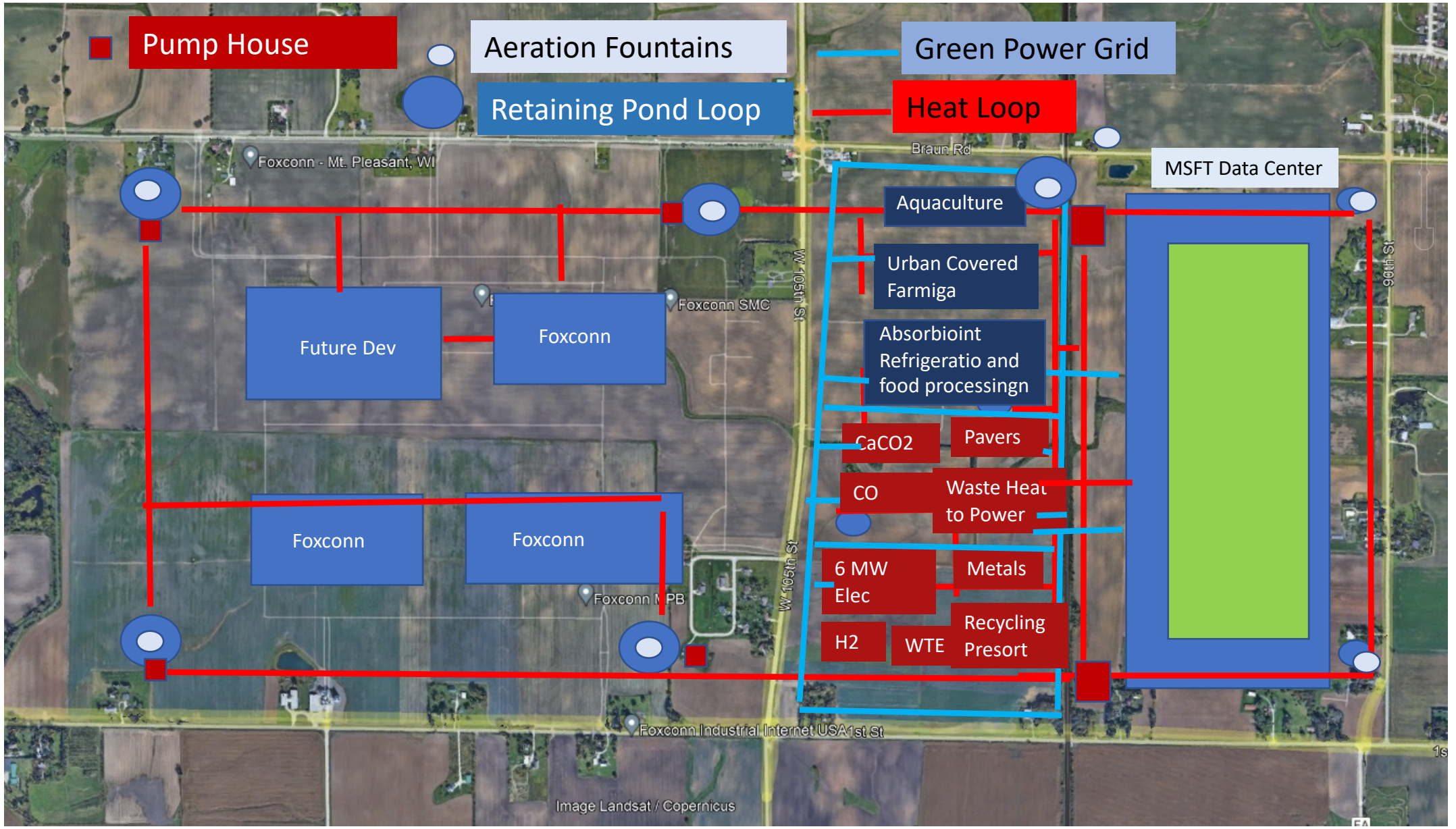
$531M
In local economic effect/ year

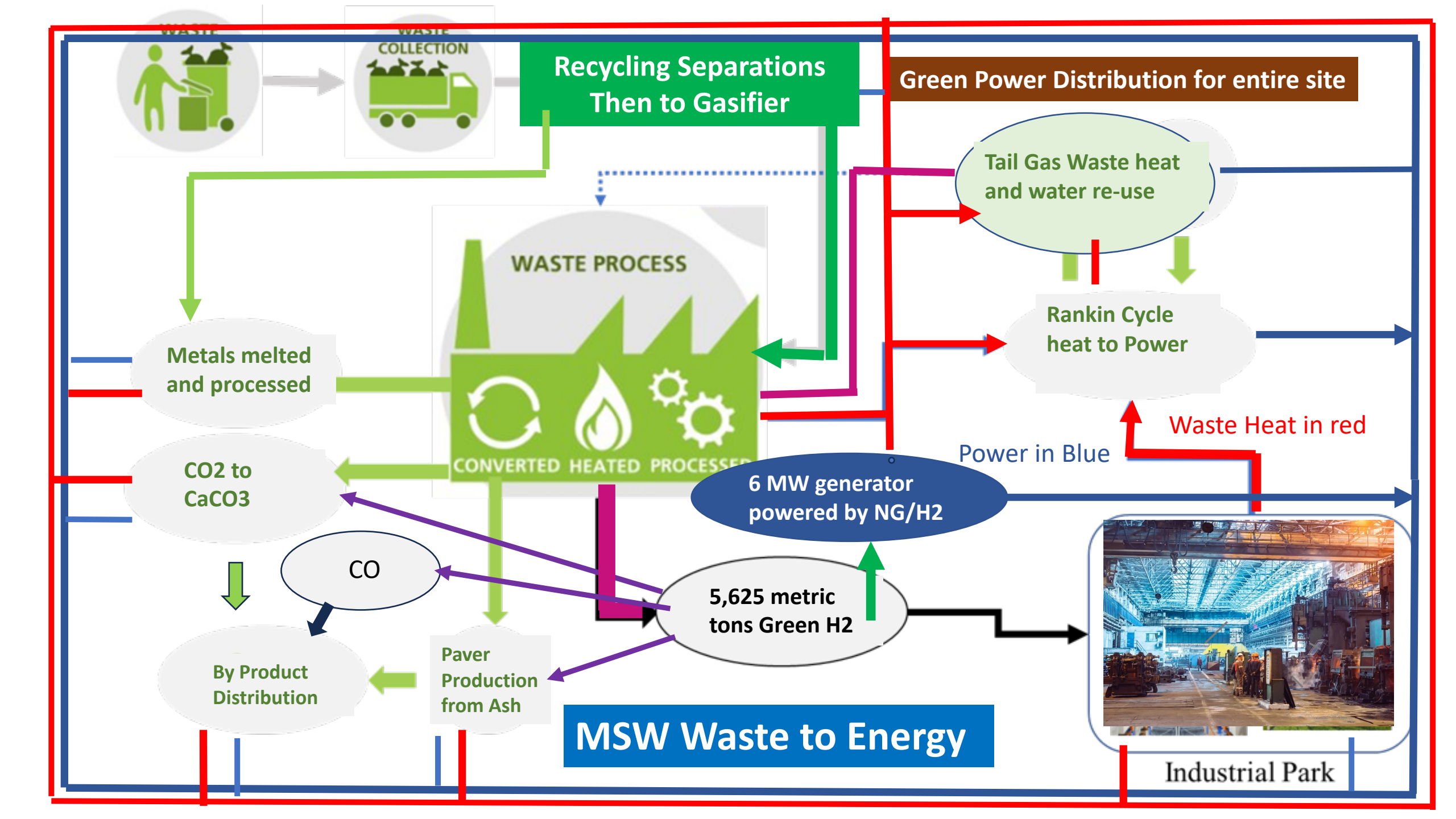
A Proposed Development Site in Racine

The main project lies on 110+ acres and will be designed to collect and utilize the average rainfall of 106M gal / year.

