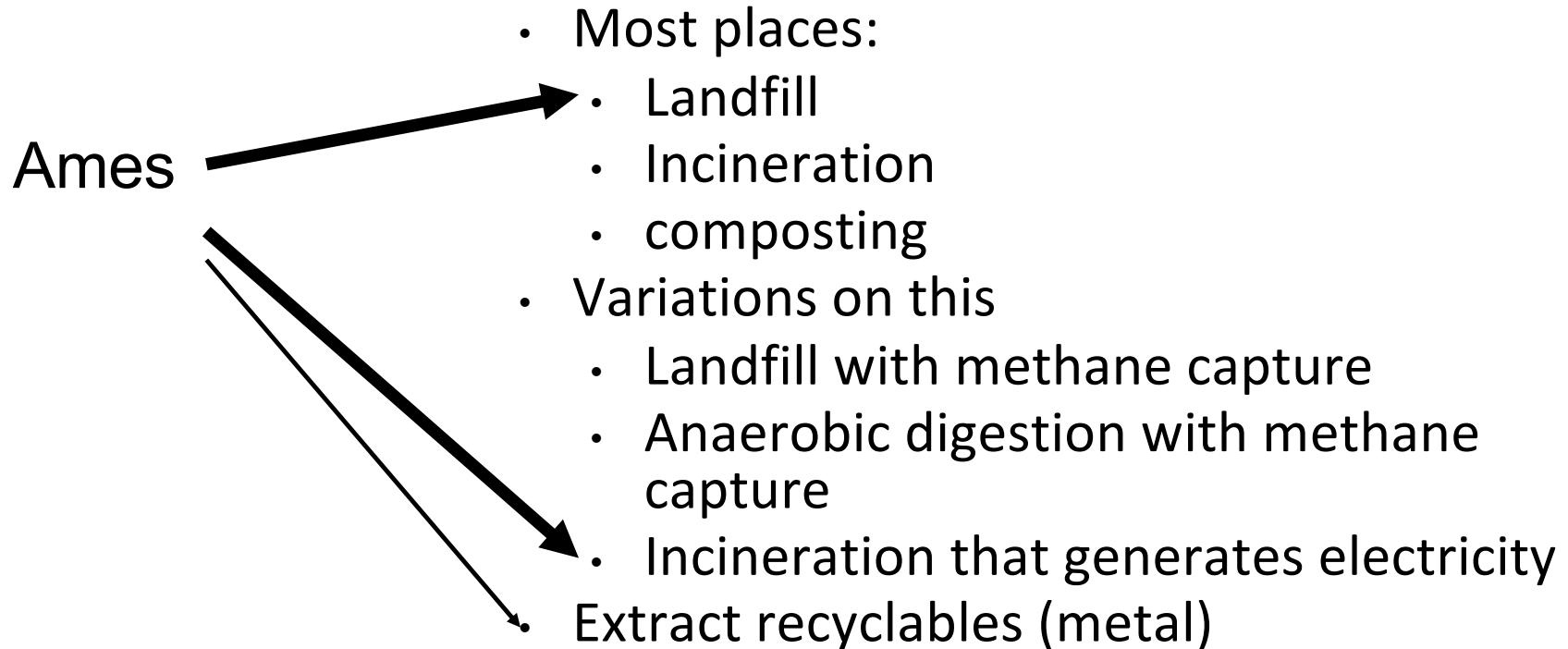




Manage your trash, save our future

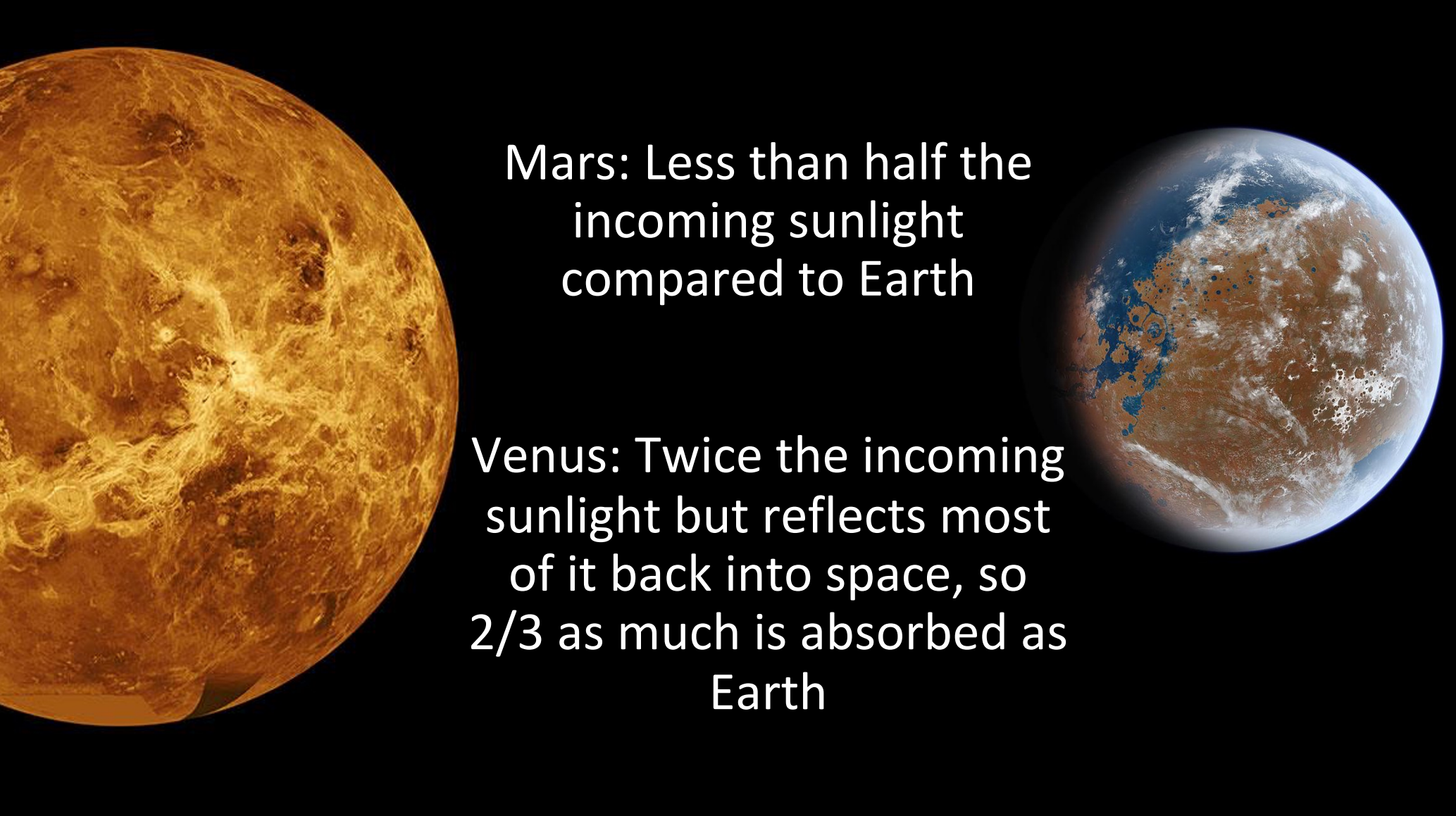
Lee Anne Willson
University Professor Emerita
Physics & Astronomy, Iowa State University

