

# TRASH LAB

## RETHINK. PROTECT. REDESIGN.

Come explore how and why we've created so much trash and **RETHINK** what we can do to consume less. Dive into the science of trash to understand how landfills **PROTECT** our environment by managing the waste our society creates. And finally, help us **REDESIGN** a world where landfills are not thought of as disposal sites, but as important places where trash is transformed into valuable resources. Our vision for the future is a circular system, where things are built to last longer, to be repurposed, or to be recycled, like in nature where the end of a life cycle fuels the beginning of another.

Let's **RETHINK** our relationship with waste, **PROTECT** our environment, and **REDESIGN** our production and waste systems!



**90%**  
of the materials  
used to create the  
Trash Lab had a  
previous life and  
were repurposed  
for this project.



**DANE COUNTY DEPARTMENT OF OF WASTE AND RENEWABLES**

*Exhibit created in collaboration with* **MADISON CHILDREN'S MUSEUM**

## PRE 1800S

Uncontrolled dumps

## 1840S

Sanitary awakening makes the connection between disease and filth

## 1959

First guide to sanitary (lined) landfills published

## 1970S

First "engineered" landfills, or sanitary landfills with gas extraction, constructed

## 1985

Dane County Rodefeld Landfill opens

## 1995

Dane County begins harvesting landfill gas to produce electricity.

## 2019

Renewable Natural Gas Facility constructed to capture and convert landfill gas into renewable natural gas (RNG)

1959 AND 1970: PHOTOS COURTESY OF THE CITY OF MADISON STREETS DIVISION

### Did you know?

In 2017, each U.S citizen produced an average of 4.5 pounds of waste per day (1,642.5 pounds per year). In 1960 when records were first collected that rate was just 2.68 pounds per person per day.

## DANE COUNTY DEPARTMENT OF WASTE AND RENEWABLES

We think it is important to show you where your waste goes and what impacts your choices have on our landscape. We want to move towards a better system with alternatives to landfilling that will help us create a healthier, more sustainable future.

In the U.S we consume more now than any other time in human history, and this produces lots of waste. We buy more than we need, we throw things that are still useful, and we are influenced by television and social media to think that we need more than we actually do to be healthy and happy.

### WHAT'S IN A LANDFILL?

#### U.S Landfill Tonnages 1960-2017

This graph illustrates the growing amount of materials sent to the U.S landfills over nearly sixty years. Wisconsin has taken steps to conserve landfill space by banning reusable and recyclable materials like yard waste, paper products, aluminum, glass, steel (tin), and #1 and #2 plastic containers from the landfill.

### CONSUMER CULTURE

Because of the messages we hear on television or social media, it's easy to get swept up into thinking we need new shoes, toys, games, or other objects before the ones we have are done with their useful life. However, buying all these new things comes at great costs. How do these ads influence you into thinking you need something new, and how can you guard yourself against these messages?

### CABINET OF CURIOSITIES

These items were all collected from Dane County's waste stream. They're still in great condition and could have been used by someone else.

- Find 5 objects that you could use in your own life.
- Think of 5 things you have thrown away that someone else could have used

5







Reuters/Enny Nuraheni

### SOCIAL IMPACT

The production and disposal of material goods negatively impacts low-income people around the world, predominately people of color, at far greater rates than wealthier individuals. The social injustice shows itself all over the world, where people with lower incomes live and work in crowded, unsanitary conditions, often adjacent to hazardous waste sites, incinerators, factories, or landfills, resulting in higher morbidity rates.

When we consume too much the damages are wide-ranging, with both visible and invisible impacts across society and the environment.

### ECONOMIC IMPACT

Mismanaged waste imposes significant costs on existing and future generations. The State of Wisconsin spends millions of dollars per year on clean up and remediation of contaminated sites. As another example, plastic pollution costs 13 billion dollars globally per year in lost revenues, remediation, loss of tourism dollars, and health consequences. The inequities can even be felt in our communities.

### ENVIRONMENTAL CONTAMINATION SITES

The orange dots represent reported environmental contamination incidents in the city of Madison that have affected soil, groundwater, and air. Take a look at their density. With this and your knowledge of the city, do you notice any patterns.

### ENVIRONMENTAL IMPACT

By consuming too much and disposing of our waste in irresponsible ways we negatively impact our air, land, and water.

