



# Source Reduction and Waste Minimization Techniques

Virtual INPLT Training

Session 3

Tuesday – May 9, 2023

10:00 am – 12:30 pm EDT

## DOE's Waste Reduction Network:

- Open to all existing Better Plants partners
- Goals are flexible
- Six goal options based on partner feedback
- Quarterly webinars
- Bi-monthly newsletter
- Access to new waste-related tools, trainings and programmatic elements

### Waste Goal Options



# Waste Virtual INPLT Agenda

- **Week 1 (April 25<sup>th</sup>) – Introduction: Waste Diversion and Reduction 101**
- **Week 2 (May 2<sup>nd</sup>) – How to Effectively Track and Measure Your Waste**
- **Week 3 (May 9<sup>th</sup>) – Source Reduction and Waste Minimization Techniques**
- **Week 4 (May 16<sup>th</sup>) – Finding Outlets for Hard to Manage Waste Streams**
- **Week 5 (May 23<sup>rd</sup>) – Construction Waste Management and Green Building Certifications**
- **Week 6 (May 30<sup>th</sup>) – Scope 3 Emission Considerations**
- **Week 7 (June 6<sup>th</sup>) – Implementation of a Waste Diversion Program – Developing a Roadmap to Zero Waste**
- **Week 8 (June 13<sup>th</sup>) – Conclusions, Summaries, and Wrap up Presentations**



# Plan of Action



## Today, we will:

- Review the previous training
- Discuss the homework
- Lecture on today's topic, "Source Reduction and Minimization Techniques"
- Test your knowledge with a Kahoot! quiz
- Conduct a Q&A session

# Takeaways

## Today, you will learn to:

- Reduce and manage waste streams
  - Source reduction techniques and where to apply them
- Identify source reduction opportunities
- Understand the benefits of proposed waste minimization strategies

### Waste Goal Options



# Presenters from Sustainable Solutions Corporation



**Lora Urbaniak, LEED Green Associate**  
Senior Project Manager  
Sustainable Solutions Corporation



**Nick Mummau, LEED Green Associate**  
Project Manager  
Sustainable Solutions Corporation

# Quick Review

## *Remembering Session 2*

# Session 2 Review: What the 9 steps for waste tracking discussed last week?

Please respond the Question in the chat



# Waste Tracking Methodology

Waste tracking can be broken into the following steps:

1. Select a system
2. Delegate responsibility and accountability
3. Gather and input data
4. Validate data
5. Process and review results
6. Conduct an onsite assessment
7. Conduct a waste characterization (recommended)
8. Set realistic goals
9. Review on recurring basis



# Review: How to Effectively Track and Manage Your Waste

- Establish standard procedure for data collection and review
- Develop a system to segregate waste streams results for increased data granularity
- Assess waste onsite utilizing waste assessment and characterization procedure
  - Conduct a site walk-through
  - Understand production process
  - Evaluate onsite waste collection
  - Characterize waste to understand feasible diversion
- Evaluate onsite waste collection strategies

# Homework Discussion

# Homework Takeaways

## Overview

- Identify a process that generates a waste stream and review its end-of-life scenario. Brainstorm some possible solutions to minimizing the waste generation and describe their implementation.

## Takeaways

- Many companies have processes which reuse a waste stream through an in-process recycling procedure
- Everyone who submitted described a possible solution to reducing the waste stream
  - Improvement of training or procedures, increased preventative maintenance, implementation of new process
- Implementation of proposed solutions always involved multiple parties

**Today's Topic:**  
***Source Reduction and  
Waste Minimization Techniques***



**Poll:** From most preferred to least preferred method of diversion, how high on the waste diversion hierarchy is source reduction?

Please respond to the Zoom poll

**Answer:** It's the most preferred.

# Waste Diversion Hierarchy



# Source Reduction Techniques

**Source reduction is the elimination of waste before it is created**

Techniques for source reduction include:

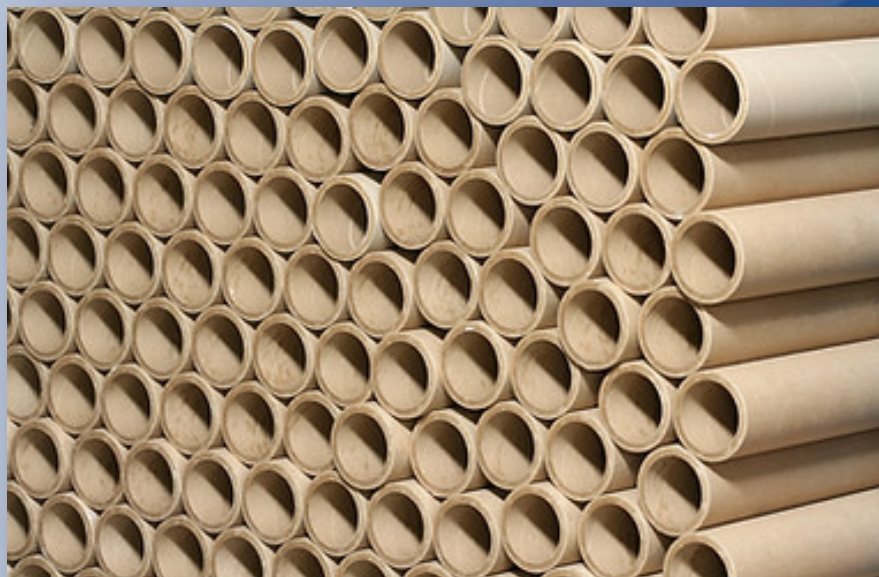
- Supplier takeback programs
- Product enhancement
- Process efficiency improvements
- Material substitution
- Inventory control
- Industrial hygiene
- Preventative maintenance
- In-process recycling

