



# Arizona Forward

Emerging Sustainability Leaders

Circular Economy Session

March 25, 2022

# Today's Agenda

- Welcome & Introductions
- Arizona Forward Circular Economy Vision and Goals
- Understanding the Linear Economy & Current Issues
- Introduction to Systems Thinking
- Group Activity Part 1
- NGTS Tour
- Current State of Waste Management Systems
- Circular Economy Overview
- Group Activity Part 2
- Wrap Up & Lunch

# Circular Economy Vision

Arizona is recognized nationally for valuing its materials through the development of a circular economy driven by local reuse, recycling, recovery and sustainable manufacturing markets, which improves the environmental, economic and social health of the communities in Arizona.

# Circular Economy Goals

## Goal Area 1: Reduce

Goal A – Product Design and Manufacturing

Goal B – Zero Waste Vision: Education and Behavior Change

## Goal Area 2: Reuse and Repair

Goal A – Product Reuse and Remanufacturing

Goal B – Product Repair

## Goals Area 3: Recover and Recycle

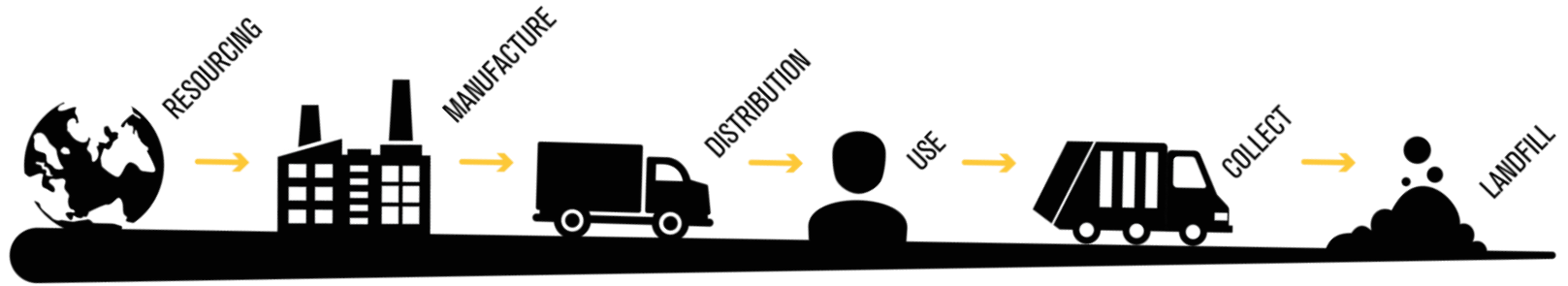
Goal A – Product End of Life Management

Goal B – Local Circular Economy Development

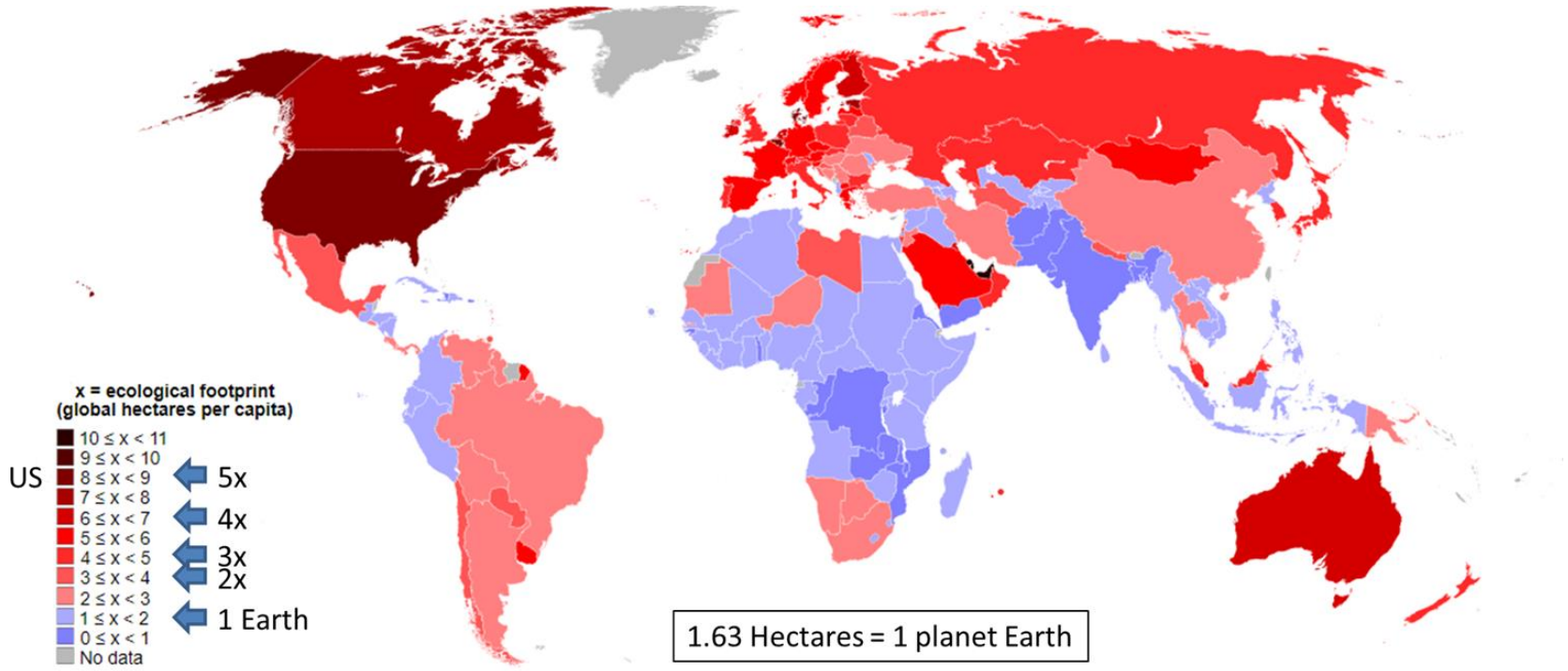
# **Understanding the Linear Economy & Current Issues**

# Linear Economy

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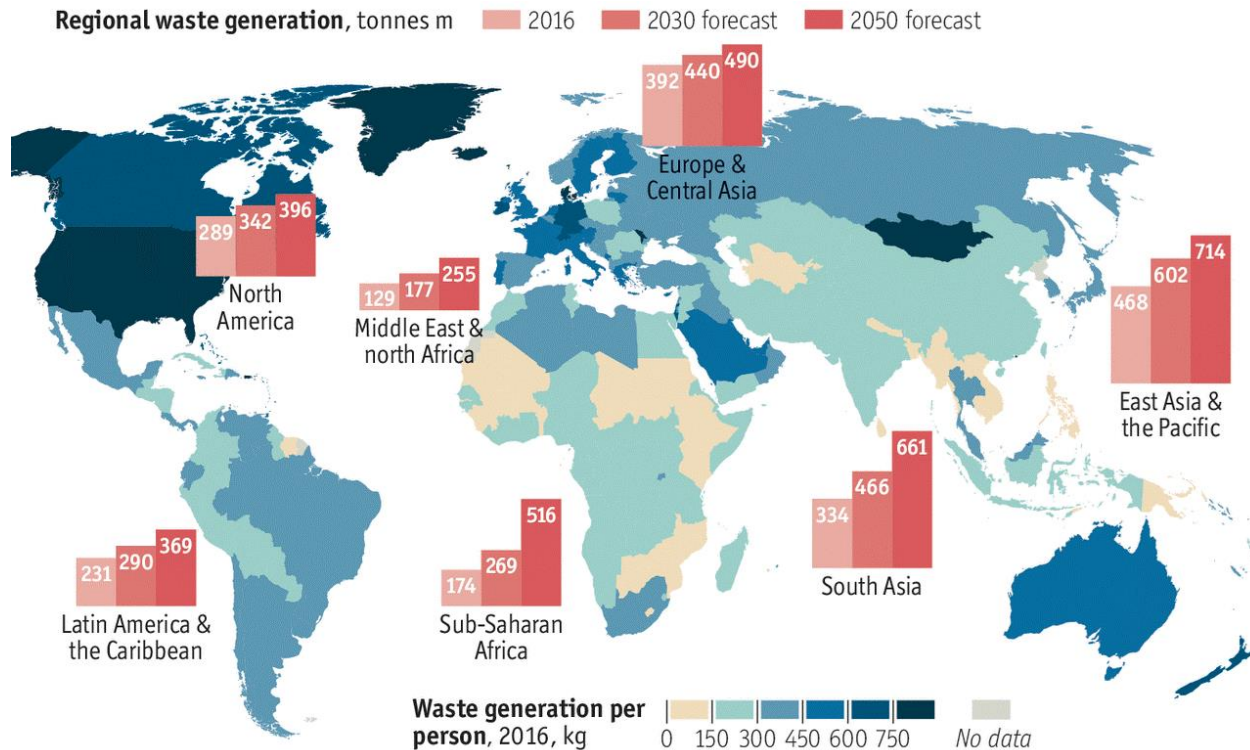