This will save over $ 700,000/ year in water and sewer costs and will be used for cooling, agriculture, heat transfer and site management.

Data Center Waste Heat can be utilized on site




COLLECTION
Recycling Separations
Then to Gasifier
Green Power Distribution for entire site
Tail Gas Waste heat
and water re-use
WASTE PROCESS
Rankin Cycle
heat to Power
Metals melted
and processed
CONVERTED HEATED PROCESSED
Waste Heat in red
Power in Blue
CO2 to
CaCO3
6 MW generator
powered by NG/H2
CO
5,625 metric
tons Green H2
By Product
Distribution
Paver
Production
from Ash
MSW Waste to Energy
Industrial Park

Recovered metals processed on site – to green steel using magnetic induction and hydrogen

Before the gasifier metals and glass are removed and separated for further processing on site

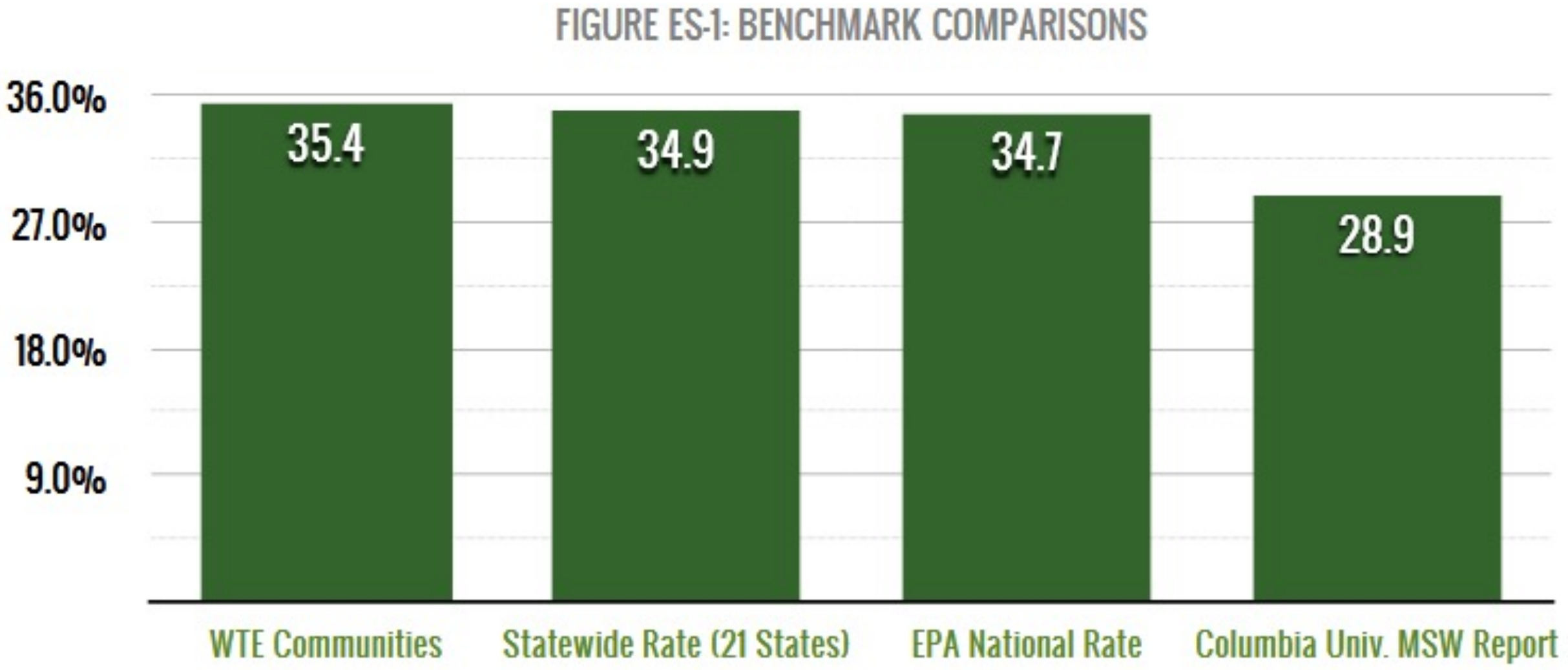
Metal to steel

Aluminum to Ingots

Glass to Pavers

Everything else goes to the gasifier to make H2

WTE plants do not reduce recycling- its just more economical



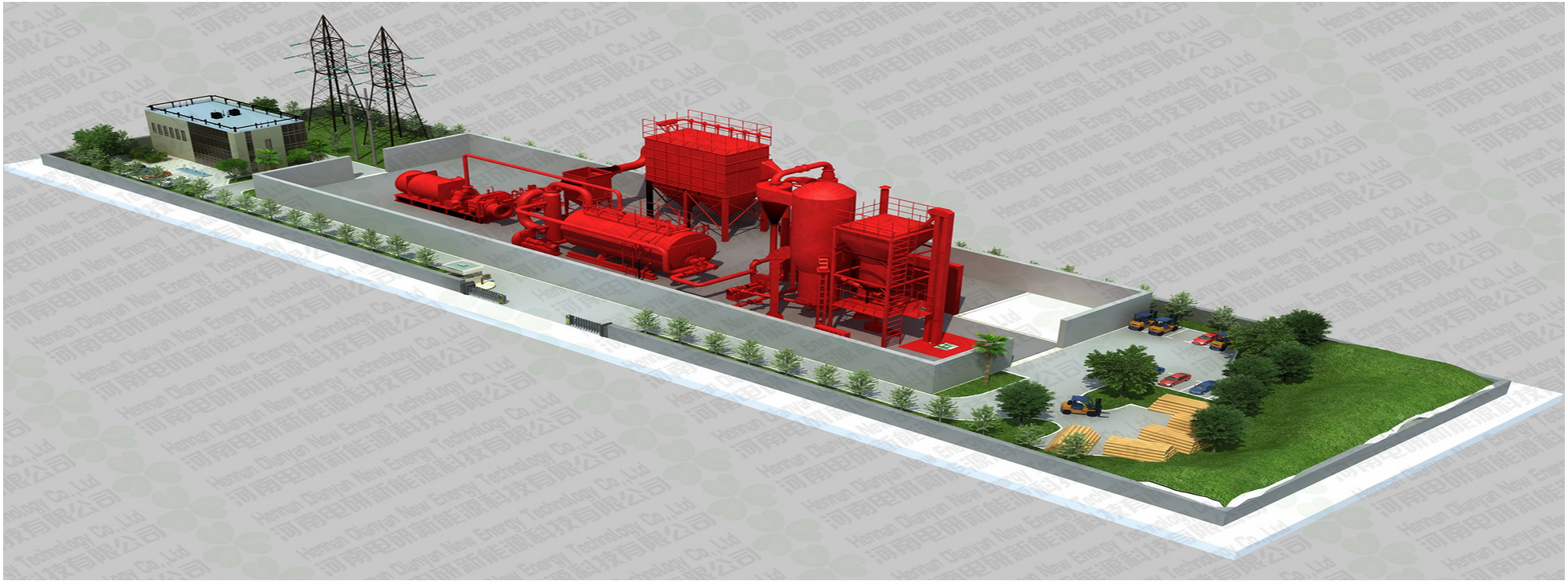
Todays residential MSW recycling does not save energy or CO2