Even if you live in Wisconsin the plastic you throw away could make its way to an ocean, where it decomposes very slowly and harms sea life, by causing entanglement, malnutrition and often times death to fish, birds, ceaceans, and turtles.

In fact, 80% of plastic in our oceans is from land sources.

This map shows how, using red and yellow ink, financial institutions in the 1930s outlined the parts of the of a city that were considered "high risk" for approving a loan based solely on demographics. These so-called "riskier neighborhoods" were prominently Black and Latino.

To prevent waste, let's start by rethinking our individual choices about what we really need to thrive.

Along with individual changes in behavior, adovating for systems of change across industry and government can have even more far-reaching impacts. Purchasing products from companies who incorporate post-consumer recycled content, lightweight reusable packaging and sustainable sourced materials is also important.

### THINK ABOUT THE LAST OBJECT YOU HAVE BOUGHT

- Could you have done without it?
- Could you have borrowed it from someone else?
- Could you pass it along when you're done with it?



Protect our environment by supporting the Dane County Department of Waste & Renewables' innovative work. Our job is to find the best solutions to responsibly manage the waste our community produces in order to protect the health of our environment. We are proud of the work we do, and are working hard to find newer and better ways to beneficially reuse and recycle our society's waste.

One of our primary objectives in conserving space in the landfill through waste diversion, recycling, and efficient operations.

While viewing disposal at landfills as a last resort, we have also found ways to use this waste once again as a resource. Landfills can use the gas they produced by waste to create renewable energy and fuels.

RECYCLE



-  Basural activo
-  Cepillo y troncos
-  Control de calidad del aire y olores
-  Gas natural renovable
-  Cobertura nativa de pradera
-  Protección y monitoreo de aguas subterráneas
-  Reciclaje en la construcción y demolición
-  Casa de Balanza
-  Descarga manual e intercambio de bicicletas
-  Neumáticos y tejas
-  Barrido completo

**WHAT KEEPS THE LANDFILL FROM LEAKING?**

The bottom of the landfill is lined with compacted, dense clay and a high-density plastic liner to prevent liquids or leachate from seeping through. Waste produces liquid as it decomposes. To manage this liquid and rainwater that seeps into the waste, a stone layer alongside a network of pipes and pumps carry these liquids to sewer pipes, and ultimately to the wastewater treatment plant.



# DANE COUNTY'S RODEFELD LANDFILL

Throughout history and across cultures, humans have produced and disposed of waste, sometimes in very unsafe ways. Today's landfills are highly engineered systems designed to protect human health, prevent groundwater contamination and reduce greenhouse emissions into the air. Modern landfills work to keep our cities clean and healthy through monitoring systems, waste stream diversion strategies, and the adoption of renewable energy systems that capture, clean, and reuse gases. Once landfills are closed, they also provide opportunities for restoration, renewable energy harvesting, and recreation.

## ABOVE THE LANDFILL

Closed landfills offer great opportunities for restorative practices that help keep our air clean. We've planted native plants to attract pollinator species and will incorporate recreation into the site once waste is no longer being accepted.

### COVER LAYER

The final cover system is placed over the waste once the landfill has reached capacity. The cover prevents waste from being exposed and keeps precipitation, like rain and snow, out of the landfill.

### PRAIRE COVER

Our native seed mix contains nearly 20 different plant species, including Black-Eyed Susans, Little Bluestems, and Yellow Coneflowers, creating a diverse habitat for pollinators.

### SOLAR FIELDS | BELOIT, WISCONSIN

Closed landfills in the U.S. are quickly becoming great sites for new solar arrays, like this one at Rock River Solar Facility in Beloit, Wisconsin. However, because landfills settle when waste breaks down, this can sometimes pose challenges to landfill solar development projects, especially after landfills first close.

Photo: Alliant Energy

## INSIDE THE LANDFILL

Waste breaks down in landfills anaerobically, or in the absence of oxygen. Landfill gas (LFG) is a byproduct of this process. LFG is made up of a mixture of gases, and over 50% is methane, the same type of gas that makes up the natural gas used in your home stove or water heater.

The liquid collected from the waste, called leachate, is pumped to the wastewater treatment plant.

LFG is pulled from our landfill through a series of vacuum wells and pipes and brought to our Renewable Natural Gas (RNG) plant.