What happens to what you throw away?





Why does it
matter?



Mars: Less than half the
incoming sunlight
compared to Earth

Venus: Twice the incoming
sunlight but reflects most
of it back into space, so
 $\frac{2}{3}$ as much is absorbed as
Earth


Why so hot?



Venus
900°F
surface

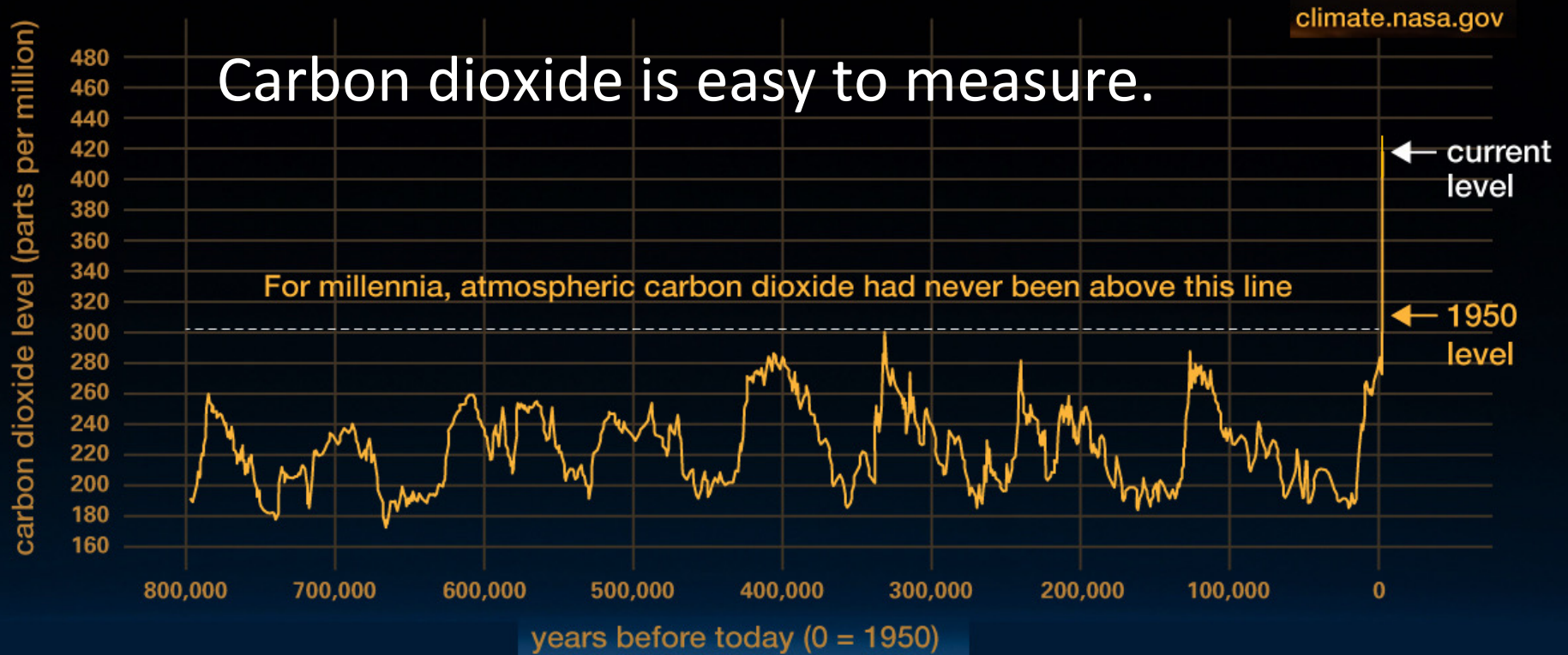
Absorbs 2/3
as much
sunlight as
Earth

Carbon dioxide atmospheres



Mars
Liquid water
in the past
Absorbed less
than 1/2 as
much sunlight
as Earth today.

Carbon dioxide is easy to measure.