Potential Savings from Modifying NYC Residential Recycling[16]

Residential paper recycling	**296,360 tons**
Cost of separate paper collection	$203,302,960 (296,360 tons x $686/ton)
Revenue from selling recyclable paper	$3,556,320 (296,360 tons x $12/ton)
Potential savings from eliminating separate paper collection	$199,746,640 ($203,302,960 – $3,556,320)
Cost of disposing paper as general waste	$37,350,251 (296,360 tons x $126.03)
Total potential savings	**$162,396,389** ($199,746,640 – $37,350,251)

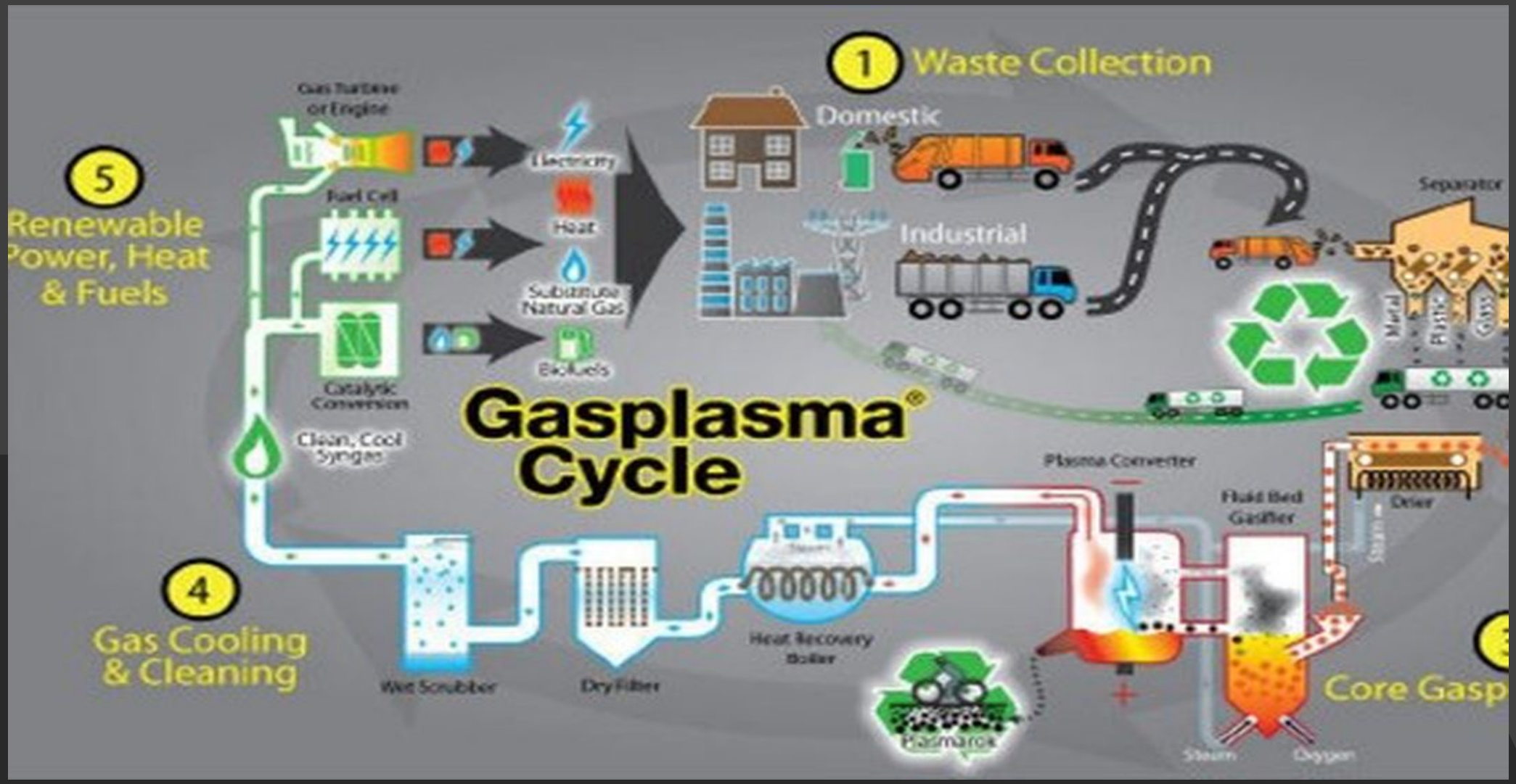
Residential MGP (metal, glass, and plastic) recycling	**278,225 tons**
Cost of MGP collection	$190,862,350 (278,225 tons x $686/ton)
Cost of MGP disposal	$22,224,613 (278,225 tons x $79.88/ton)
Total MGP collection and disposal cost	$213,086,963 ($190,862,350 + $22,224,613)
Cost of MGP disposal as general waste	$35,064,697 (278,225 tons x $126.03)
Potential MGP-related savings	**$178,022,266** ($213,086,963 – $35,064,697)
Total potential savings	**$340,418,655** ($162,396,389 + $178,022,266)

The remaining waste that is compressed and dried is calld RDF (Refuse Derived Fuel) This fuel is fed into the gasifier and converted to SYNGAS. The gas is further processed into Hydrogn by removing the CO2 and CO.



Waste to Energy Video- click arrow at bottom to start

Gasification plant Circular Cycle



Green H2 production from MSW does not use electrolysis and the net cost is equal to NG if used on site

Wholesale Cost Target with Hydro-Genyse Ecosystem attached. This cost is the same as gasoline or NG in equivalent energy.