# Source Reduction Targets

Example targets for source reduction are:

- Raw material usage
- Inventory losses
- Spills and releases
- Packaging wastes
- Hazardous and solid wastes





## Supplier Takeback Programs



# Supplier Takeback Program: Supplier Communication

## Strategy

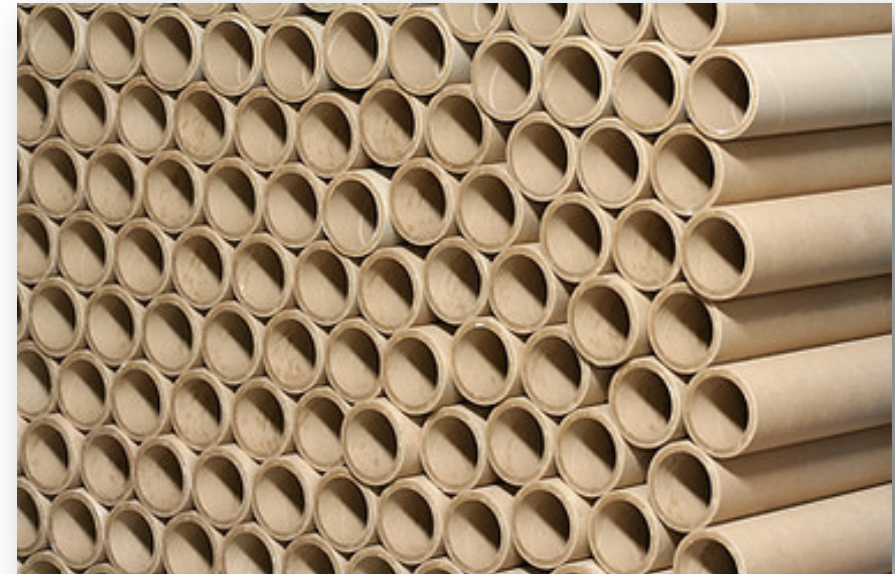
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- Work with suppliers to identify what materials may be returnable
  - Packaging materials
    - Wood or cardboard cores
    - Pallets
    - Totes
    - Foam padding
    - Plastic straps
    - Spools
  - Raw material scraps
- Store materials onsite until there is enough to ship
- Work with suppliers to find strategies to enact returnability

## Applicability

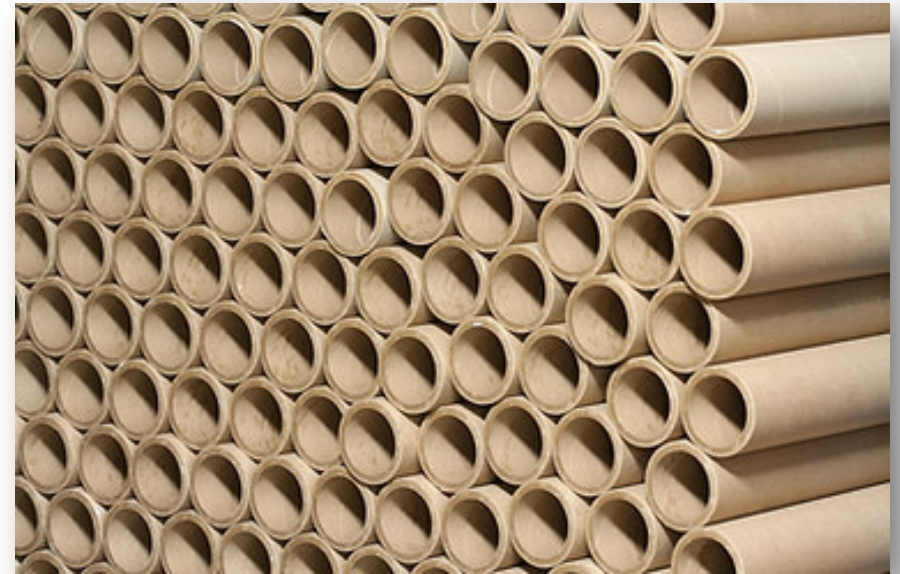
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- Textiles
- Building products



# Supplier Takeback Program: Industry Example

- A textile manufacturer was throwing away tons of cardboard cores per year
- Discussions with the supplier determined that they were returnable if not damaged
- The site stored cardboard cores until a pallet could be filled and were able to ship these back to the supplier, essentially eliminating this waste stream