# Worldwide Map of Global Consumption



# Global Waste Generation Per Person

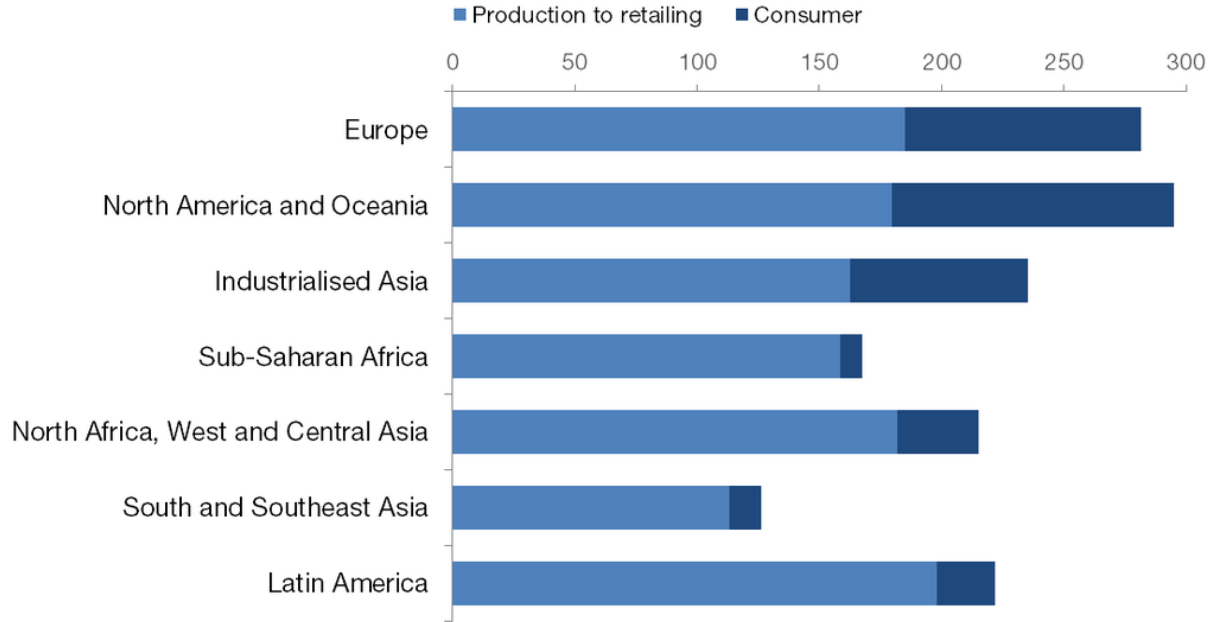
Throwaway World



# Global Wastes: Food

## Which regions waste the most food?

Per capita food losses and waste, kg/year



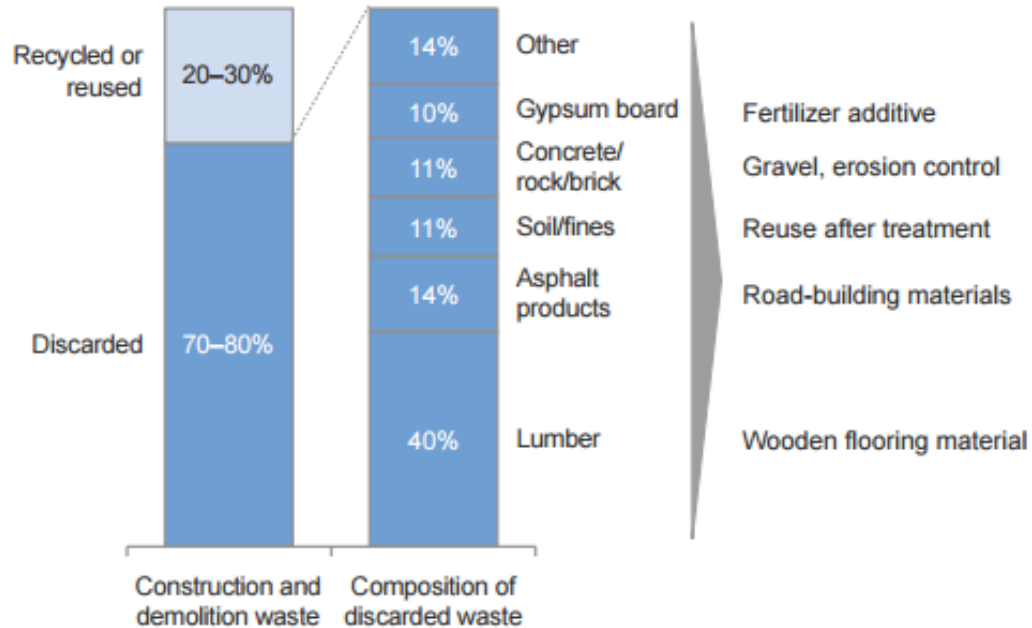
Source: World Economic Forum; The Food and Agriculture Organization of the United Nations (FAO)



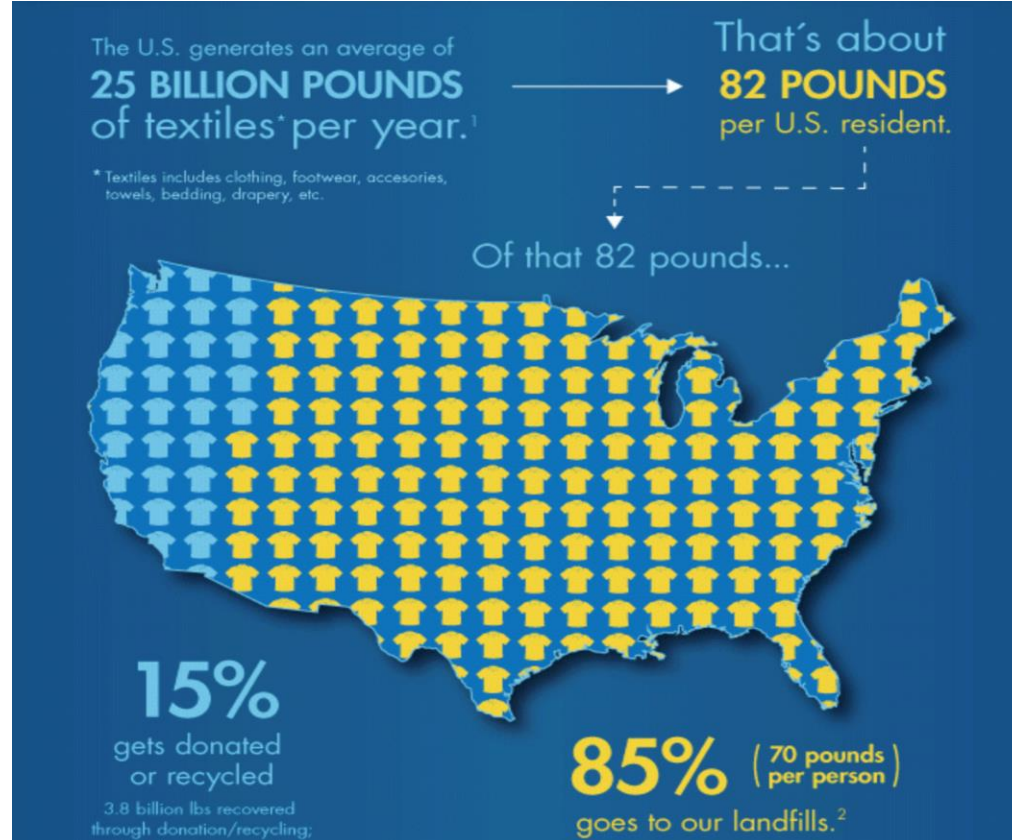
# Construction & Demolition

Less than one-third  
of construction and demolition waste is currently  
recovered