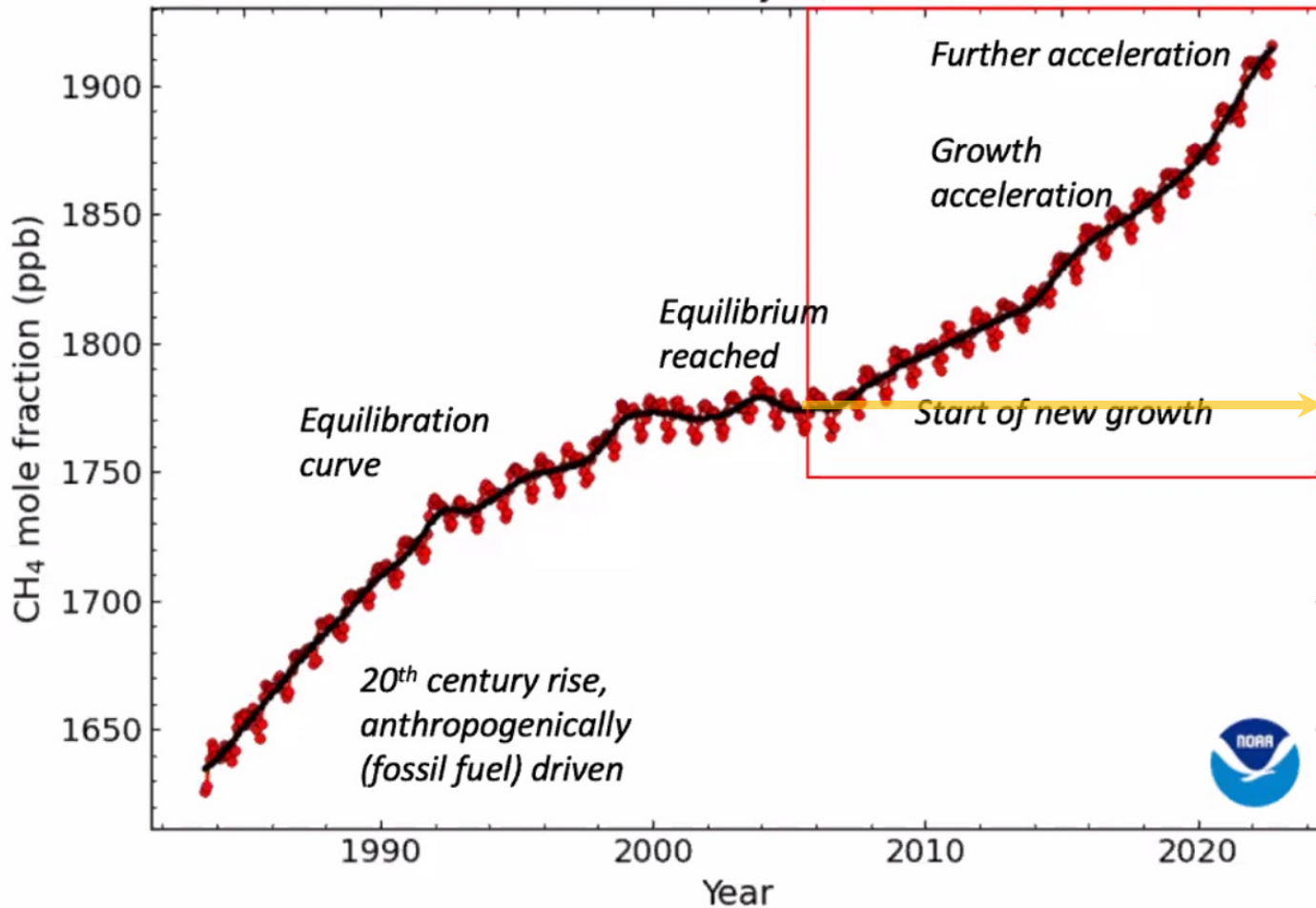
Below 300 for 800,000 years or more.

300 when my parents were born, 310 when I was born, 425 now.

Sources of green-house gases from human action

- CO_2
Carbon dioxide Combustion (transportation, energy generation, **waste incineration**), cement production
- CH_4
Methane Anaerobic fermentation and decay (wetlands, **landfills**, manure, ruminant stomachs), fossil fuel extraction.
- N_2O
Nitrous oxide Excess fertilizer
- Complex molecules Refrigerants, manufacturing