**Question:** Do any of you engage your suppliers in a takeback programs? If so, what materials?

Please respond to Question in the chat



## Product Enhancement

# Product Enhancement

- Work with research and development teams to minimize raw material use in the product and packaging
- Consider conducting a product mass intensity (PMI) analysis

$$PMI = \frac{\sum \text{mass of materials}}{\text{mass of isolated product}}$$

- Align materials with their process and work to identify improvements



# Product Enhancement: Optimizing Sizes

## Strategy

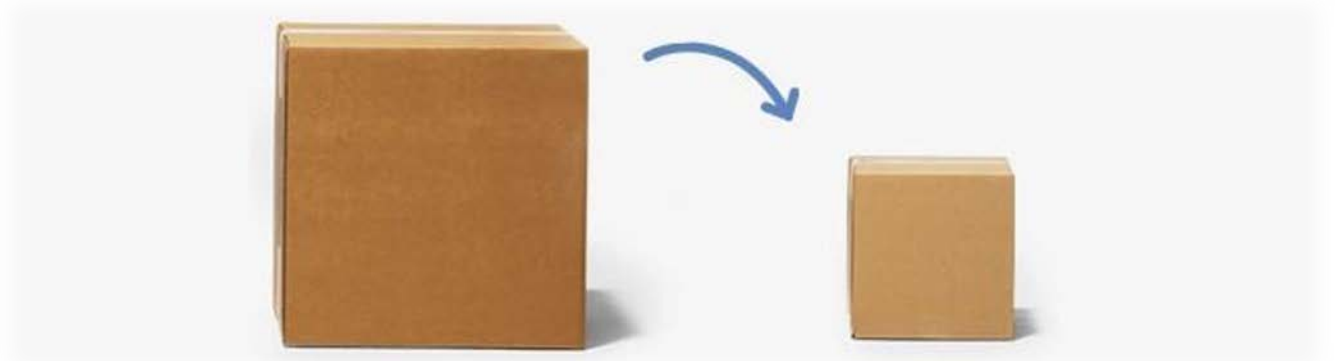
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- Optimize the size of the product or components
- Reduce the use of environmentally harmful materials
- Enhance packaging sizes for products
  - Minimize or eliminate filler materials

## Applicability

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- All industries



# Product Enhancement: Industry Example

## Amazon worked to reduce packaging waste

- Amazon enhanced their packaging, first identifying which products are appropriate for various types of packaging
- Using their findings and adjustments in an algorithm which selects packaging, they “have reduced the use of corrugate boxes by 35% in North America and Europe”



[Amazon article](#)

**Question:** Has anyone enhanced their product to reduce waste? If so, what did you do?

Please respond to Question in the chat



# Process Efficiency Improvements

# Process Efficiency Improvements

Process efficiency is the amount of effort required to make a product



Improvements to process efficiency could be:

- Physical location improvements
- Improved machinery or equipment
- Increasing yield-decreasing waste generated
- Scheduling changes
- Reduce or eliminate startup and shutdown waste



# Process Efficiency Improvements: Raw Materials

## Strategy

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- Institute collection system for spillage during unloading
- Create measurable requirements for raw material use, eliminating operator discretion
- Utilize digital platforms to share materials between sites
- Do not use liners in recycling bins
- Engage laundry service for rags and uniforms

## Applicability

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- Manufacturing
- Offices



# Process Efficiency Improvements: Industry Example

- A manufacturer was losing raw materials during the granule unloading process
  - Adding a boarder around the unloading area blocked granules from dispersing



# Process Efficiency Improvements: Industry Example

## A BMW plant in Germany reduced paint use, operating hours, and carbon emissions by utilizing a robotic painting system

- Increased precisions allows designs to be applied without stencils or masking the vehicle
- Reductions in overspray chemicals and compressed air required have resulted in over 7,000 operating hours
  - This resulted in a reduction of 2,000 tons per year from the carbon footprint



[Article Source](#)

# Process Efficiency Improvements: Production Waste

## Strategy

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- Eliminate startup and shutdown waste
  - Feed damaged or unusable raw materials
- Install guards or covers on production lines
- Upgrade equipment to reduce waste generated
- Limit rework
  - Institute increased quality checks
  - Install automated sensors and monitoring where feasible

## Applicability

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- Manufacturing





# Process Efficiency Improvements: Industry Example

- A rice mill was losing 1% of their final product due to a shaker filter process
  - Adding a cover to this process eliminated this waste stream





# Process Efficiency Improvements: Industry Example

- A food manufacturer was disposing of over 100 lb. of product per batch due to issues with consistency
- This waste was equal to over \$150,000 annually in final product
- Installing a valve at the packaging line to remove water from the product prior to packaging eliminated this waste stream



# Process Efficiency Improvements: Chemical Use

## Strategy

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- Reduce evaporative loss in heated tanks for material or product treatment by installing hard or flexible covers
- Avoid unnecessary changes or replacement of chemicals by installing pH sensors or conductivity meters

## Applicability

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- Steel manufacturing
- Textiles
- Aerospace



# Process Efficiency Improvements: Industry Example

- A manufacturer installed conductivity meters on their chemical tanks for metal treatment
- The meters resulted in over a 50% reduction in water treated along with reduced chemical use and generation of hazardous wastewater sludge



**Question:** Has anyone improved a process onsite to be more efficient, thus reducing waste? If so, what did you do?

Please respond to Question in the chat





## Material Substitution



# Material Substitution

**Raw material substitution is the replacement of materials with those which will produce less waste**

Some examples include:

- Using fewer toxic alternatives to achieve the same result
- Identify materials from one waste stream that could be used in place of a raw material
- Using raw materials which have a longer lifespan



# Material Substitution: Breakrooms

## Strategy

- Reusable cutlery
- Dishes and glasses
- Reusable takeout containers
  - Some places will allow you to use your own
- Coffee makers that are bean-to-cup coffee or utilize coffee grounds rather than single use pods
- Do not provide individual beverages at catered events
- Do not provide individual condiment packets