Much discarded material  
could be recovered – for  
purposes of



# U.S. Textiles, Apparel and Fibers Waste



Source: <https://harmony1.com/textile-waste-infographic>

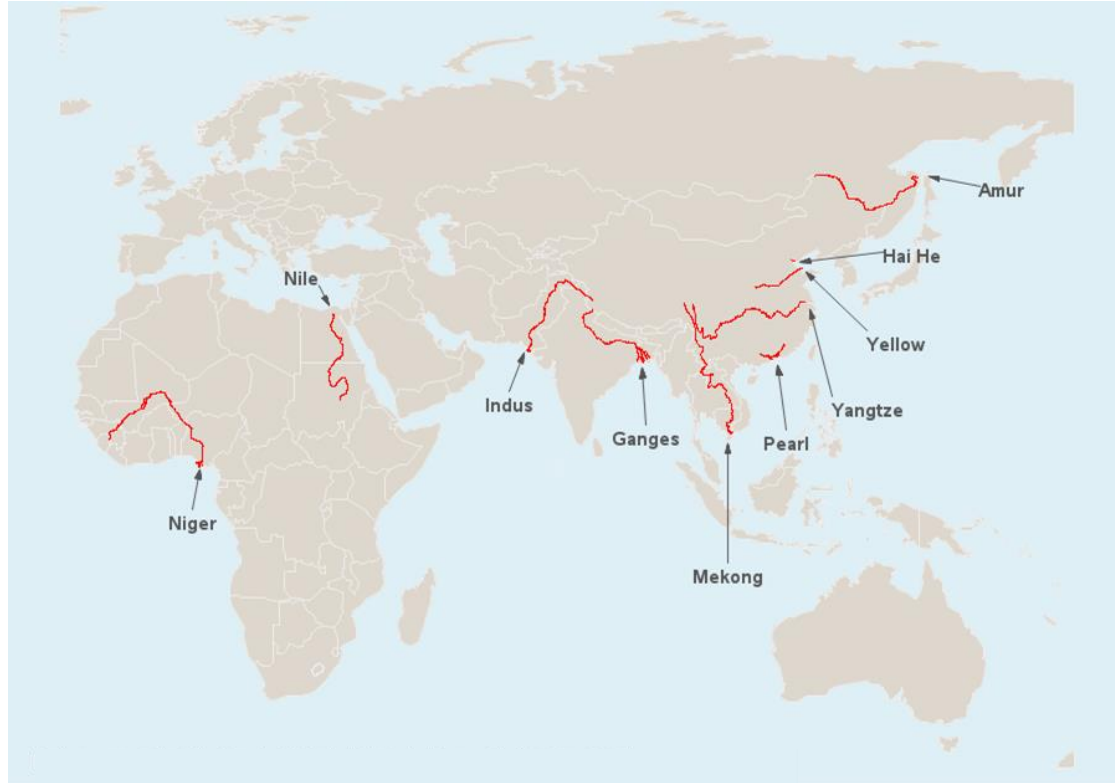


# Electronic Waste Trajectory



# Plastic Waste: Polluting Rivers

95% of plastic polluting the world's oceans comes from these 10 rivers



Source: Schmidt, Export of Plastic Debris by Rivers into the Sea (2017)

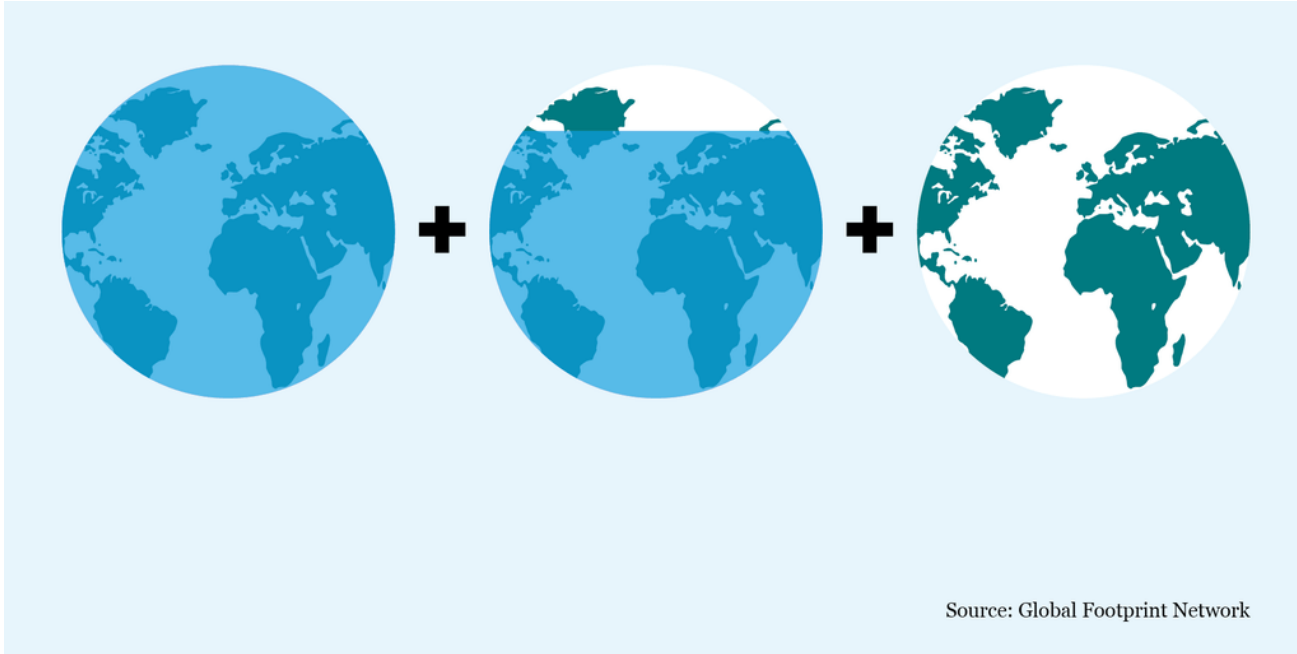




**100 billion tons of resources  
consumed today**

**218.5 billion tons by 2050**

**1.7 earths, unless things change, we'll need 3 by 2050**



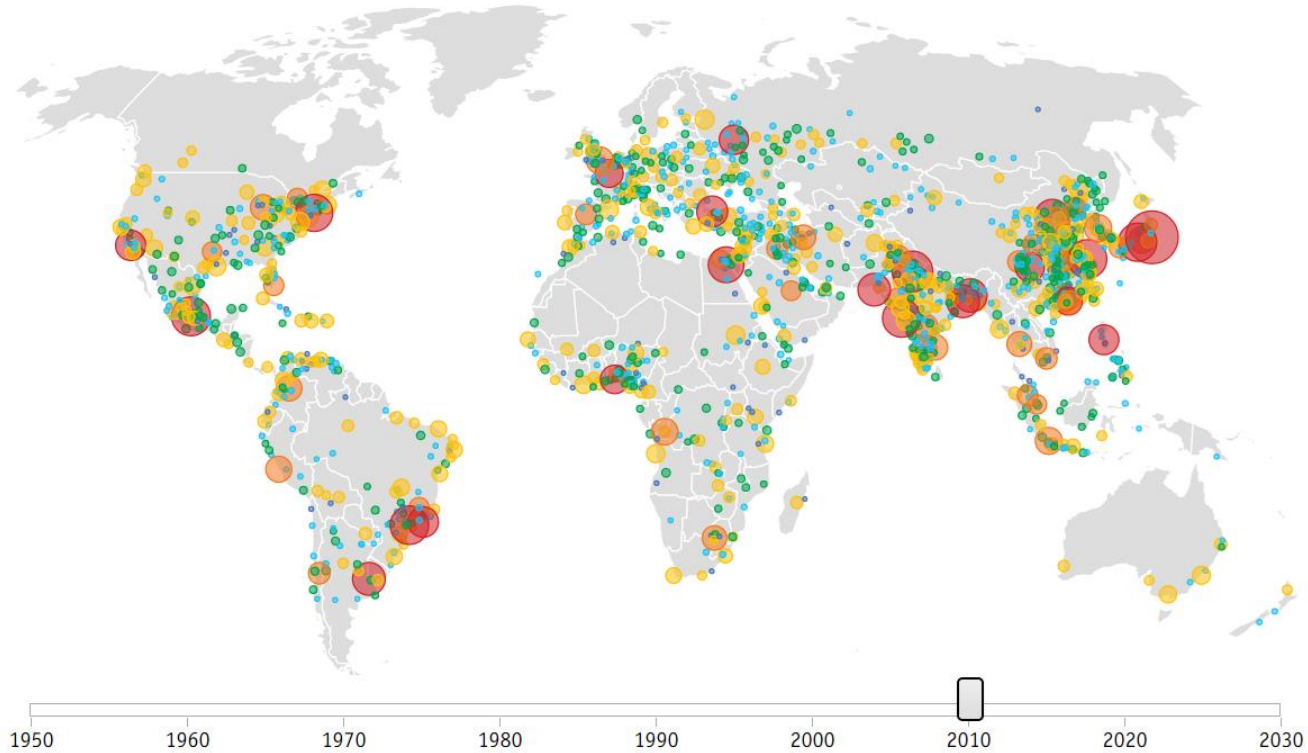
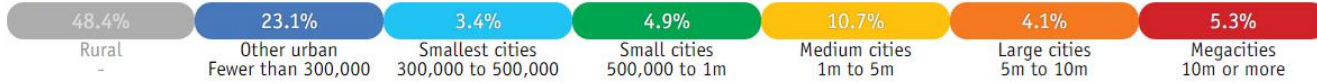
**2 billion tons of MSW today and 3.4 billion tons by 2050**