## HOW LONG TO DECOMPOSE?

When disposed of in a landfill, each item breaks down at a different rate; some taking more than 500 years to decompose. This is why it is so important to put items you no longer need in the right places.

If not managed properly, flammable gases that are produced from decomposing waste can build up and create dangerous situations. We design and monitor the landfill to ensure gases produced by the waste do not migrate and cause explosions, but rather, are captured to create renewable natural gas (RNG) fuel, which we use in Dane County's vehicle fleet.

Gas explosions from underground landfill gas migration are dangerous and have happened here in our own community.

## THE RENEWABLE NATURAL GAS (RNG) PLANT

The landfill gas that is pulled from the waste gets sent to our Renewable Natural Gas (RNG) plant, where it is cleaned, compressed, and injected into the natural gas pipeline that is buried by our site. From there, the gas gets transported to gas stations to be used as renewable vehicle fuel.

The RNG plant is located next to the Rodefild landfill and cleans captured gas to make QUALITY NATURAL GAS.

### Renewable Natural Gas (RNG) Plant

Here, at the plant, the landfill gas is cleaned of contaminants and the methane is separated from the carbon dioxide, oxygen, and nitrogen. Finally the gas is compressed and injected into the natural gas pipeline that is buried by our site. From there, the gas is transported to gas stations to be used as renewable vehicle fuel.





# WHAT'S REMOVED

To meet the strict quality standards of the natural gas pipeline, the RNG plant depends on media to absorb and remove contaminants and unwanted gases from the landfill gas before it can enter the pipeline.

## HYDROGEN SULFIDE (H<sub>2</sub>S)

Hydrogen sulfide smells like rotten eggs and is produced from decomposition of organic materials. Drywall and construction debris are major contributors to H<sub>2</sub>S levels in landfill gas.

### HOW IT'S REMOVED:

- Activated Carbon Media fills the H<sub>2</sub>S Polishing vessels and filters out the H<sub>2</sub>S through "adsorption," a process where compounds in the gas react chemically with the carbon and stick to the pellets. Once this media is filled up with H<sub>2</sub>S it has to be replaced with new media.
- Iron Hydroxide Media is another substance used to adsorb and filter out H<sub>2</sub>S from landfill gas.
- Acidithiobacillus Thiooxidans is a special bacterium that converts the H<sub>2</sub>S in the landfill gas into other elements. The Biological Desulfurization towers (BioD) are filled with these plastic, wheel-spoke-shaped media that serve as a place for the bacteria to live.

## VOLATILE ORGANIC COMPOUNDS (VOCs)

VOCs are chemicals often used in paints, cleaning solutions, and other household products, which can ultimately end up in the landfill with your trash.

### HOW THEY'RE REMOVED:

Regenerative Carbon Media fills the Temperature Swing Absorption (TSA) vessels and removes VOCs from the landfill gas. When the media is exposed to the system's excess heat, VOCs are released, allowing the media to be used again and again. Once free from the media, the VOCs are sent to the Regenerative Thermal Oxidizer to be destroyed with other waste gases.

## CARBON DIOXIDE (CO<sub>2</sub>) OXYGEN (O<sub>2</sub>) AND NITROGEN (N<sub>2</sub>)

Although these gases are found in the air we breathe, we do not want them in the natural gas pipeline. The gas in the pipeline needs to be at least 96% methane to be considered quality natural gas that people can use.

### HOW THEY'RE REMOVED:

- Carbon Molecular Sieves are a very porous media, like sponges, that fill the three sets of Pressure Swing Absorption (PSA) vessels and remove CO<sub>2</sub>, O<sub>2</sub>, and N<sub>2</sub>. This media also regenerates, but under changes in pressure. Under positive pressure (like a balloon full of air) certain gases stick to the media and under negative pressure (like a vacuum produces) these gases are released from the media. This process allows the media to regenerate, or be used over and over again.