## Applicability

- All industries



# Material Substitution: Industry Example

- Bridgestone is developing guayule shrub as commercially viable source of rubber
- Ford uses discarded tires for the seals and gaskets of new vehicles

[Bridgestone Article](#)

[Ford Article](#)



**Question:** Have any of your company's substituted materials before, reducing waste onsite? If so, what did you do?

Please respond to Question in the chat





# Inventory Control



# Inventory Control

## Inventory control relates to active monitoring, organization, and material selection

- Buy and use only what you need
- Use the first in-first out approach
- Limit variety so that unused materials can be used elsewhere
- Separate reusable from recyclable waste
- Monitor shelf-life
- Extend shelf-life where feasible
- Establish overflow database and communication between facilities
- Sell defect products at a discount to distributors



# Inventory Control: Optimize Purchased Materials

## Strategy

- Work with suppliers to ship in larger quantities
- Install silos or holding tanks onsite to hold raw materials
- Coordinate supplies between buildings or sites
- Purchase in lower quantities to reduce spoilage

## Applicability

- All industries



# Inventory Control: Industry Example

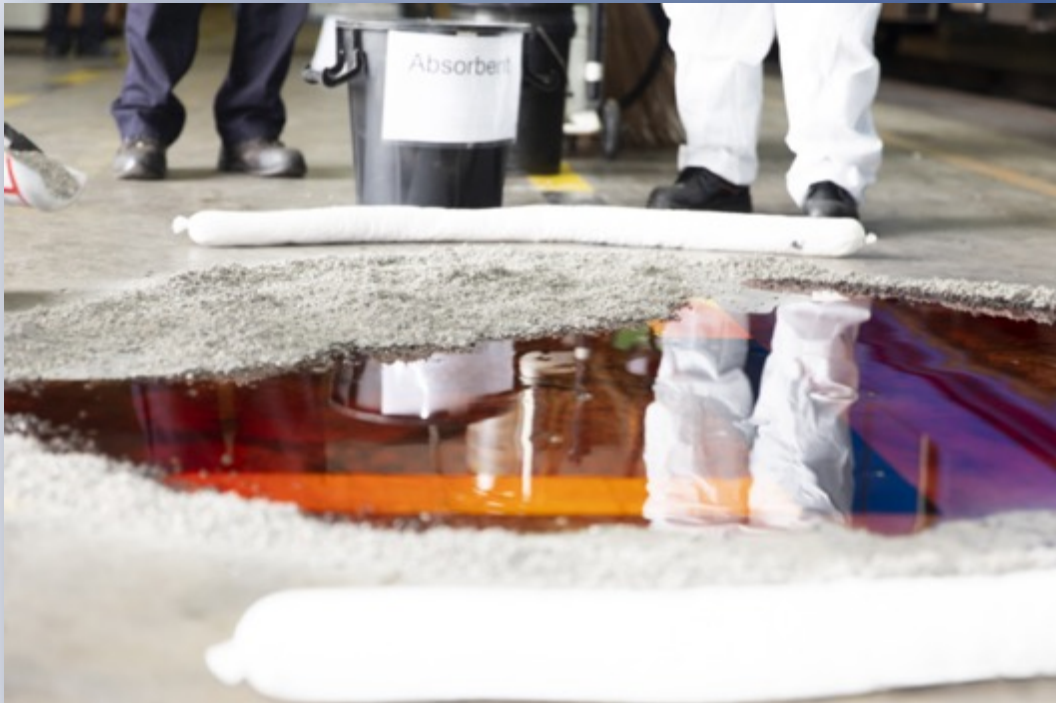
- A manufacturer was purchasing over 500 totes of a raw material per year
- Installing a holding tank would divert over 25 tons of waste from landfill annually