**150 million tons of plastic in oceans today,  
10 million tons enters every year,  
1 garbage truck per minute**

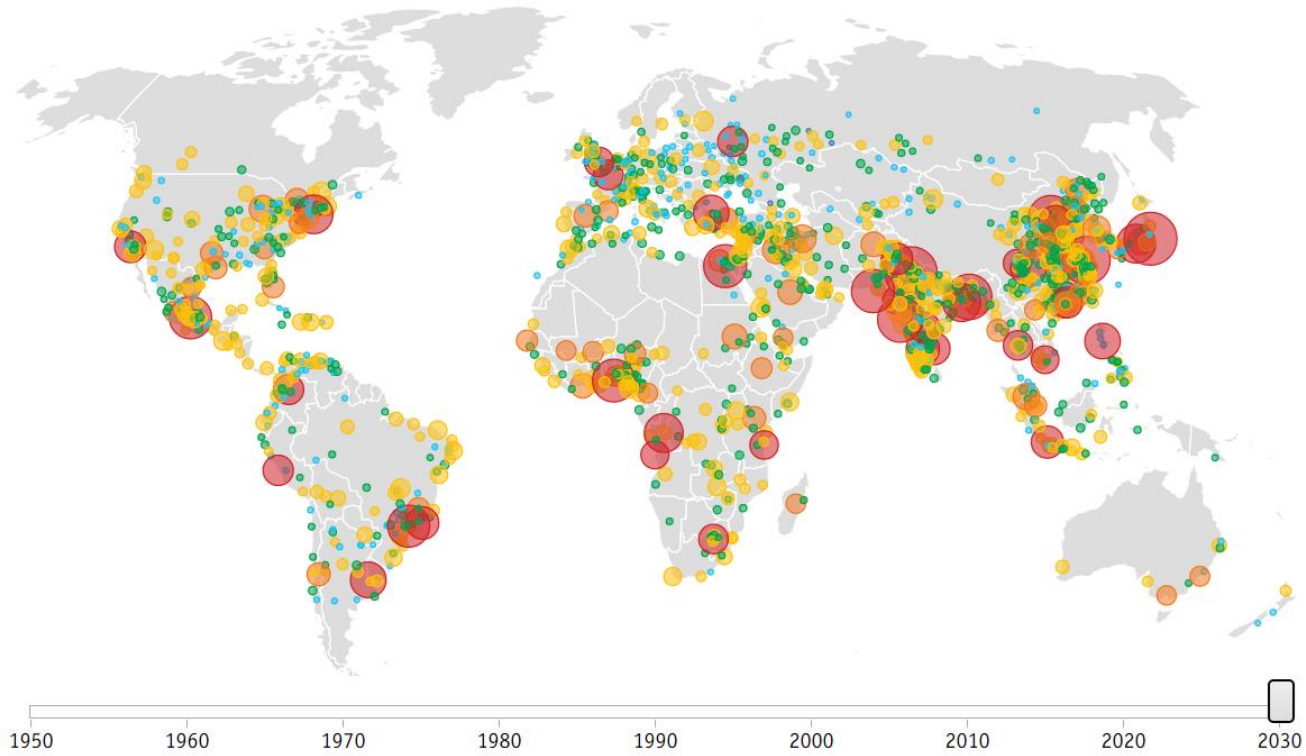
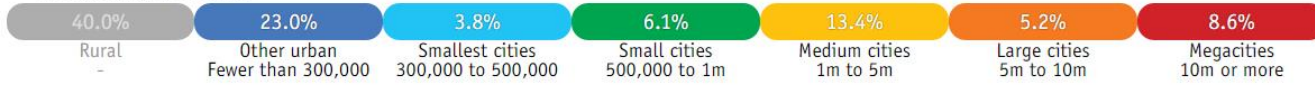


GLOBAL CITY POPULATIONS\*



Source: <http://www.economist.com/node/21642053>

GLOBAL CITY POPULATIONS\*

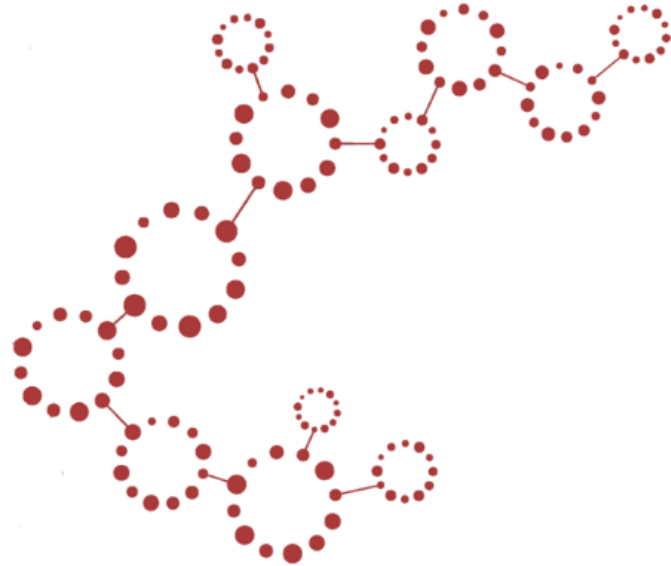


Source: <http://www.economist.com/node/21642053>

# **Introduction to Systems Thinking**

# Guiding Questions:

- What is a system?
- What is systems thinking?
- Why is systems thinking important?



# What Is a System?

A set of interconnected parts forming a whole that work together to achieve something.

**Parts**

**Relationships**

**Organization**

**Boundary**

*“The whole is greater than the sum of its parts”*

—Aristotle



# What Is Systems Thinking?

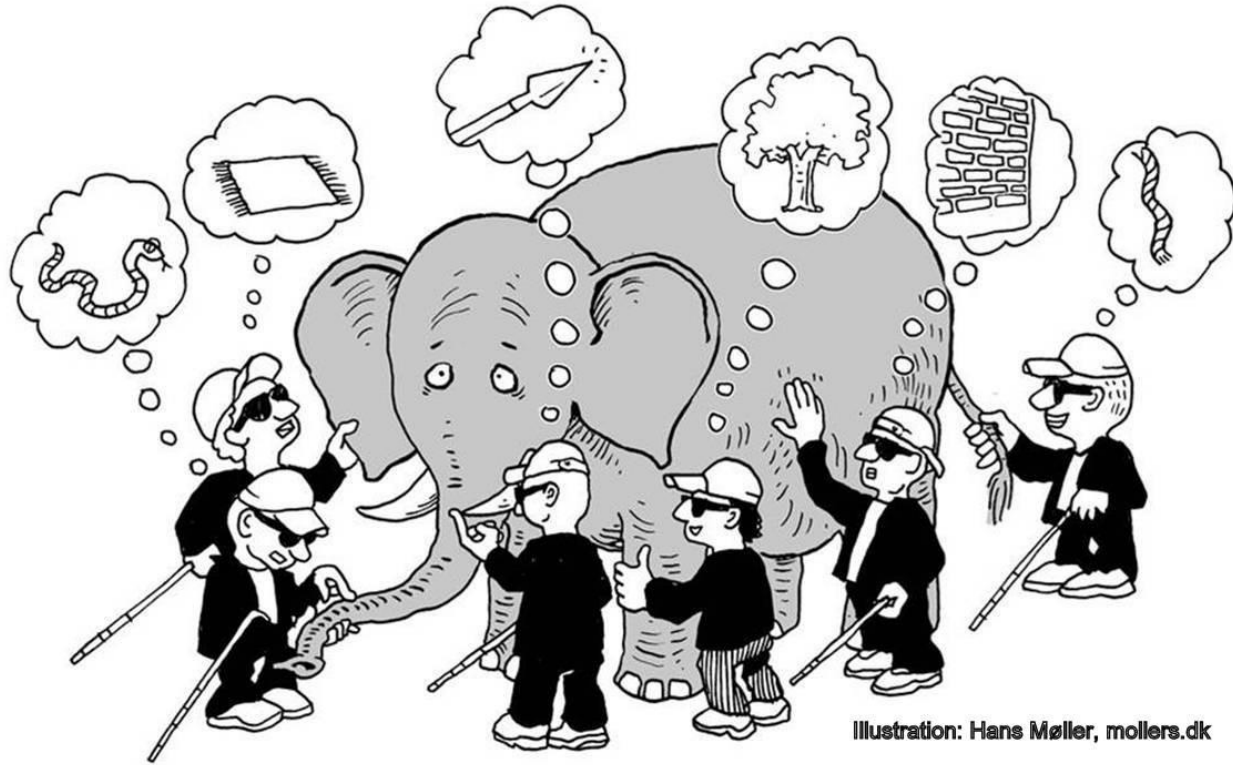
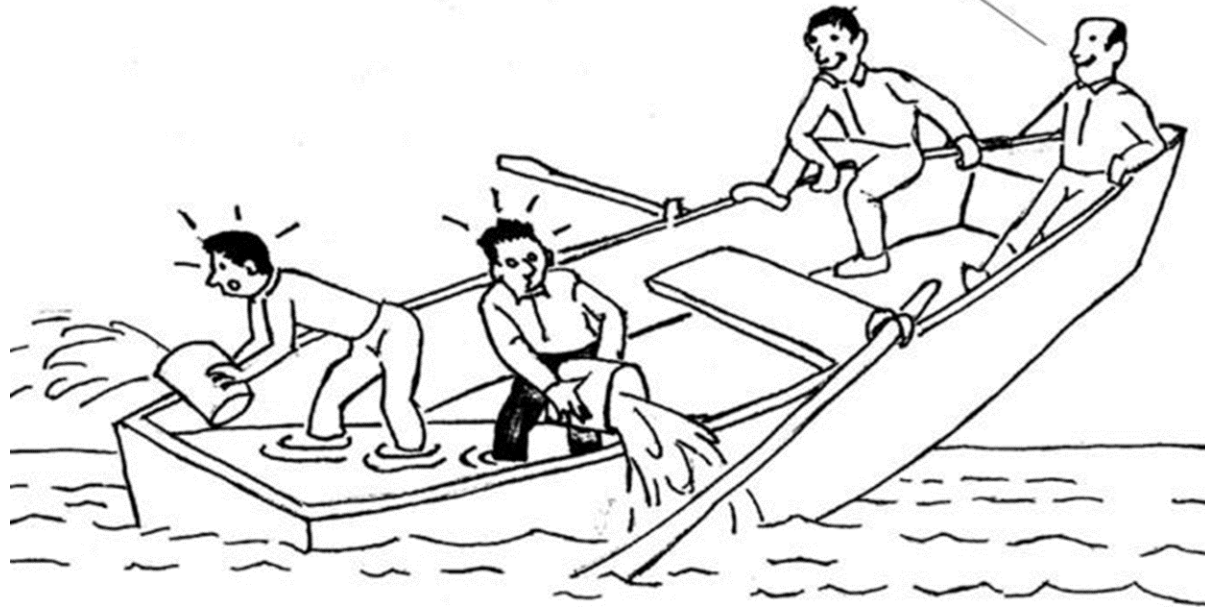