Green H2 cost	W/O Ecosystem	W Ecosystem
H2 Cost/ KG	$ 7.00	$ .60-$ 1.50*

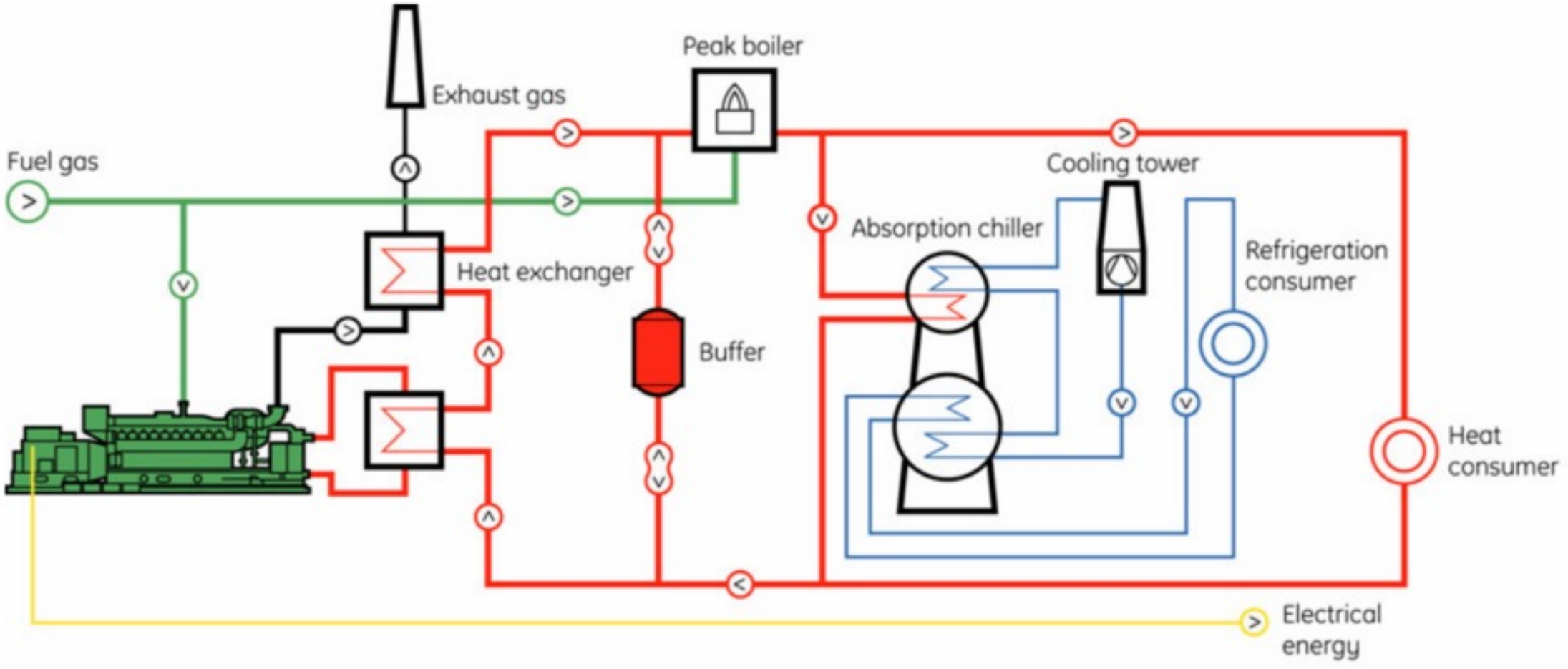
* Sale price includes the $ 3.00/ KG subsidy from the DOE for the first 10 years

MSW will be converted to 5,625 metric tons of H2 at this plant per year. This can be used to run a 6 MW generator

Then the heat will be recovered and converted back to electricity with the Rankin Cycle and refrigeration using a Vapor Absorption Cooling Technology

<u>All with no emissions</u>

This Generator can provide Combined Cooling Heating and Power CCHP



90,000 metric tons/ year of CO_2 is converted to 200,000 tons carbonate ($CaCO_3$) for permanent sequestration.

Manufacturing pavers utilizes glass and ash from the process

Recovered metals processed on site – to green steel using magnetic induction and hydrogen

Processing the metals directly from the plant has a substantial economic advantage for local use.

An induction system can alloy the metal for required specifications and/ or process to standardized stock or parts.

Recovered metals processed on site – to green steel and aluminum

Metal from MSW is mostly low sulfur high grade steel and aluminum which is separated in the process.

This would make alloy processing simpler to standardize an output grade for specific vendors.

Data Center waste heat utilization can cut cooling for the data center costs while supplying waste heat to the ecosystem. We are proposing a 100M gal heat sink utilizing the retaining ponds

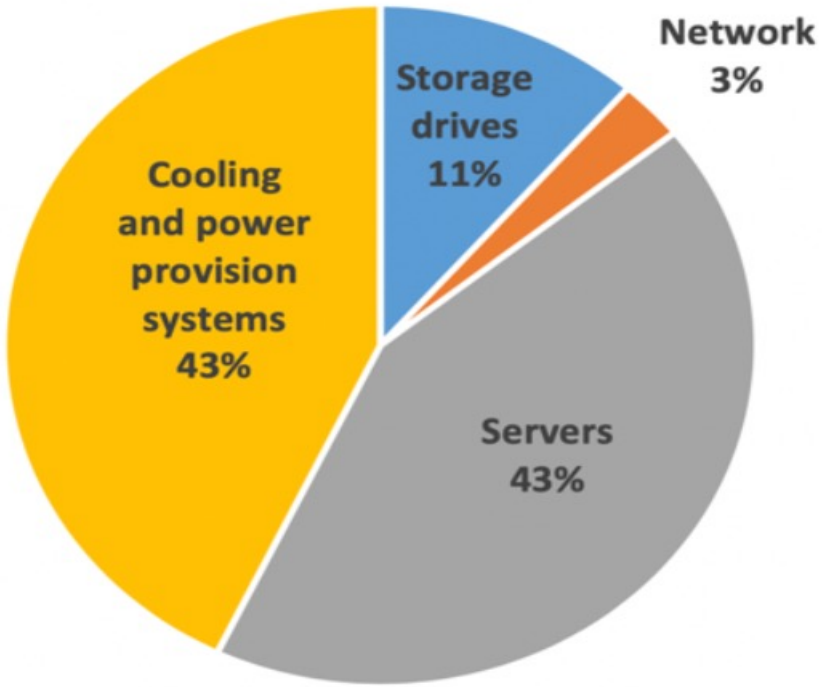


Figure 1. Fraction of U.S. data center electricity use in 2014, by end use. Source: Shehabi 2016.

Hydroponic Produce Production on Site

By having waste heat and CO2 available on site, a large scale indoor heated hydroponics/ greenhouse system will be profitable and sequester 1000's of tons of C02.

This will be at a lower cost than trucking from CA and can generate approx. $ 3.6M in gross revenue.