**Question:** Has anyone assessed inventory control to reduce waste onsite? If so, what did you find could be done?

Please respond to Question in the chat





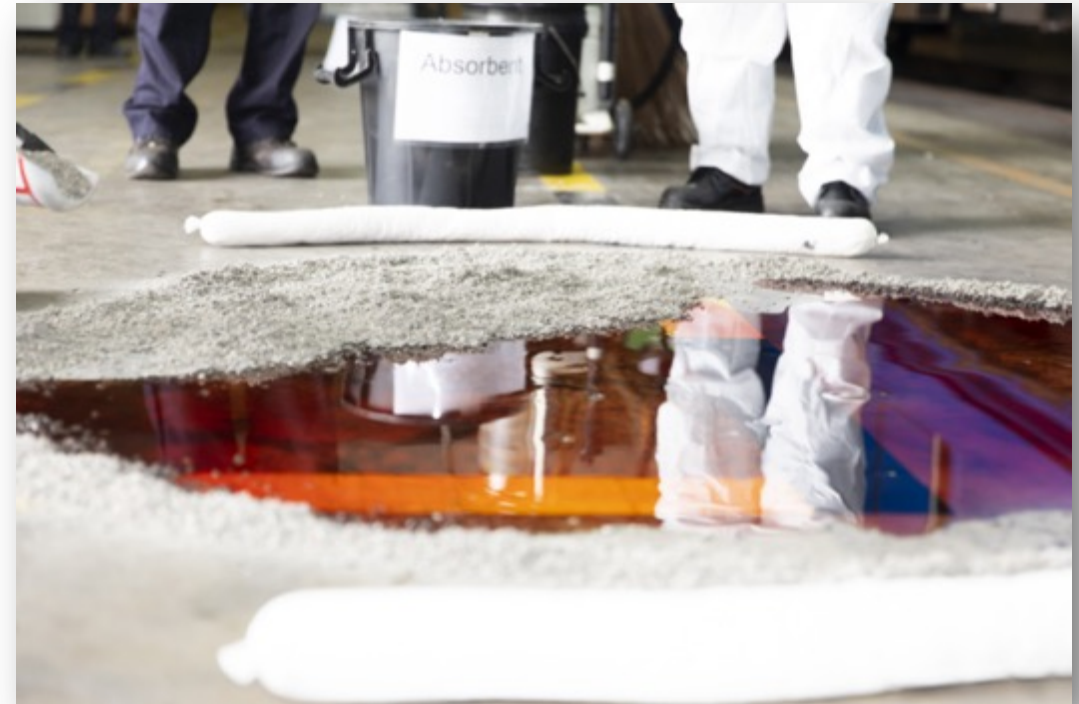
# Industrial Hygiene



# Industrial Hygiene

## Industrial hygiene can assist with managing wastes and reducing unplanned waste streams

- Do not mix wastes
- Keep areas clean
- Minimize spills
- Reduce waste streams onsite
- Conduct a training for employees on waste segregation, handling, and diversion



# Industrial Hygiene : Hazardous Waste

## Strategy

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- Do not mix hazardous and non-hazardous wastes
  - Increase sampling of waste streams to ensure segregation
- Empty hazardous wastes out of individual containers into one larger communal
  - Cleaning original containers will prevent them from being hazardous waste

## Applicability

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- Manufacturing
- Pharmaceutical



### Example:

Do not dispose of rags used for general cleaning in the same bin as those contaminated with hazardous waste. This will increase the volume of the hazardous waste stream and increase treatment fees

# Industrial Hygiene : Industry Example

- A manufacturer was disposing of all rags in the same bin, whether they were hazardous or not
- This increased the volume of the hazardous waste stream and increased treatment fees



# Industrial Hygiene: Industry Example

- A manufacturer was a large quantity generator of hazardous waste due to their hazardous paint waste
- Processing this waste paint into pucks and grease cleaner significantly reduced their waste weight and volume
  - Grease cleaner could be used elsewhere onsite
  - This process reduced them from a large quantity generator to a small quantity



**Question:** What are some housekeeping strategies you employ onsite to reduce waste generated?

Please respond to Question in the chat





## Preventative Maintenance

# Preventative Maintenance

**Assists with limiting costly or unplanned equipment failures which could lead to downtime or production wastes**

- Adhere to maintenance schedules
- Minimize leaks from piping and equipment
- Look for opportunities to reduce wastes associated with maintenance, plant outages, and unit overhauls
- Keep an up-to-date maintenance log



# Preventative Maintenance: Industry Example

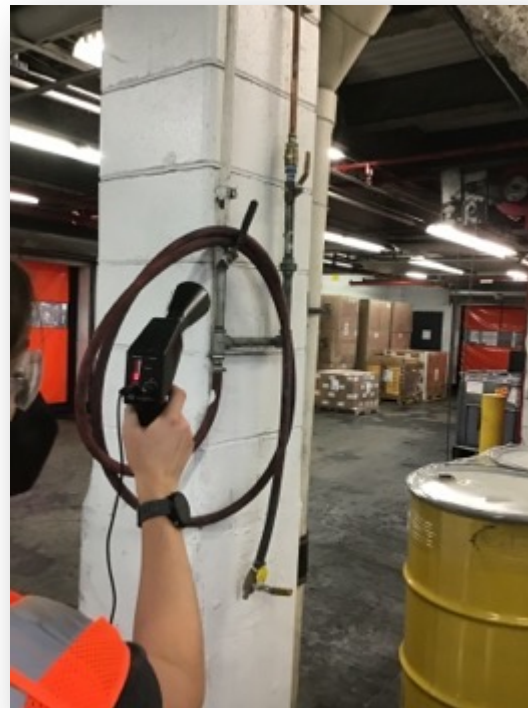
- A chemical manufacturer had a leak in a piece of equipment which would cost them \$3.50 per gallon in materials and another 11 cents per gallon in wastewater costs
- A 50-gallon leak once a shift for a year would over \$100,000





# Preventative Maintenance: Industry Example

**Maintenance issues increase waste and may require significantly more materials and resources to address**



**Question:** Are there pieces of equipment or processes that undergo specific preventative maintenance? If so, what are they and what does this PM help reduce?