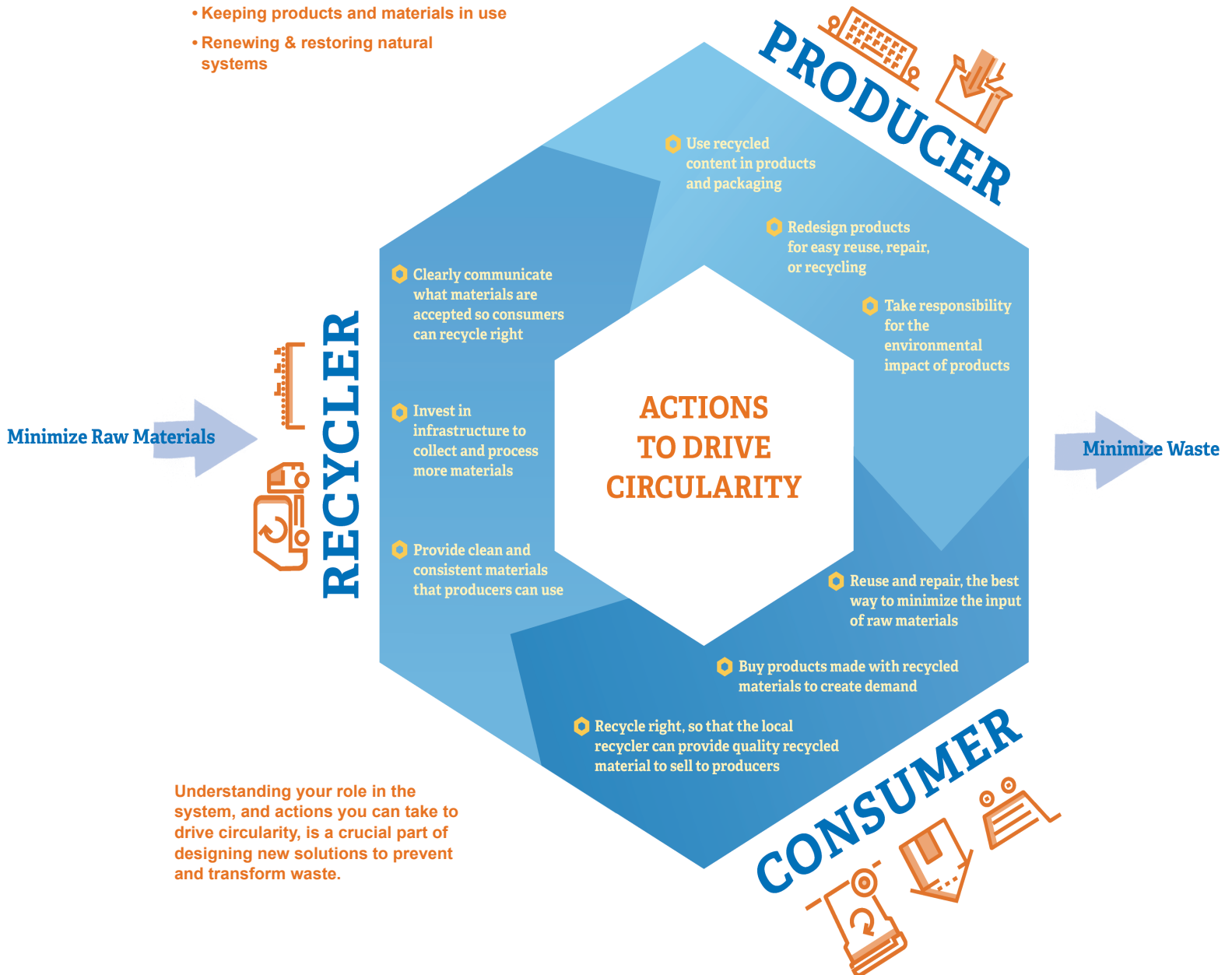
# CLOSING THE LOOP

Help us imagine new solutions to prevent and transform waste. We're working toward designing circular systems that reuse and recycle everything our society creates so there is no such thing as "waste" in the first place.

Let's REDUCE, REUSE, RECYCLE and most importantly REFUSE a waste-filled future while we REDESIGN a future with less waste. We'll need individual behavior changes to get there and also systemic, large scale changes throughout industry and through government legislation.

There's a world of opportunity to redesign the way we make and reuse stuff. We strive to think with circularity, which is based on three principles of:

- Designing out waste and pollution
- Keeping products and materials in use
- Renewing & restoring natural systems



Understanding your role in the system, and actions you can take to drive circularity, is a crucial part of designing new solutions to prevent and transform waste.