Food Processing further utilizes heat and refrigeration

Waste heat can be used in food processing on site- again directly piped from the plant and utilize CO2 refrigeration

Placing this on the site with its own water treatment will lower costs for both industries.

Food Processing further utilizes heat and refrigeration

Refrigerated warehousing will be integrated to utilize energy and waste heat through the *Absorption Cycle*

This will be a hub of urban food distribution for SE WI.

Waste Heat Utilized for advanced aquaculture production

UWM freshwater sciences advancements in aquaculture have reduced high value fish production from 4 years to 9 months.

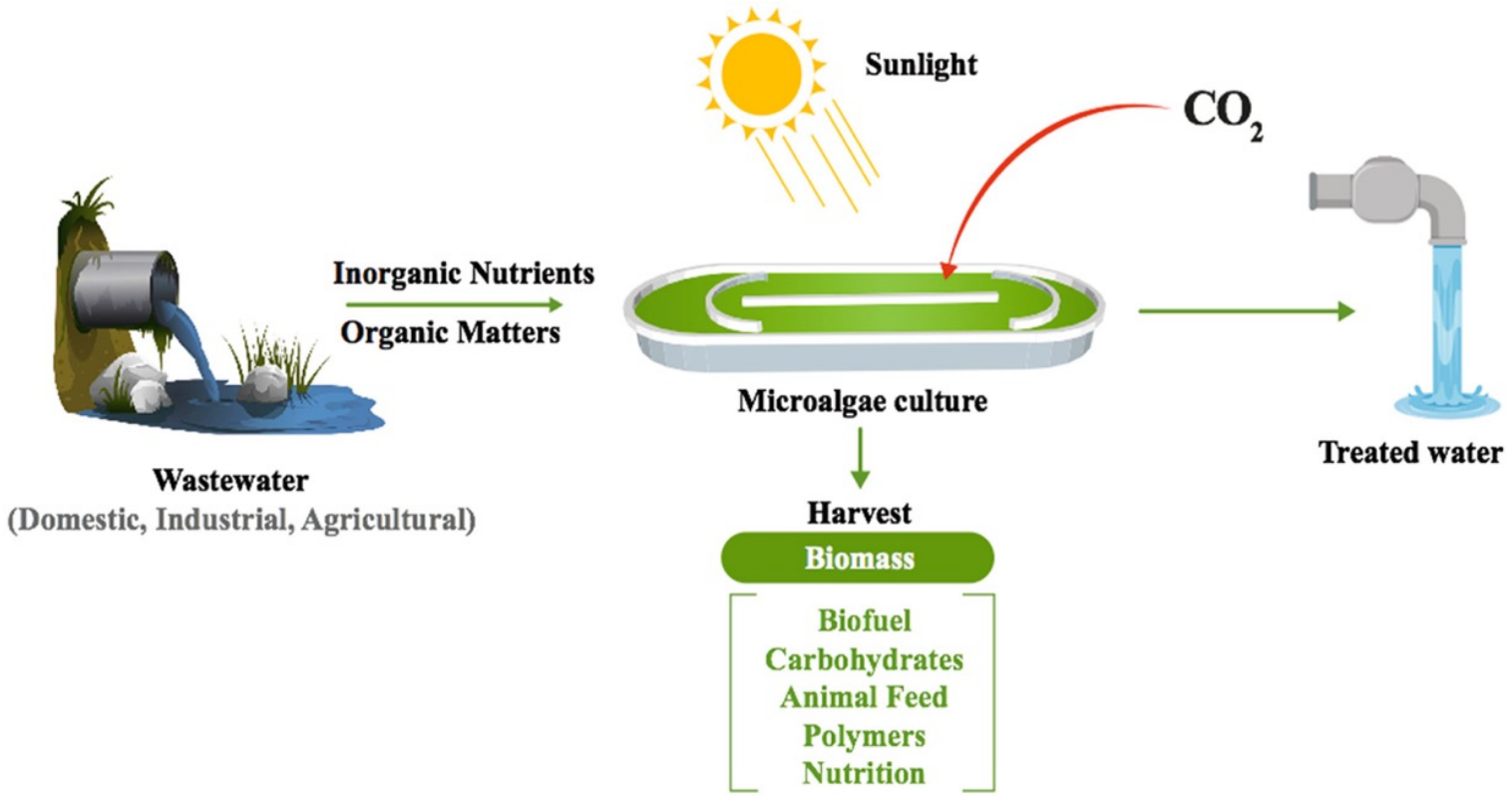
Having a low and consistent cost of energy will change the economics of this operation.

Advantages of the Circle City Ecosystem

- Energy from Waste will Power the greatest sources of CO2 with sustainable energy and water conservation

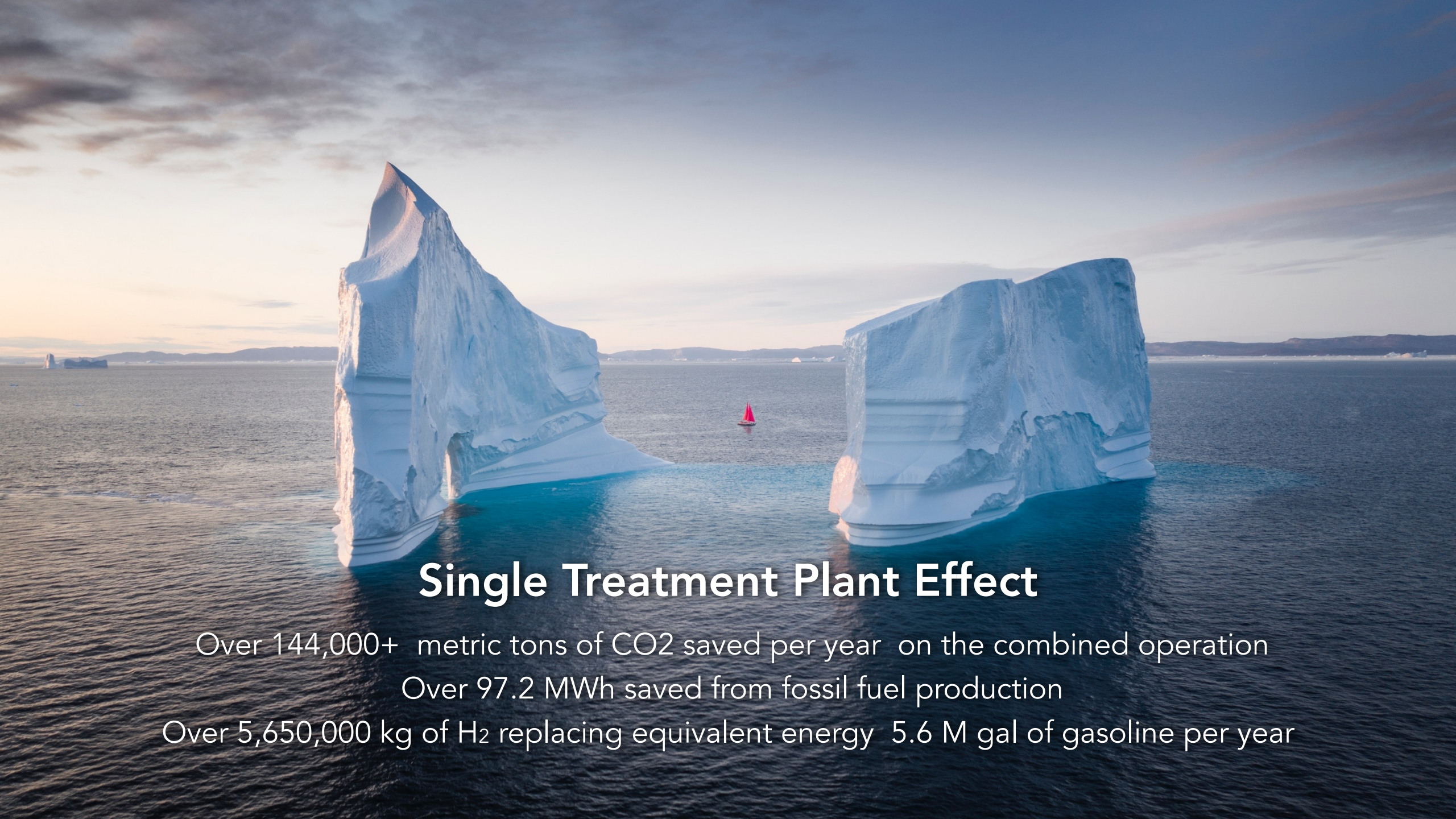
Electrical Power
Steel and Metals
Hydrogen
CaCO3 and CO
Food Processing
Data Centers
Urban Farming