Please respond to Question in the chat





## In-Process Recycling

# In-Process Recycling

## Process of capturing waste for reuse before it goes to a MMO

- The feasibility of in-process recycling is highly dependent on the manufacturing process and the product(s) being created
- Look for opportunities to institute a closed loop system to capture and recycle materials



# In-Process Recycling: Closed Loop Design Considerations



## Closed Loop (Cradle-to-Cradle) Design:

- Closing the loop is the process of collecting end-of-life or scrap products and materials and recycling them back into the same or equal products
- Using a closed loop process not only reduces the amount of waste going to a landfill but also saves significant resources and energy
- Sustainable Product Innovation can facilitate the design of more closed-loop and reusable products



# In-Process Recycling: Raw Materials

## Strategy

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- Collect products that do not meet specifications for remelting or regrinding
- Create customer takeback program
- Capture grindings, trimmings, shavings, or dust for remelting

## Applicability

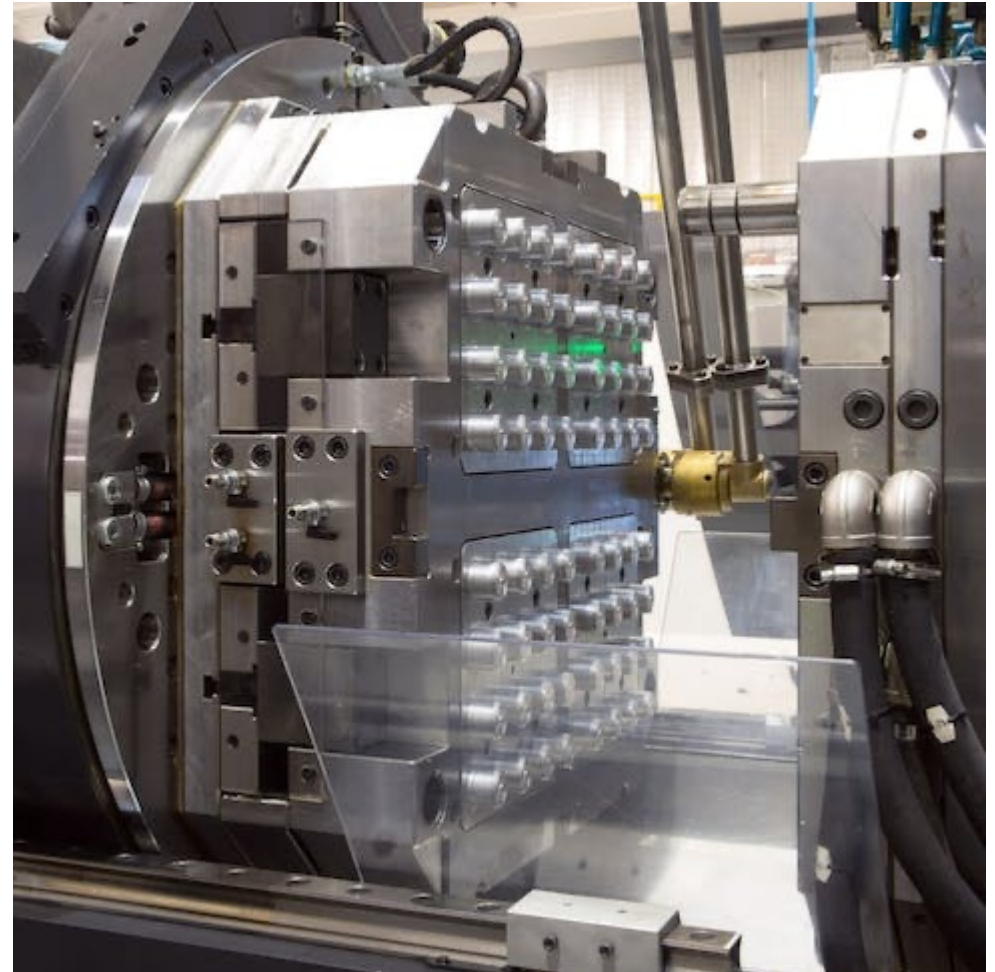
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- Manufacturing
  - Steel
  - Building products
  - Packaging – bottles



# In-Process Recycling: Industry Example

- An injection mold had brackets which needed broken off at the end of the line
- Brackets are reground and remelted with raw materials
  - Imperfect products are also reground and remelted





**Question:** Does anyone have a process that currently has in-process recycling or possibly could in the future? If so, what is it?

Please respond to Question in the chat

**Poll:** Which of the following is not a source reduction technique?

Please respond to the Zoom poll

**Answer:** Increase purchasing frequency.

# Identifying Source Reduction Opportunities

# Data Review

- Review data to search for:
  - Waste streams with large volumes or disposal costs
  - Raw materials that end up in waste streams and their costs
  - Trends related to certain production processes or products

# Onsite Assessment

## Recall strategies and processes from Session 2

- Prepare for the site assessment
- Walk through the facility evaluating manufacturing processes and procedures
- Identify where and how waste is being generated
- Conduct additional analyses as needed





# Evaluating Opportunities

- After an onsite assessment, compile findings and begin assessing source reduction opportunities
- Consider the following:
  - What processes or procedures need to change to minimize waste?
  - What personnel need to be involved?
  - Which opportunities will yield the largest or most important results?
  - Does a product or process redesign need to occur?
  - Does there need to be any external coordination?