# REDUCE

By weight, food waste is the largest waste in American landfills. 40% of all food purchased or grown in the U.S. is thrown away! Imagine bringing home five grocery bags and throwing two of them away before you unpack them. That is a lot of food! Food goes to waste spoiling in transport, at the store, in our refrigerators, and when we don't eat everything on our plate.

Packaging and single-use plastics are also a significant problem in landfills, because they take up so much space and take hundreds and hundreds of years to decompose.

**HOW MUCH SINGLE-USE PLASTIC DO YOU USE?**  
Get an estimate with our [Plastic Usage Calculator](#).



Imagine bringing home five grocery bags and throwing two of them away before you unpack them.

## YOUNG INVENTORS

18-year-old Doorea Shin from Hawaii noticed Styrofoam waste products littered around trash bins and on beaches. She gathered more than 1,000 signatures to ban Styrofoam from her school and then city and state.



# REUSE

Sure, recycling is great, but reusing, repairing, and refurbishing is even better because it saves the energy that comes with having to dismantle and re-manufacture products. By extending a product's life, you also reduce the need for raw materials, saving land, forests, and water supplies.

**IT'S FUN TO MAKE SOMETHING NEW FROM SOMETHING OLD, WHICH IS WHAT "UPCYCLING" IS ALL ABOUT!**

- 1. TURN OVER THE TIMER.**
- 2. SPIN BOTH WHEELS**
- 3. DRAW AN UPCYCLED INVENTION WITH THE OBJECTS YOU SELECT. YOU HAVE ONLY ONE MINUTE, SO INVENT QUICKLY!**

## YOUNG INVENTORS

14-year-old Sahil Doshi from Pennsylvania invented an eco-friendly battery named Pollucell that was made from aluminum foil, old guitar strings, and club soda to generate electricity that cuts down greenhouse gases.

# RECYCLE

Have you ever wondered what happens after you put something into the recycling bin? Once items are sorted at the recycling center, the materials get shipped to different businesses who manufacture these items into new products.

When you can't reuse or repair, the next best thing is to recycle, so materials can be reused and made into a new product, which is more cost effective and environmentally friendly than extracting new materials.

**MATCH THE 100% RECYCLED PRODUCTS TO THEIR ORIGINAL SOURCE.**

- PLASTIC #1
- PLASTIC#2
- NEWSPAPER
- GLASS
- METAL
- CARDBOARD
- PAPER

## YOUNG INVENTORS

14-year-old William Kamkwamba from Malawi, Africa, known as "The Boy Who Harnessed the Wind," created a windmill out of recycled materials to help his family power lights and appliances in their house.



By refusing to purchase items that are not created responsibly and by refusing to accept things as they are you can have a big impact. You can set an example for others to follow and know you are making a difference.

Make a commitment to refuse and share it with others. Tag us on Instagram @renewaste with your commitment and follow us below to see what others strive to do.



#### YOUNG INVENTORS

16-year-old Sean Russell from Florida refused to accept that garbage in the ocean is a given. He created a program called “Stow It—Don’t Throw It” to combat the negative impact of marine debris on marine life by repurposing tennis ball containers into fishing line recycle bins and distributing them to anglers while educating them.

# REDESIGN

While personal behavior changes are critically important, our impacts grow exponentially when we ask our government and industries to change their behaviors and design responsibly too. Use your voice and power to let your elected officials and favorite companies know that you want better legislation, more responsible design, and less waste.

LET OTHERS KNOW THAT YOU’D LIKE RESPONSIBLE DESIGN AND LESS WASTE.

- DESIGN FOR REPAIRABILITY
- DESIGN FOR MODULARITY
- DESIGN FOR REUSE
- DESIGN FOR ENDURANCE


#### YOUNG INVENTORS

16-year-old Azza Abdel Hamid Faiad from Egypt invented a method of breaking down plastic to make biofuel. Her invention allows plastic to be recycled for energy use.

IMAGE VIA EUROPEAN COMMISSION RESEARCH

# WHAT ARE YOU WASTING FOR?


You've had a chance to **RETHINK** our society's consumer culture and your role in it. Now help **PROTECT** the environment by consuming wisely and **REDESIGN** our future and your relationship with waste.



**RETHINK** our society's consumer culture and your role in it.



**PROTECT** our environment by safely managing the waste you create and creating less waste in the first place.



**REDESIGN** a system and society that minimizes waste and operates with circularity.



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