All made with sustainable energy in a closed loop generated from MSW



- **Utilizing algae would divert wastewater from filtered primary treatment to the algae bioreactors.**
- **During the day they would be fed waste CO_2 from the plant or associated waste to energy.**
- **At night they would be fed oxygen from the electrolysis plant.**

Domestic and Industrial Wastewater Treatment Using Algae on site



Single Treatment Plant Effect

Over 144,000+ metric tons of CO_2 saved per year on the combined operation

Over 97.2 MWh saved from fossil fuel production

Over 5,650,000 kg of H_2 replacing equivalent energy 5.6 M gal of gasoline per year

Waste to Energy Connected Ecosystem Projected Economics

Process	Revenue
Income Generated by Average based on 144,540 tons/ year / $ 85.00	$ 12,285,900.00
Waste Heat to electric from Generator waste heat	$ 4,931,141.00
Electrical generation of 6 mw with 25% H2/NG and tail gas	$ 6,212,500.00
27462 tons of steel from waste – compressed to blocks	$ 17,850,690.00
5622 tons of aluminum - processed to ingots	$ 12,650,863.50
Land lease income based on 1.00 /sq/ft/year	$ 630,000.00
Water/ sewer and storm water saving from capture and reuse	$ 946,541.00
Bottom Ash turned into pavers on site- 2.3M pavers	$ 5,201,694.02
Hydrogen used on site @ $ 3.60/ Kg with fed subsidy ($ 3.00/ KG)	$ 20,250,000.00
198,674 metric tons Calcium carbonate based on sygas-H2 CO2	$ 202,648,438.00
CO2 capture based on CO2-CaCO3 converted- Fed grant	$ 7,731,090.00
Fed incentive for generating clean power on site	$ 1,207,035.00
Haz Mat Disposal added to tipping fees	$ 4,210,140.00

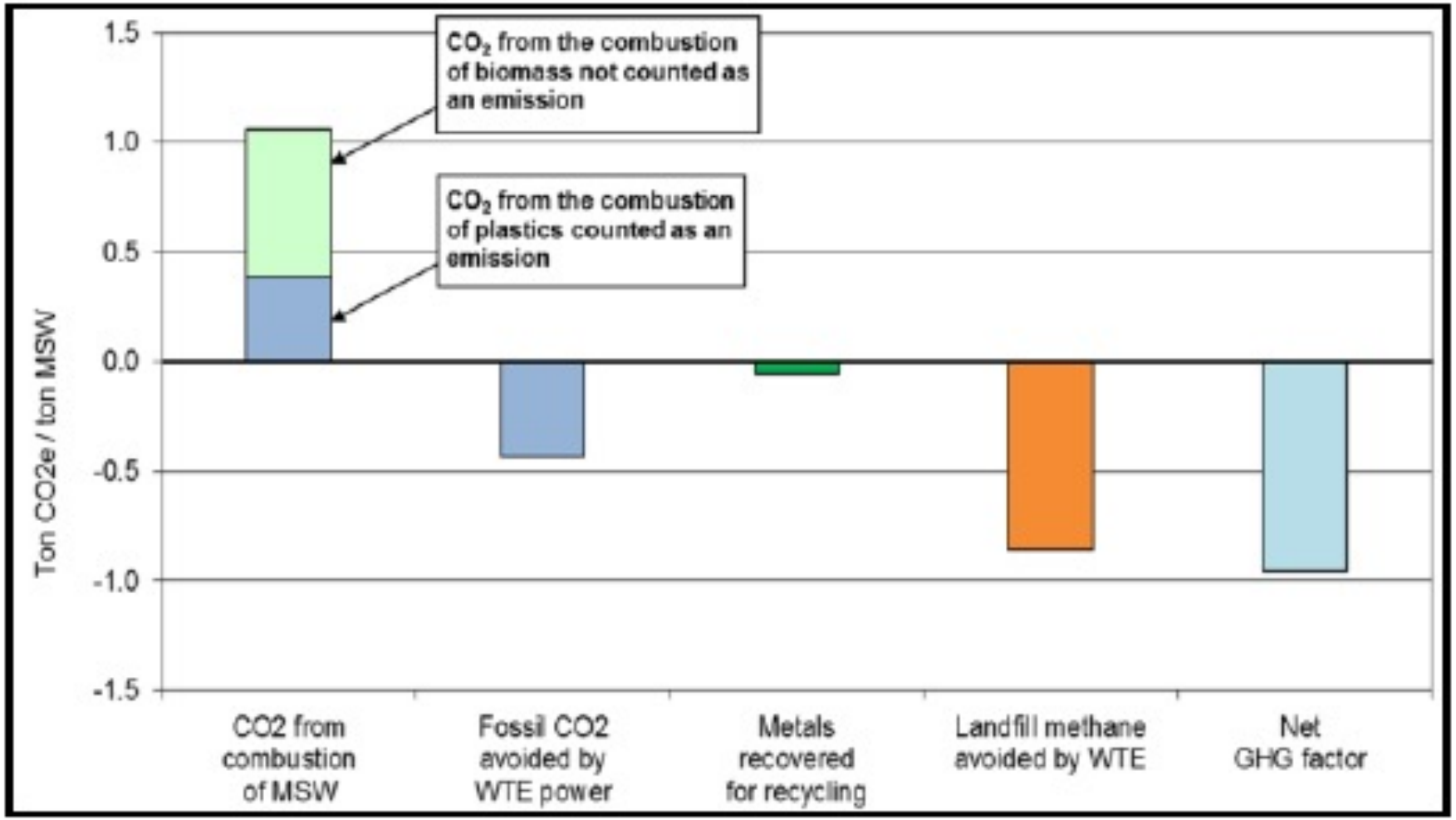
Calculated Gross Revenue	$ 300,523,528.87
Calculated IROR 25%	$ 75,125,882 year
Estimated ROI	TBD Est < 6 years.
Local Economic Effect x 1.77	$ 531,891,246.00*

*Energy Recovery Counsel 2018 report on local economic effect

Note: Income from additional business is only calculated as rent except for the steel/ Al, gases and by-products

Every ton processed achieves 1 negative ton of CO2- DOE

equivalents (CO2e) for every ton of MSW diverted from landfill and processed.