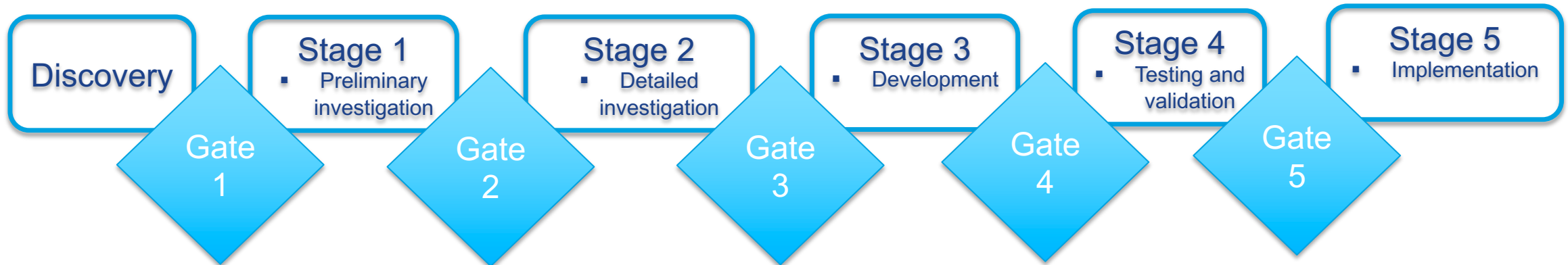
# Utilizing Familiar Strategies

## Waste can be part of the discussion for product innovation

- Understand where waste is generated and how
  - What stages and processes of the production process
    - Feeding or mixing raw materials
    - Treatment, product movement, adding in more materials, trimming, etc.
    - Final specification review and packaging
- Determine what can change to reduce or eliminate waste
  - Utilize source reduction strategies in the conversation
  - Focus on high-cost raw materials or difficult to divert waste streams first

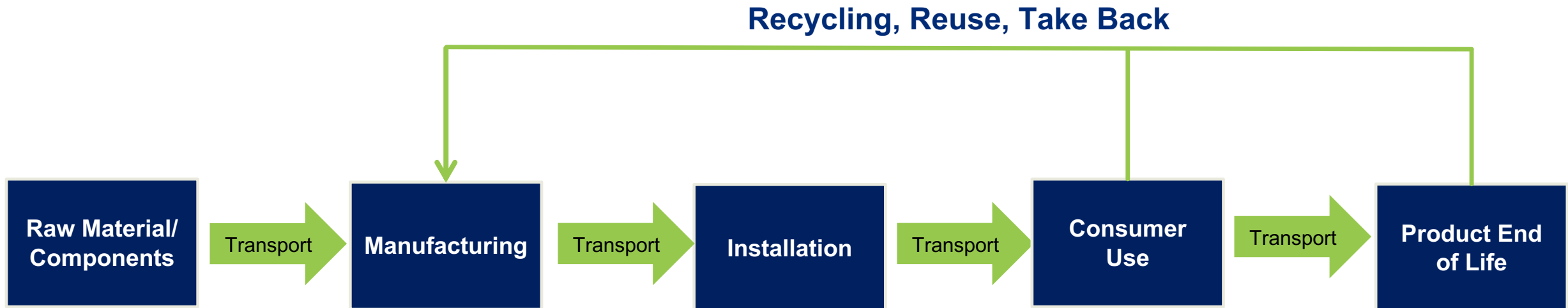
# The Stage Gate Process

- The Stage Gate process is used for:
  - New product development
  - Optimization of an existing product
  - Enhancement of a production process