Illustration: Hans Møller, molers.dk



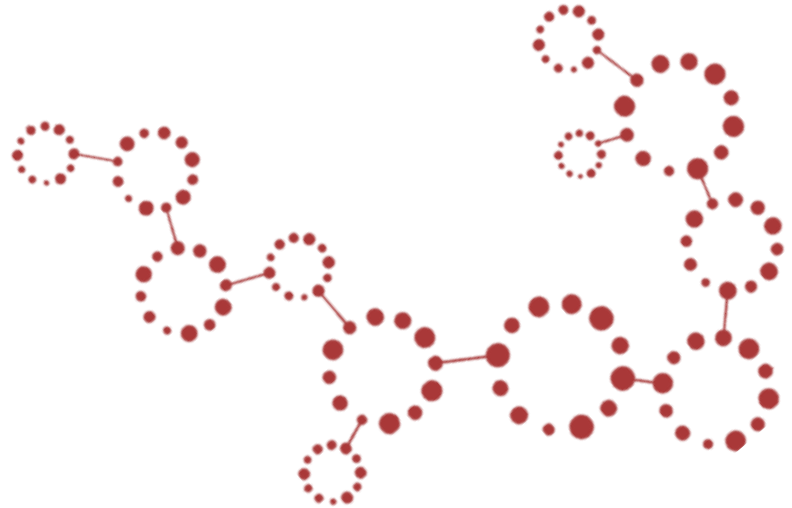
# Systems Thinking and Business

Sure glad the hole isn't at our end.

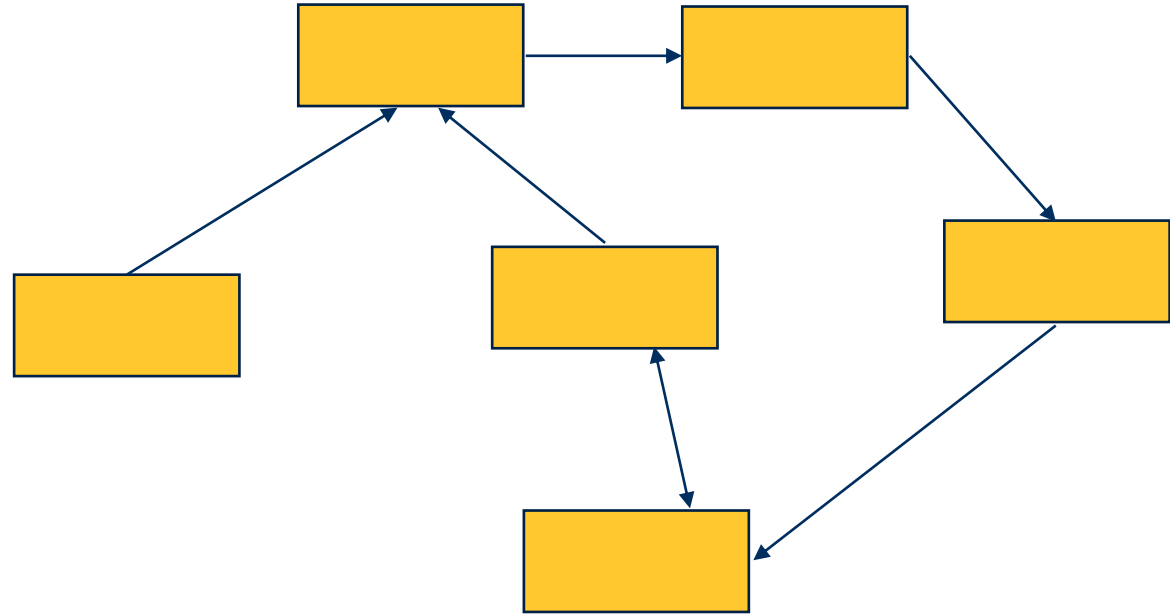


# So then...systems thinking?

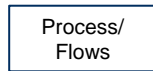
- **Not individual, but rather as part of something bigger**
- **An intentional process: cause and effect**
- **Systems thinking is the mental discipline for sustainability practice**



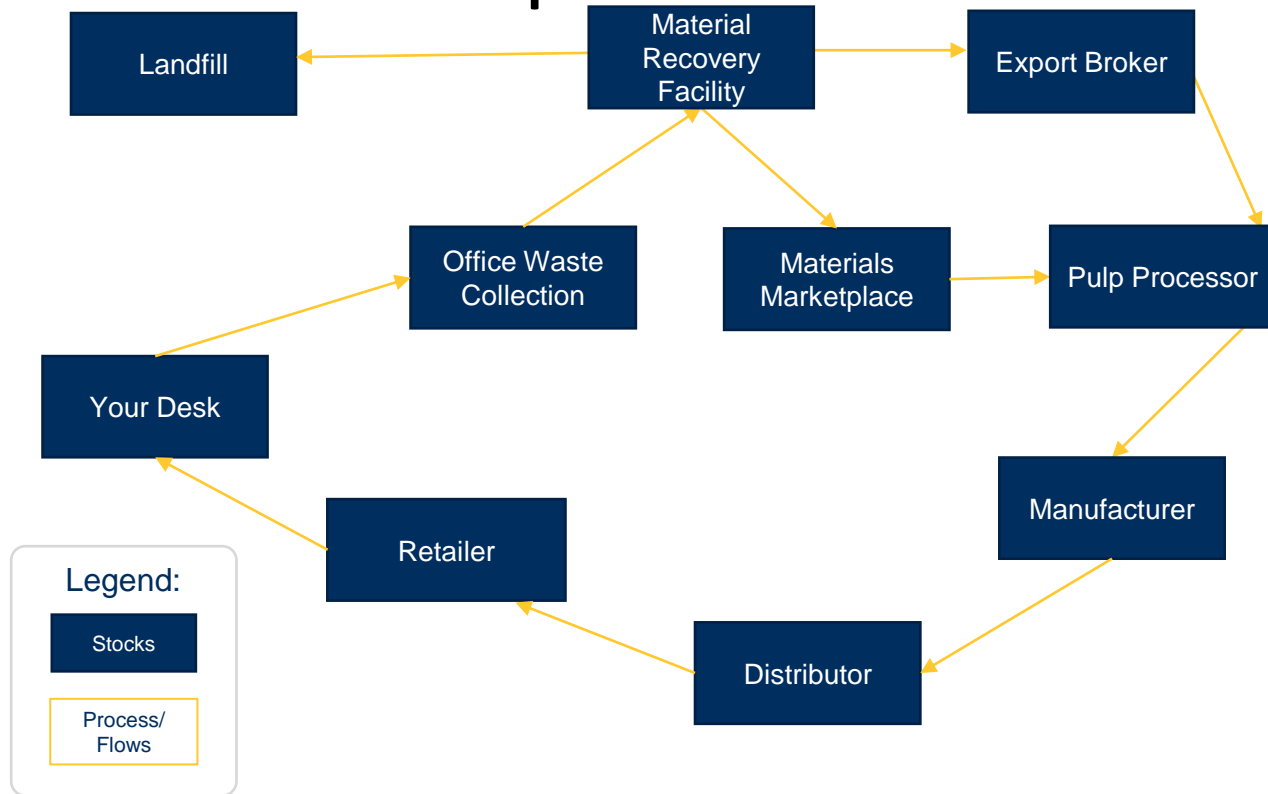
# Types of Systems Mapping: Stock and Flow