Global Monthly Mean CH₄

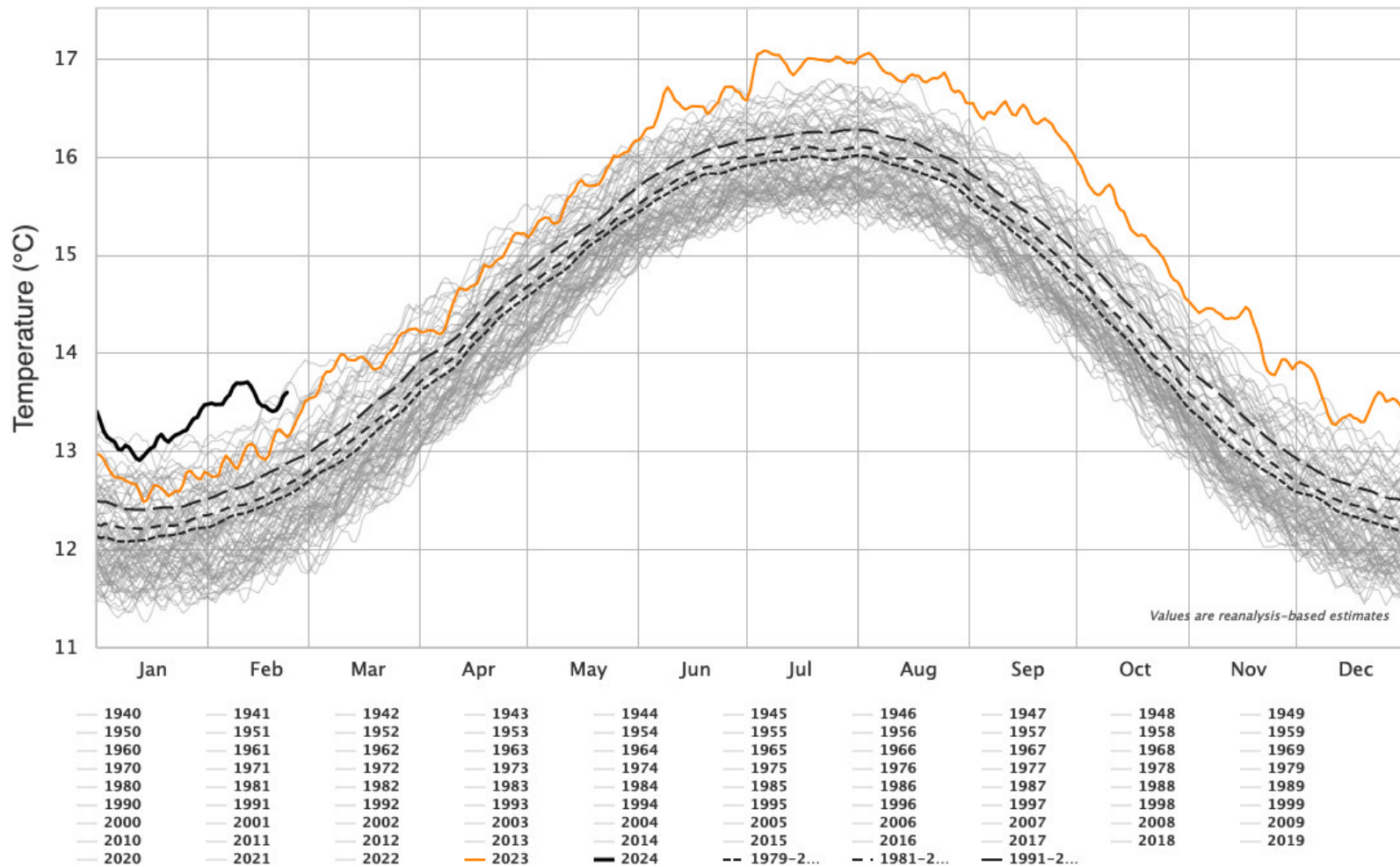


Methane is more than 80x as effective at trapping heat as CO₂ over 20 years (30x over 100 years).

The recent rise: High-latitude wetlands, emitting more as they are warmer and cover more area.

Daily Surface Air Temperature, World (90°S–90°N, 0–360°E)

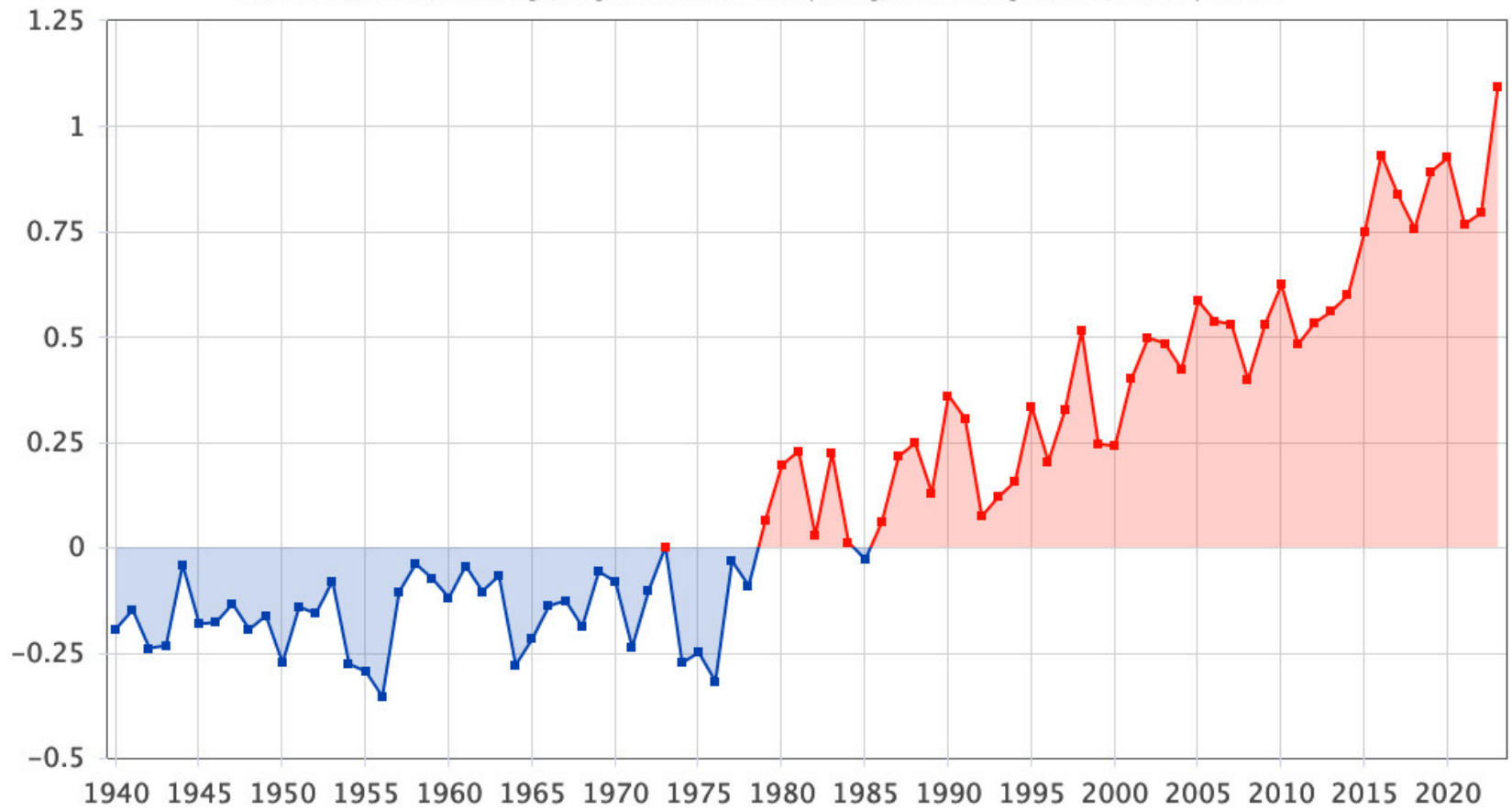
Dataset: ECMWF Reanalysis v5 (ERA5) downloaded from C3S | Image Credit: ClimateReanalyzer.org, Climate Change Institute, University of Maine



Data from [ClimateReanalyzer.org](https://climatereanalyzer.org)

Annual 2m Temperature Anomaly (°C) [1951–2000] World (90°S–90°N, 0°E–360°E)