Advantages of WTE vs Solar, Wind and Nuclear

- Direct conversion of MSW to Syngas, then separated into H2, CO2 and CO for processing and sale.
- Each WTE plant can act as a back up for the electric grid and provide power in the event of a terror attack
- Green H2 capitol costs are a fraction of other options
- The plant is paid to take and process the fuel- this will never go down or diminish

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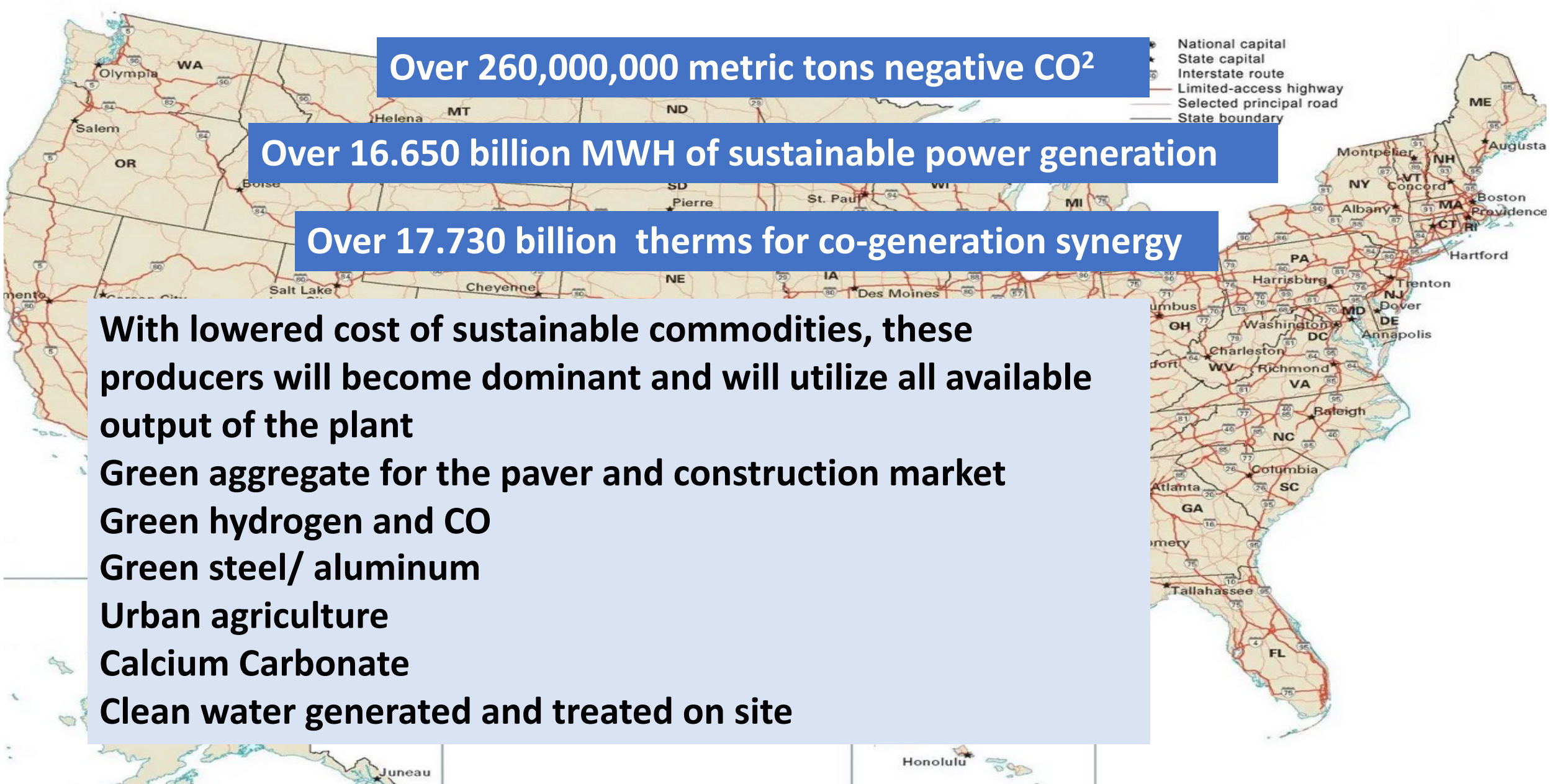
There are 2200 landfills in the US that could be developed



Over 260,000,000 metric tons negative CO^2

Over 16.650 billion MWH of sustainable power generation

Over 17.730 billion therms for co-generation synergy

With lowered cost of sustainable commodities, these producers will become dominant and will utilize all available output of the plant