Legend:

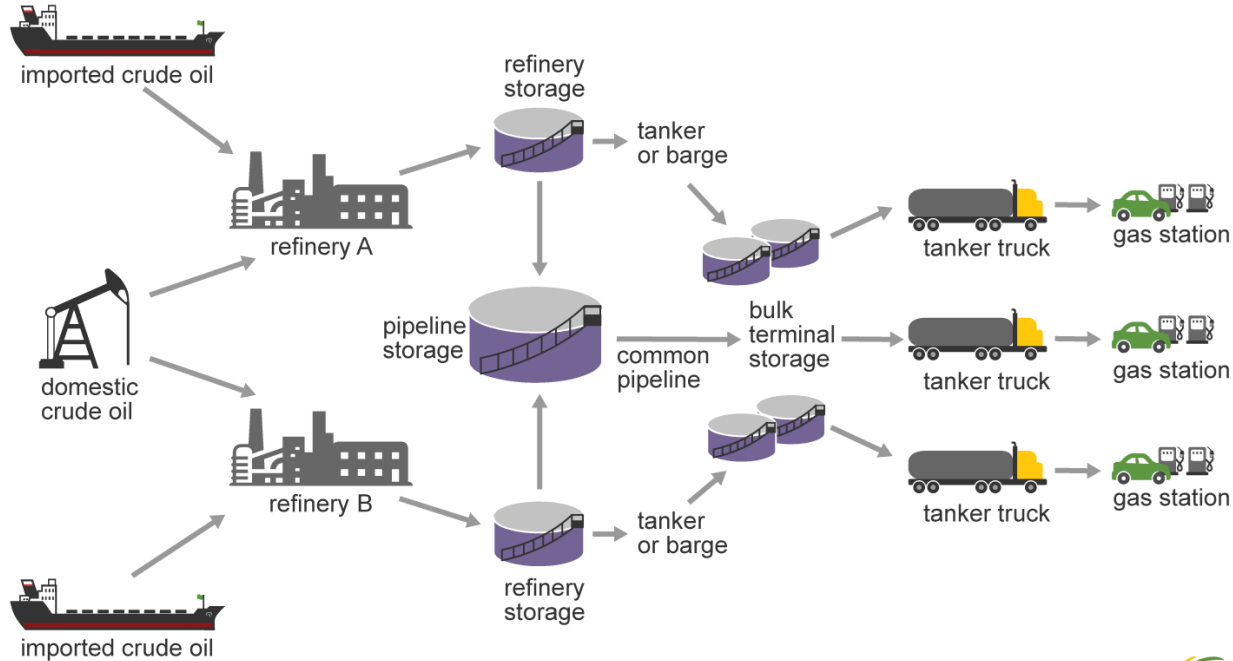


# Types of Systems Mapping: Stock and Flow of Paper



# Crude Oil Stock and Flow Map

Flow of crude oil and gasoline to your local gas station



Source: U.S. Energy Information Administration



# Food Stock and Flow Map

## The Food Supply Chain

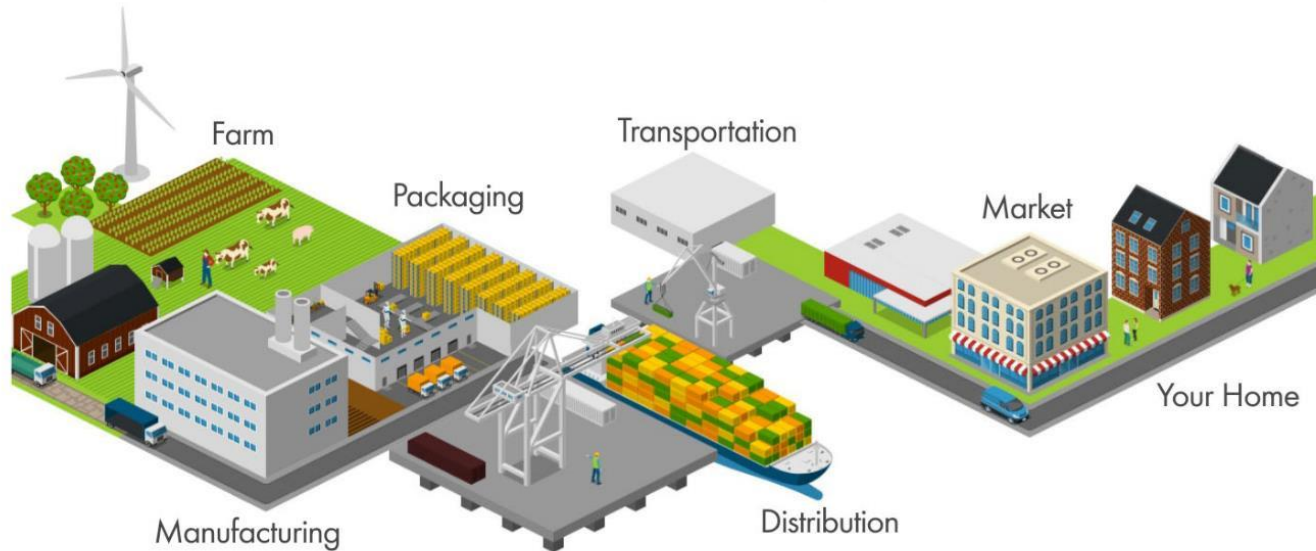


Image source: <https://money.howstuffworks.com/food-supply-chain-pandemic.htm>

# Building a Value Chain Map

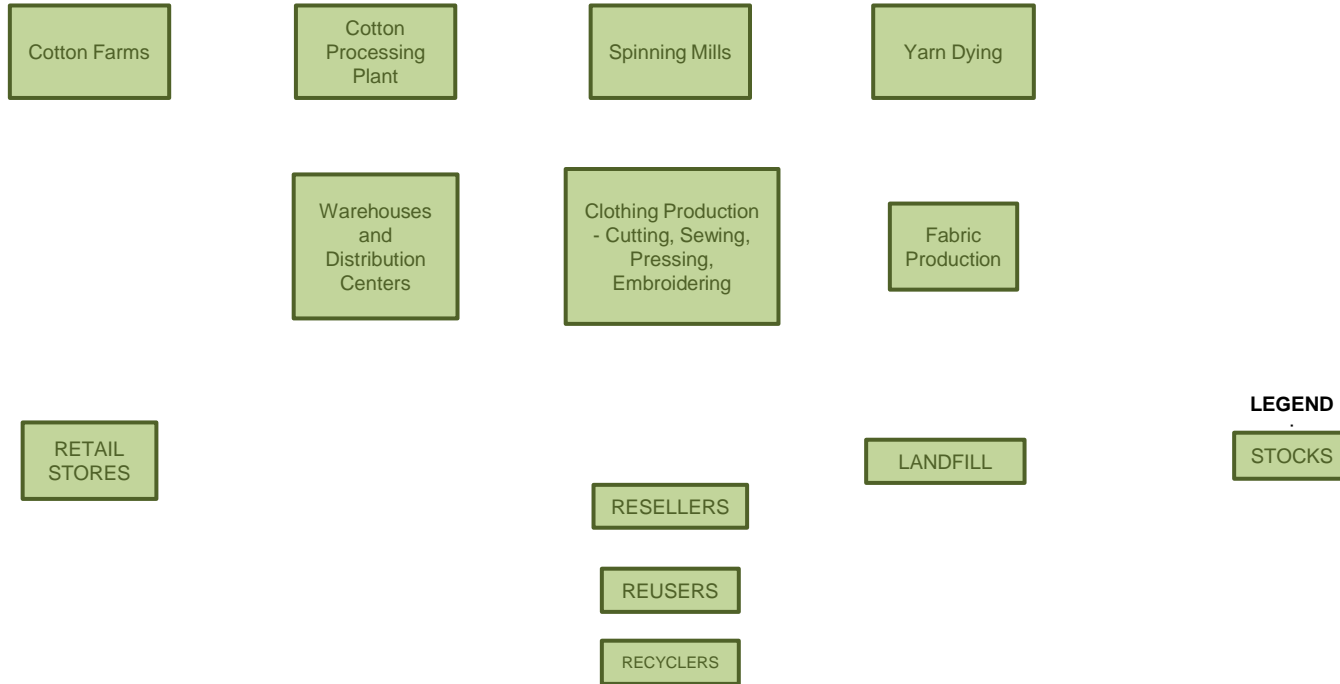
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## For a pair of jeans:

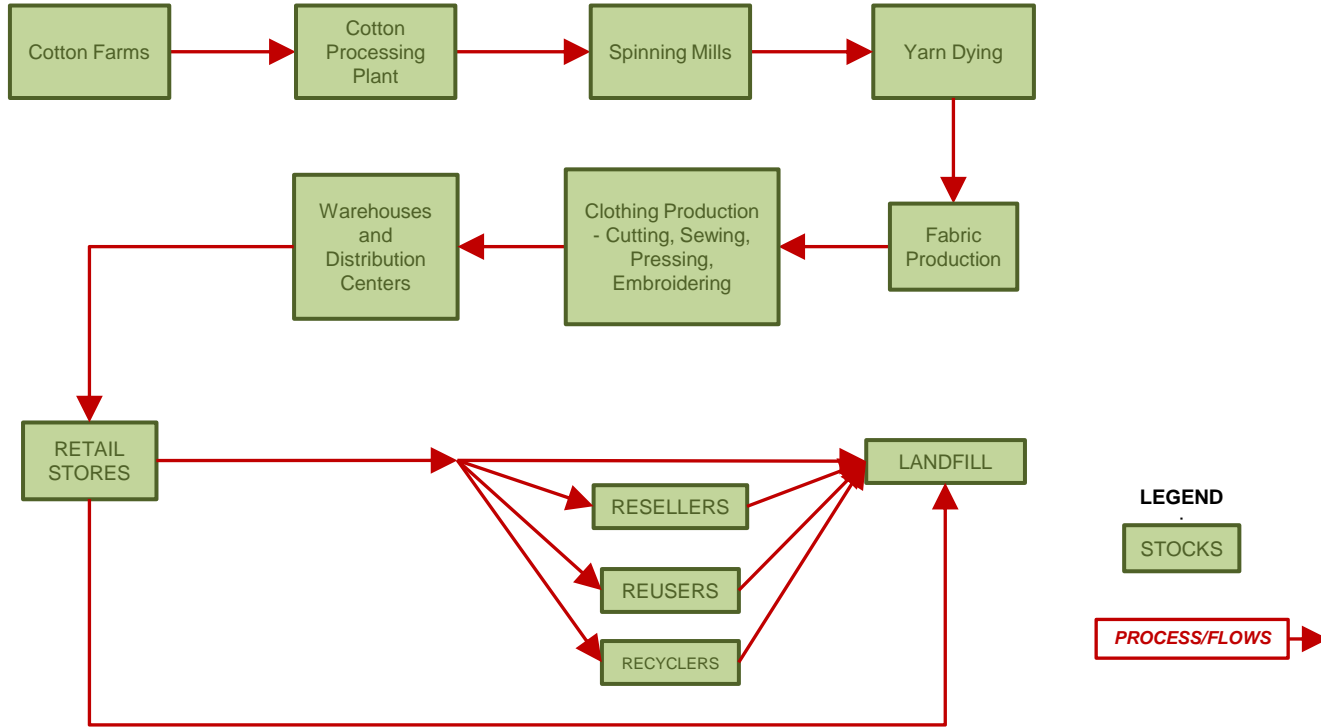
- **1+ billion pairs of jeans sold worldwide = \$60+ billion**
- **2.7 billion meters of fabric**
- **500+ Denim mills worldwide**

Source: <http://www.gtnexus.com/resources/blog-posts/denim-supply-chain-complexity>