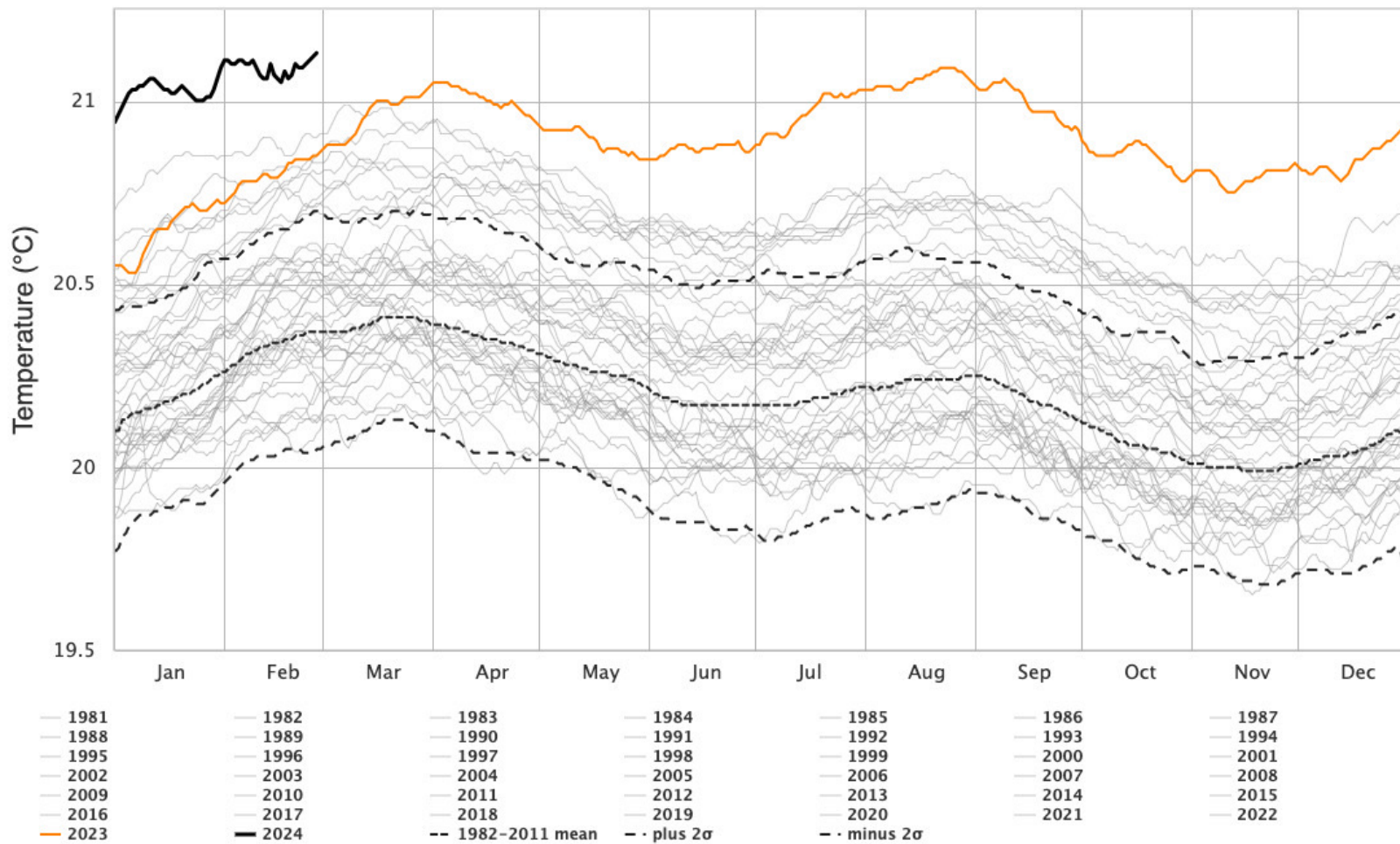
Dataset: ECMWF ERA5 (0.5x0.5 deg) | Image Credit: ClimateReanalyzer.org, Climate Change Institute, University of Maine



Data from [Climatereanalyzer.org](https://climateranalyzer.org)

Daily Sea Surface Temperature, World (60°S–60°N, 0–360°E)

Dataset: NOAA OISST V2.1 | Image Credit: ClimateReanalyzer.org, Climate Change Institute, University of Maine



Data from [Climatereanalyzer.org](https://climatoreanalyzer.org)

What happens to what you throw away?

- Most places:
 - Landfill -----> Emits methane (CH_4)
 - Incineration -----> Emits carbon dioxide (CO_2)
 - Composting
- Variations on this (greener, but not really green)
 - Landfill with methane capture -----> Emits less CH_4
 - Anaerobic digestion with methane capture -> May leak CH_4
 - Incineration that generates electricity -----> Emits CO_2

In Ames – what happens to what goes into the garbage can

- Trash is processed into cm-sized bits
- Metals (including aluminum) are extracted with magnets
- Material is separated into burnable (“Refuse Derived Fuel”) and not burnable
- RDF goes to the electric utility where it is burned to produce electricity, with 9 parts natural gas to 1 part RDF. (The gas for this cost Ames \$12M last year. Electricity from the grid is usually cheaper and often greener.)
- The rest goes to the Boone landfill – about 30% of the total.

In Ames –
RR = resource
recovery

E = Electrical
Utility

Recycling –
all at R and
cardboard
(C) by E



Ames Waste to Energy Plant

- 1974: Ames' electricity was produced locally by burning coal. The waste-to-energy plant replaced some of the coal with refuse-derived fuel.
- By 2022:
 - (1) Gas replaced coal, with 9 parts gas to 1 part RDF.
 - (2) Ames has joined the MISO grid: Cheaper and often greener electricity than burning RDF with gas.

The boiler is used because we need to get rid of trash, and it produces expensive electricity.

From best to worst:

- **Reduce:** Avoid buying one-time products.
- **Re-use:** If it still works, don't replace it, or find it a new home.
- **Repair:** If it isn't working, fix it rather than replacing it.
 - Ames Repair Café – 2 to 4 times/year - may fix it on the spot, or show you how to fix it, or help you find someone who can fix it.
- **Recycle:** The material in the item can be used again – glass, metal, some plastics.
- **Recover:** Get some value from it:
For example, burn it for electricity.