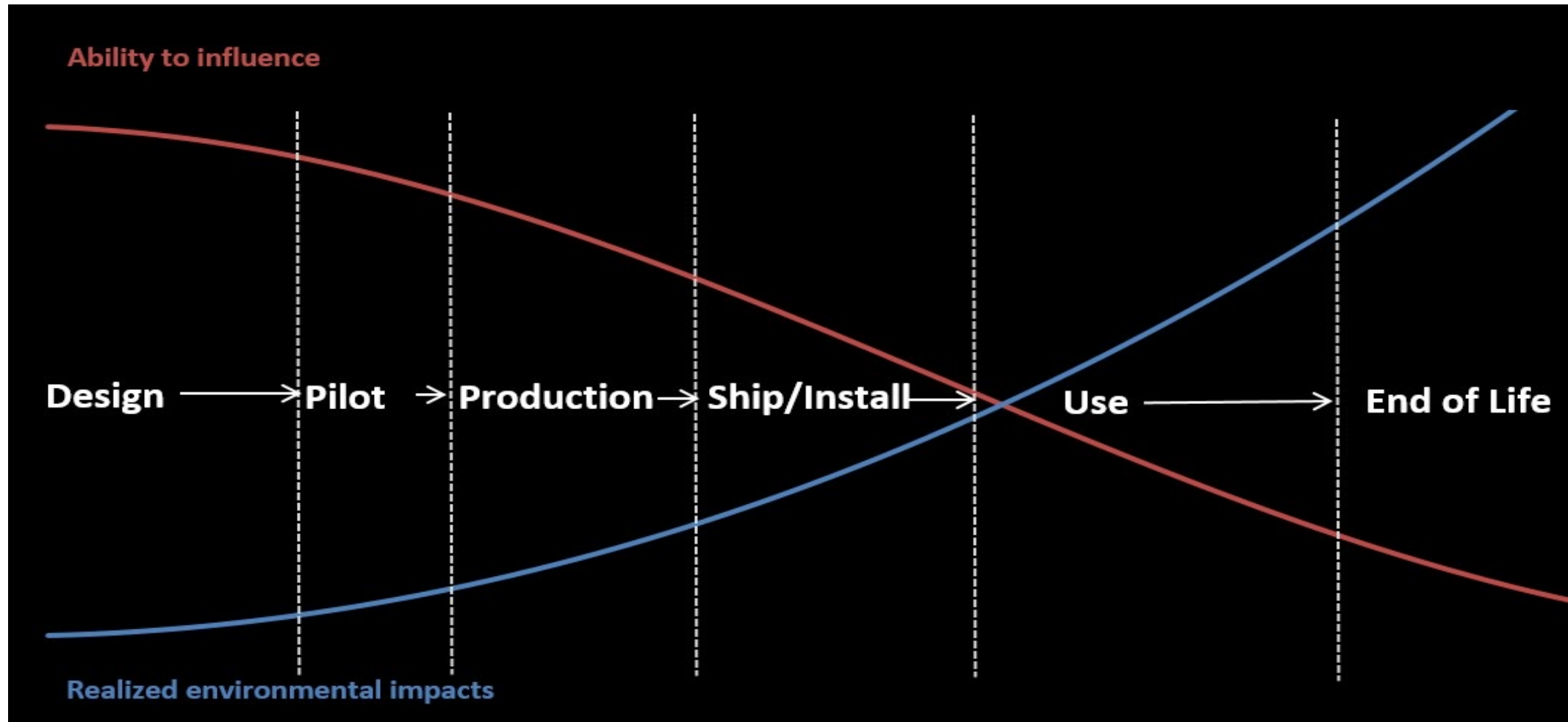


# Sustainable Product Innovation

- Integration of sustainability reduces the impacts of the product in all life cycle stages with a goal of improving long-term competitive advantage



# Influence Versus Realized Environmental Impacts





# Benefits of Waste Reduction and Minimization

# Benefits to Waste Minimization

- Reduces disposal and management costs
- Improves worker health and safety
- Reduces impacts of regulatory requirements
- Minimizes potential environmental liability
- Reduces company emissions
- Demonstrates environmental leadership to stakeholders
- Improves public image

# Reduced Disposal and Management Costs

- Less waste will equal less hauling which results in lower costs
- Additional strategies:
  - Compacting and baling
  - Segregating waste streams to eliminate charges based on minimum weight
  - Single stream recycling



# Improved Worker Health and Safety



- Reduced material handling
  - Limiting disposal of expired materials
  - Less handling of more impactful materials such as chemicals and hazardous wastes
- Less waste onsite
- Waste can stay cleaner when segregated well



A close-up photograph of a person's hands writing on a document with a blue pen. The person is wearing a watch on their left wrist. The document has some blue and green markings. The background is blurred, showing other people and documents.

## Minimizes Impacts of Regulatory Requirements

- Transition from large quantity generator to small
- Reduced risk of onsite spills and environmental fines
- Less paperwork
- Reduced future liability for methane emissions

# Reduces Company Emissions

- Less waste = less emissions
  - Scope 1
    - Onsite water treatment
    - Onsite vehicle use
      - Material handling and transport
  - Scope 3
    - Supply chain
    - Waste transport
    - End-of-life



# Benefits to Waste Minimization and Diversion – Industry Example

- Sprint, a participant in the DOE's [Waste Reduction Pilot](#), executed a company pilot program from 2010-2014 with goals to reduce waste to landfill by 30%
- Results of the program included
  - Increased recycling rate from 23% to 46%
  - Decrease in annual waste cost per square foot from \$0.283 to \$0.164
  - Diverting more than 175 million lb of e-waste from landfill in 2013, saving an estimated \$275 million for the company
- As part of the program, Sprint established steps for waste profile analysis, diversion strategies for the company, and steps for program implementation

[Sprint's Waste Pilot Achievements](#)

**Poll:** Which of the following is not a potential benefit of waste minimization and diversion?

Please respond to the Zoom poll

**Answer:** None of the above.

# Closing Remarks



- Reduce and manage waste streams
  - Source reduction techniques and where to apply them
- Identify source reduction opportunities
- Understand the benefits of proposed waste minimization strategies
- Homework!
- Next training:
  - Finding outlets for hard to manage waste streams
  - May 16, 2023



# Homework Overview

- Homework will:
  - Engage participants in the topics to be discussed in the following session
  - Serve as a guide for waste diversion and minimization
- If a homework is completed, please send to presenter, Nick, at [nick@sustainable-solutions.com](mailto:nick@sustainable-solutions.com)
  - Please use the subject “Better Plants Session # Homework: Complete – Company Name”
  - Participants will be asked to share their learnings and experiences in session 8, and if you would like to participate in this, please reach out to Nick

# Homework Overview – Session 3

## Assignment

1. Review the waste streams generated at the facility and determine which of these streams are considered hard to manage or difficult to divert.
2. Describe what makes this stream(s) difficult to manage or why it is hard to divert. Is it difficult to handle, is there a large volume, are there no outlets in the areas, are you unaware of any outlets anywhere or other uses for the waste?
3. Based on the response to Question 2, determine what it would take for the waste stream(s) to be easier to manage or divert?
4. Reflecting on the response to Question 3, is there anything the site can do to make the waste stream(s) more manageable or divertible? Do streams need to be segregated better, does waste need to be broken down further, does there need to be time dedicated to outlet identification and correspondence?

## Goal

- Identify hard to manage waste streams onsite and understand what makes them difficult to manage
- Begin understanding what steps need to be taken to make a waste stream easier to manage

# Kahoot!

Quiz link:

# Q&A