Green aggregate for the paver and construction market

Green hydrogen and CO

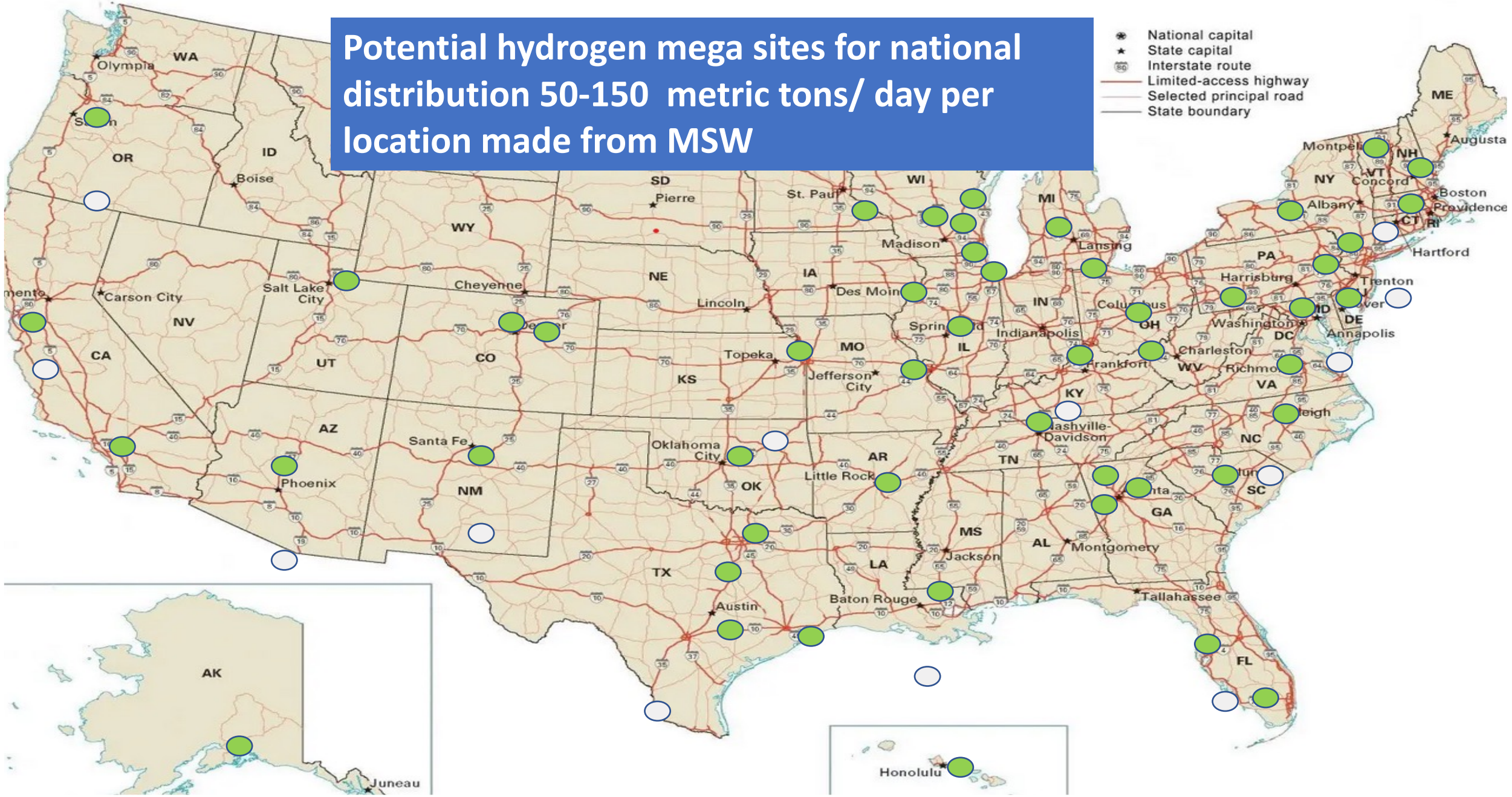
Green steel/ aluminum

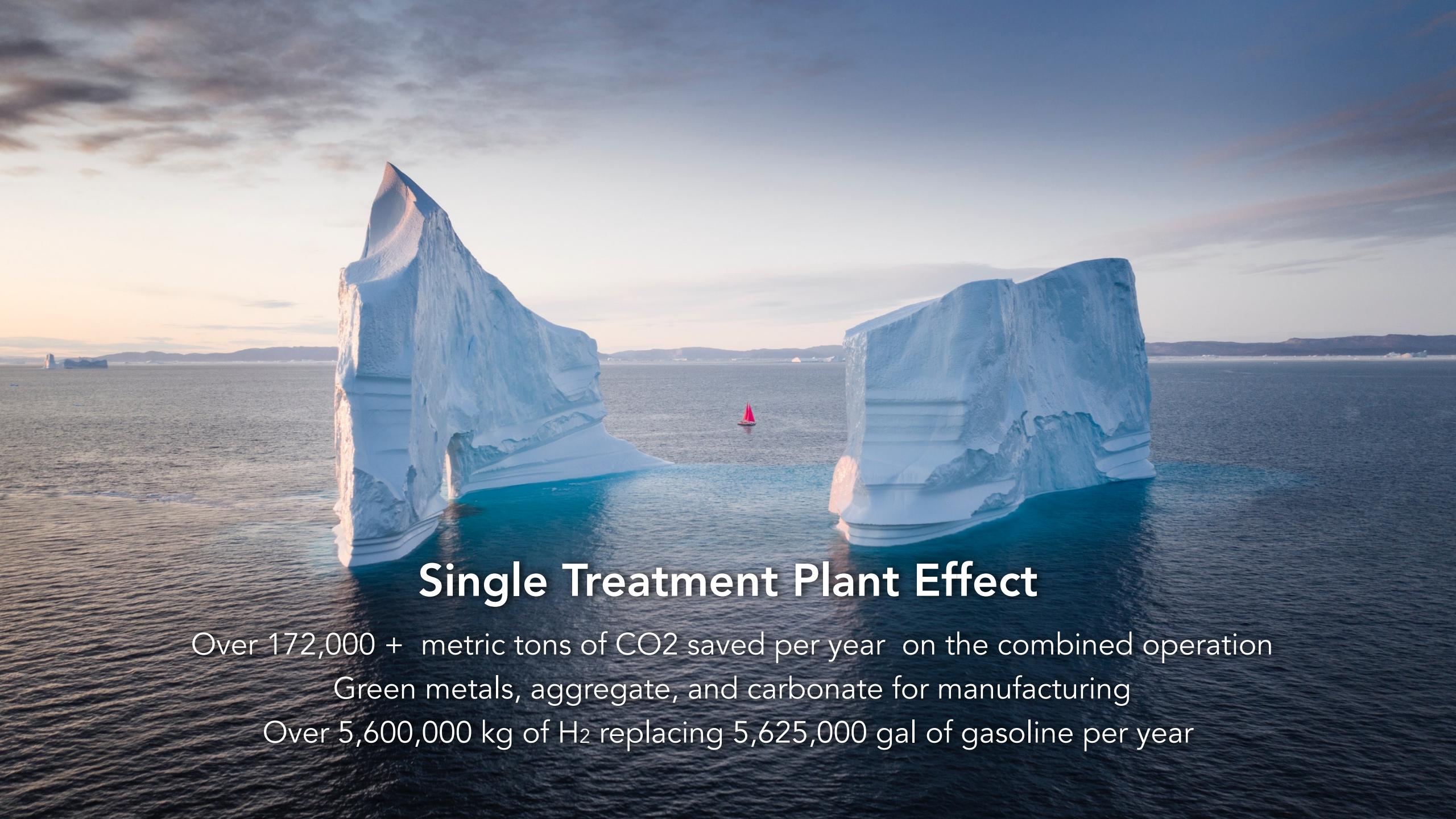
Urban agriculture

Calcium Carbonate

Clean water generated and treated on site

Potential hydrogen mega sites for national distribution 50-150 metric tons/ day per location made from MSW





Single Treatment Plant Effect

Over 172,000 + metric tons of CO_2 saved per year on the combined operation

Green metals, aggregate, and carbonate for manufacturing

Over 5,600,000 kg of H_2 replacing 5,625,000 gal of gasoline per year


Hydro
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