Landfill is a last resort!

Some things that work at our house:

- Handkerchiefs replace most paper tissue
- Cloth napkins replace paper napkins most days
- Re-usable paper towels and rags replace most paper towels
- Wash and re-use plastic bags
- Sodastream makes seltzer from tap water

Analyze the content of your trash can – what can you reduce?



Reducing your waste stream

- *Most one-time use plastic or paper items have re-usable alternatives.*
- *Visit ZW Mercantile at 301 Main Street to see what those might be.*



Finding a home for your surplus

- On Facebook:
 - Ames Re-Use Re-Cycle
 - [Ames Neighbors Helping Neighbors Free Market](#)
 - [Ames Buy/Sell/Trade](#)
 - [Ames and Local Online Swap and Sales](#)
- Donate clothes and re-usable goods
 - Goodwill
 - Salvation Army
 - Reliable Street
- Clothing and shoes
 - The Bin at 5820 Lincoln Way
(near *Ames Bottle & Can*)



Finding a home for your surplus – look for local organizations or individuals that can use them

- Plastic containers with lids that can survive a dishwasher (e.g. yogurt), and egg cartons:
 - Food at First
- Newspapers
 - Friends who are moving
 - Art center
- Packing materials
 - Artist friends, shop owners
 - People who will be moving soon



Finding a home for your surplus (Ames)

- Bicycles
 - WeCycle at Reliable Street: “To responsibly and safely redistribute used and refurbished bicycles to homeless or at-risk members of the community.”
- Fabric and sewing supplies
 - Quilting groups,
 - ISU textile & design department
- Furniture and appliances
 - Habitat for Humanity
 - Salvation Army
- Ames Rummage Rampage – end of July annually.



<https://www.amesclimateaction.org/post/a-local-guide-to-reuse-and-recycling>

Improved options for recycling by the City of Ames

- **cardboard** (boxes used for mailing should be broken down and flattened). [multiple locations including Resource Recovery (RR)]
- **mixed paper** (including newspapers, magazines, junk mail, chip board, cracker/cereal boxes, greeting cards). [RR]
- **metal** (including beverage cans, food cans, tins). [RR]
- **plastics with twist-off tops** (including milk jugs, laundry detergent, dishwashing liquid, water bottles). [RR]
- **food waste** (no bones, plastic, diapers, aluminum foil). [RR]
- **glass** (no mirrors, cookware, window, or windshield glass). [RR and grocery stores].

For redemption, Ames Bottle & Can at 5820 Lincoln Hwy #106, Ames, IA 50014 will take a bag full, pay you there, or send your payment to Venmo, or donate to their non-profit of the month.

In Ames – what we can keep out of the garbage

- Glass.
 - This is nearly 100% recyclable.
 - Corning in Kansas City uses it – prefers recycled glass to new materials.
 - Collection points at most grocery stores plus the Resource Recovery Plant.
 - Creates a major mess if it gets into the incinerator.



*Note: All collection points accept jars and bottles.
The collection point at Resource Recovery also
accepts window glass / glass from framed pictures.*

In Ames – what we can keep out of the garbage

- Cardboard

- Can be recycled up to 5 times, if clean.
Do not include plastic foam.
Do not need to remove all tape or staples.
Flatten boxes before recycling.
- Collection points at at the Ames Public Librar ,
the end of Main Street, behind Main Street,
and near the Ice Rink south of campus, plus the
Resource Recovery Plant.
- Makes up a lot of the volume of trash
(but not a lot of the weight)



*The Octagon has a machine that turns cardboard into packaging material.
Oatmeal cartons and decorative tissue boxes are gold for children's art programs*

In Ames – what we can keep out of the garbage

- Mixed paper
 - Includes newsprint, office paper, glossy paper (magazines, catalogs) and cardboard.
 - Clean – no food residue.
 - Collection point at the Resource Recovery Plant.

Other ways to recycle-reuse mixed paper:

Use newspapers instead of bubble wrap to package items for shipment.

Use magazines for collage or origami.



In Ames – what we can keep out of the garbage

- Metals
 - Relatively easy to recycle.
 - Is reclaimed from the trash stream, but more efficient to collect directly.
 - Collection point at the Resource Recovery Plant.
 - Ideally, clean and remove labels.



In Ames – what we can keep out of the garbage

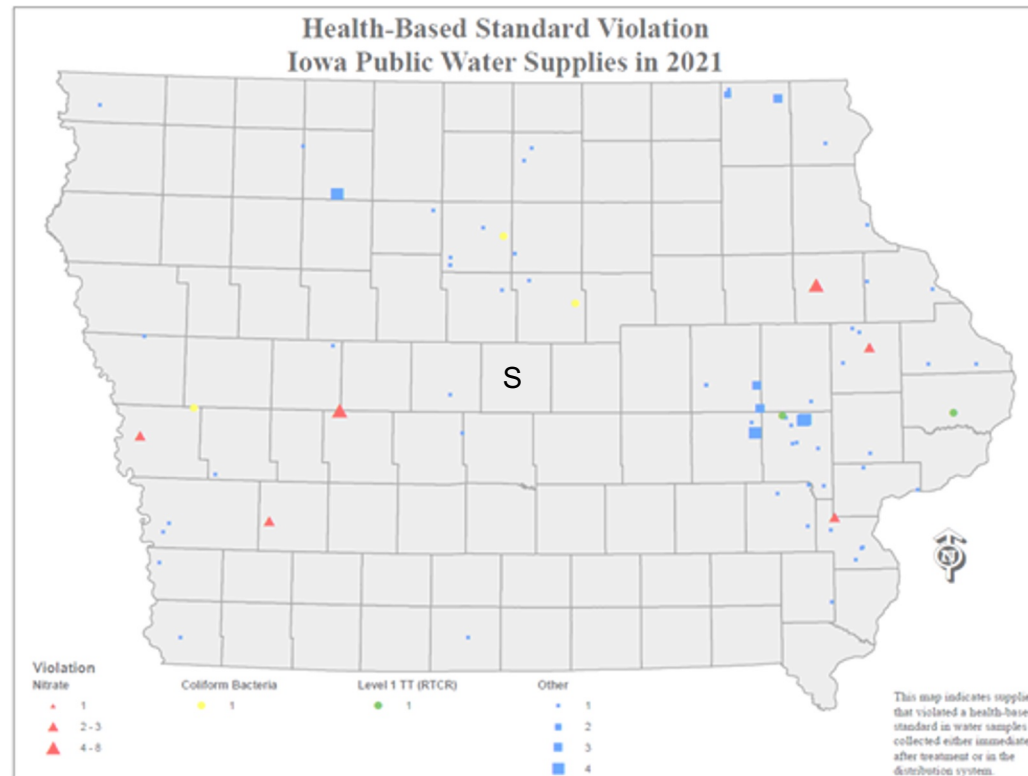
- Plastic
 - Most recyclers accept **screw-top plastic containers**; some accept other kinds. Ames is collecting screw-top plastic.
 - Plastic has its origin in oil, so if burned it is a fossil fuel that took a detour on the way to the incinerator.
 - Recycling is also problematic:
 - Uses energy, may release microplastics..



The best management of (one-time) plastic is: Don't buy it.

Plastic water bottles vs. tap water

- *50 billion bottles of water per year in US*
- *This corresponds to 4 million tons of CO₂ emissions before the cost of disposal is included.*
- *Ames' water is at least as high quality as what is in those bottles, a lot cheaper, and doesn't produce plastic waste.*
- <https://naturalresources.extension.iastate.edu/drinking-water-quality-iowa>



In Ames – disposing of batteries

- **Alkaline and carbon-zinc batteries** (non-rechargeable batteries) -> trash.
- Any other batteries -- drop off at Resource Recovery at no charge.



Rechargeable lithium batteries cause fires at the resource recovery plant

Small batteries: The Battery Store (by Lowe's) will take them for recycling, no fee.



In Ames – disposing of electronics (Ames City web page)

- Dead computers, TV: Can go to Resource Recovery. \$10 per carload.
- Functional flat-screen, cable read TVs, also computer monitors / accessories: **Goodwill Industries, 3718 Lincoln Way, Ames**, no charge.
- For recycling TVs, laptops, monitors <32” diagonally ...
Best Buy, 1220 S. Duff Avenue. Check their web site for details.

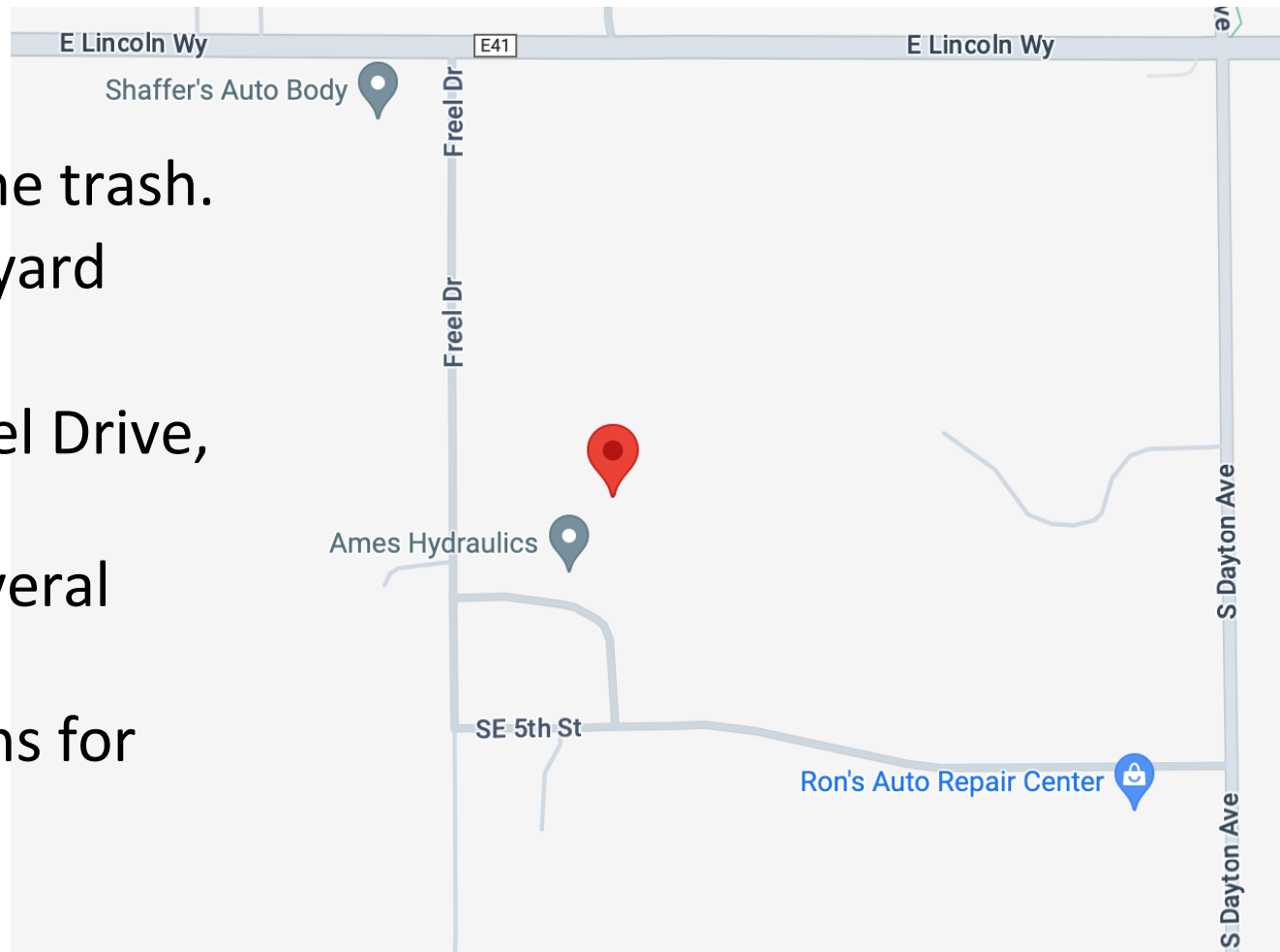
Adapted from:

<https://www.cityofames.org/government/departments-divisions-i-z/resource-recovery-system/computer-and-television-disposal-options>



In Ames – what we can keep out of the garbage

- Yard waste
 - Does not go in the trash.
 - Special bags for yard waste.
- Drop off at 400 Freel Drive, Ames
 - Free drop off several times per year.
 - Special collections for Christmas Trees



In Ames – what we can keep out of the garbage

- Food waste – not oils and fats
 - Composting program:
 - (a) encourage people to compost at home;
 - (b) collect composting for commercial disposal.
 - Green buckets available from Resource Recovery to collect composting.
 - Collection point at the Resource Recovery Plant.

*Why we want to keep it out of the incinerator:
It is wet, so takes more gas to burn.*

*Why we want to keep it out of the landfill:
It will produce methane as it decays anaerobically.*

Resource Recovery has Special collection days for Halloween Pumpkins.

Our experience with composting

- Keep a small container in the kitchen – such as a 4-cup measuring cup.
- Empty daily into green bucket in the garage.
- When the green bucket is full, take it to Resource Recovery. (Currently we keep 2 green buckets and take them when both are full.)



Why I like it: My kitchen garbage can doesn't get smelly. The small container doesn't get smelly before I take it to the garage. The green bucket has an airtight lid, so the garage doesn't get smelly (and in the winter the contents are likely to freeze, so no smell).

Big commercial composters can accept a bigger variety of foods – including meat and dairy products – that one would not want to put in a back-yard composter. Bigger – hotter.

What the City food waste diversion program accepts



YES

Fruit and vegetable / scraps and spoiled

Meat, shellfish, fish

Pasta, bread, cereal

Dairy products, egg shells

Coffee grounds & tea bags

Candies, cookies, & cake

Baking ingredients, herbs, spices

Household plants including soil

Pet food

Floral arrangements (not artificial)

Corn husks and cobs

Old cereal & chips

NO

Plastic of any kind

Styrofoam trays and cups

Aluminum foil

K-cups

Bones

Waxed paper/cardboard

Cooking oil and grease

Animal waste, pet litter, or fur

Diapers

Hair



Food waste – fats, oils and grease (“FOG”)

- Used cooking oil: Resource Recovery Plant will accept up to five gallons of cooking oil at no charge, and it's just 25 cents per gallon after that.
- Ames collects oils and fats from restaurants.
 - Some ends up as biodiesel
 - Some goes through the anaerobic digester at Ames Water Pollution Control (where they also use the digester for some waste that comes as sewage).



London Fatberg

<https://www.cityofames.org/government/departments-divisions-i-z/water-pollution-control/fats-oil-and-grease-fog>

Fats at home

- Fats, oils, and grease can damage to your plumbing and the City sewer system.
- Remove fats, oils, and grease: : Wipe with a paper towel & put into the garbage or pour into a sealable container and place in the garbage.
- Use the garbage disposal as little as possible.
- Don't leave oil in a fryer to reuse.

<https://www.cityofames.org/government/departments-divisions-i-z/water-pollution-control/fats-oil-and-grease-fog>

In Ames –
mixed recycling is offered by some haulers

- This goes to a sorting facility.
- A smaller fraction of the total ends up recycled (cross-contamination), but it is easier for more people to participate in recycling.



Recycling - economics

- It takes resources to sort, collect, and process recycled materials. How is that paid for?
 - **Ideal case:** There is a market for the recycled material, and it will pay enough to cover the cost of recycling.
 - **Still good:** The net cost of recovering the recycled material and getting it to a recycler is less than the cost of incineration and/or landfill.
 - **More challenging:** It costs more to recycle than it does to incinerate or landfill the material, but the net cost is less than most “cost of carbon” estimates (= cost of harm done by burning or landfill).
 - **Worst case:** It is very expensive to recycle.

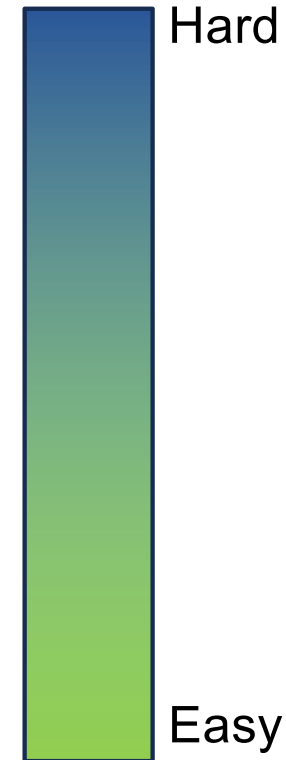


*Can help offset the cost of collection:
Fees for haulers who pick up the recycling.*

Complication: Market prices vary – last year, cardboard ranged from \$0 to \$250/ton, and the price for recycled plastic varies with the price of oil.

The 90% rule

- 10% is easy,
50% is still relatively easy,
90% can be reached with effort, and
100% is nearly impossible.
(Numbers are approximate.)
- Example:
10%: Use smaller paper towels.
50%: Use a reusable sponge or cloth to clean
surfaces, spills.
90%: Reusable paper towels, sponges, and rags
cover most situations where a paper towel
might be used.



Artists can make a difference

- Monitor and reduce your own trash
- Use recycled materials for shipping
- Look for ways to use recycled materials in your art
- Use your problem-solving skills to find ways to encourage use of reusable alternatives (handkerchiefs, napkins, etc.)



“Washed ashore” exhibit, Reiman Gardens, 2017



Conclusions

Minimizing waste is important to reduce greenhouse gas emissions.

- Reduce, re-use, repair, repurpose, recycle, recover ... landfill is the last resort.
- Many options for re-using and recycling in Ames.
- Plastic is hard to recycle – look for alternatives to buying one-time plastic items.

Don't try to be perfect – the 90% rule.

Artists can play a key role in reducing the waste stream.