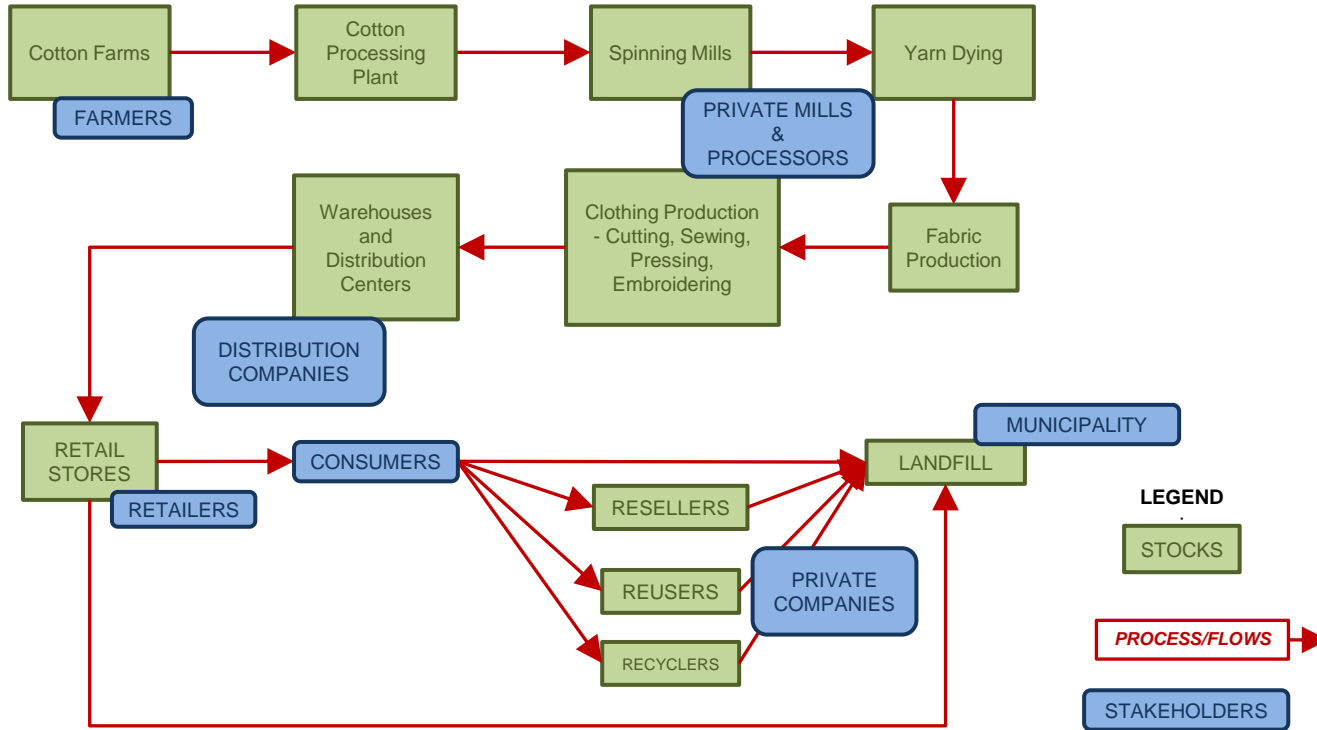
# Building a Value Chain Map



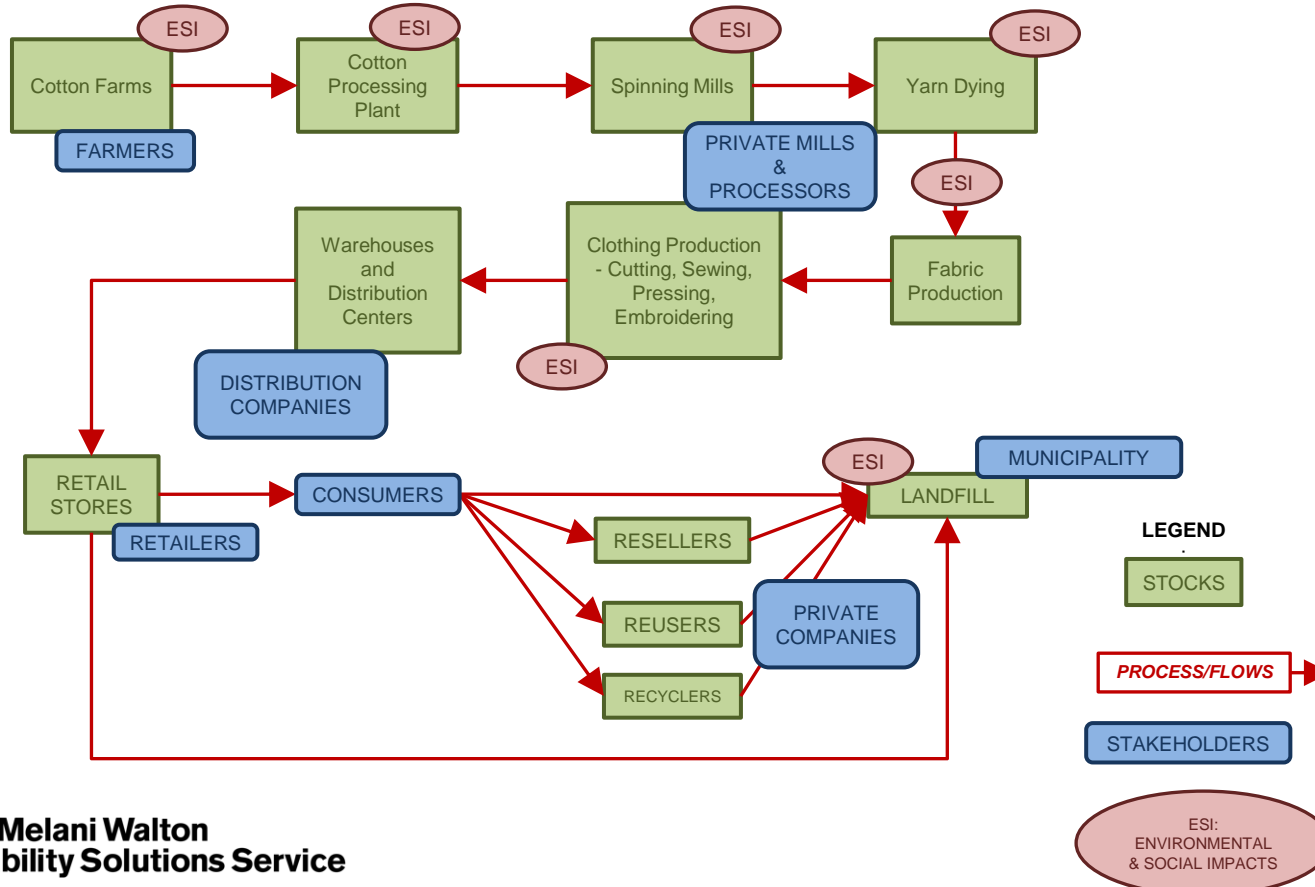
# Building a Value Chain Map



# Building a Value Chain Map



# Building a Value Chain Map



# Key components in a map

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- Quantities or amounts of material flows
- Spatial distribution around a region, country or the world
- Delays, or time dependencies within the system
- Transportation modes and distances
- Costs
- Technologies
- Information flow
- Policies or regulations
- Environmental impacts
- Social impacts

# **Group Activity Part 1**

### **Group 1:**

- Adrian Keller
- Brittany Keim
- Daksha Masurkar
- Mackenzie Haehl

### **Group 2:**

- Andrea Ramirez
- Brooke Gutierrez
- Cole Pihl
- Natalie Shepp

### **Group 3:**

- Emily Wilcoxson
- Jaimie Galayda
- Tessa Martinez
- Siobhan Lyons

### **Group 4:**

- Kaileigh Walker
- Mike Schwartz
- Maureen Salloom
- Stanley Wong

### **Group 5:**

- Simon Charter
- Veronica Gonzalez
- Viviane Baji
- Yiyun Zhang

# **Group Share Out**

**Break & Tour**

# Current state of waste: Private Sector Perspective

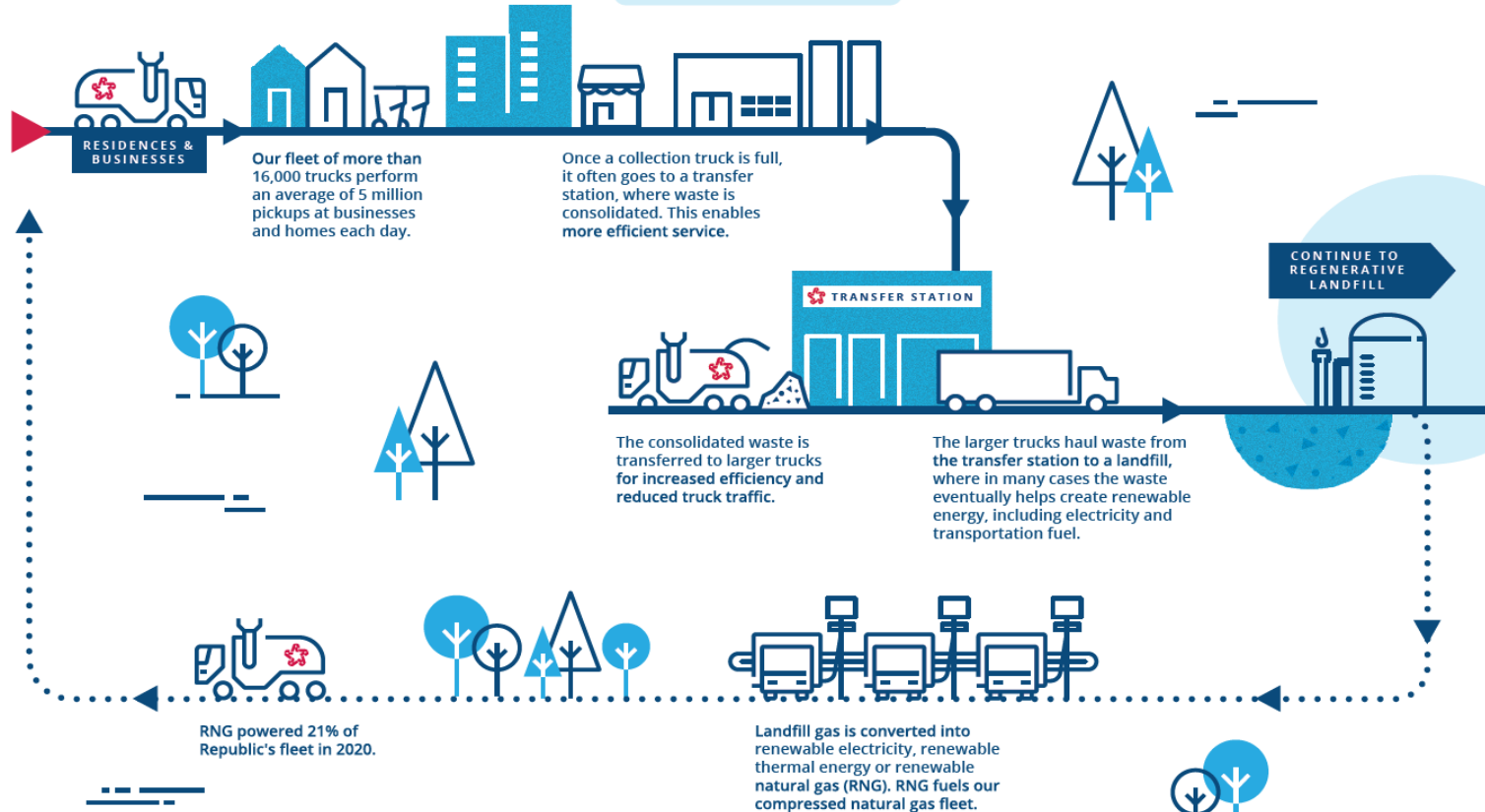
Collection, processing, reuse & what's next



# Waste Operations

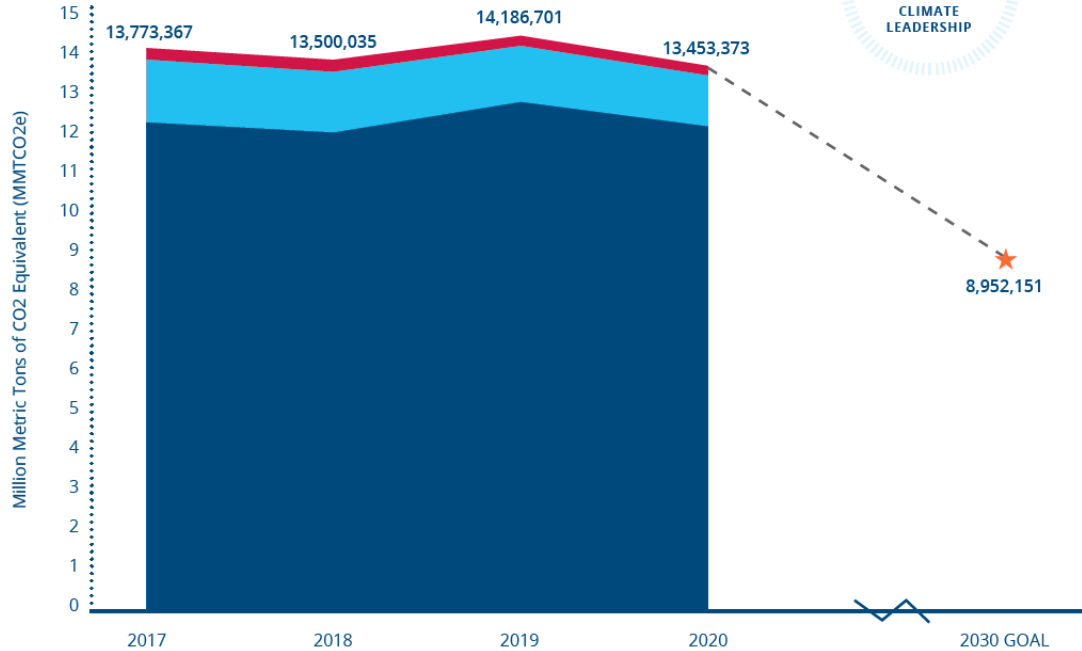


According to the EPA, Americans generate 4.9 pounds of waste and recycle or compost 1.6 pounds per person per day.



# Emissions from Waste

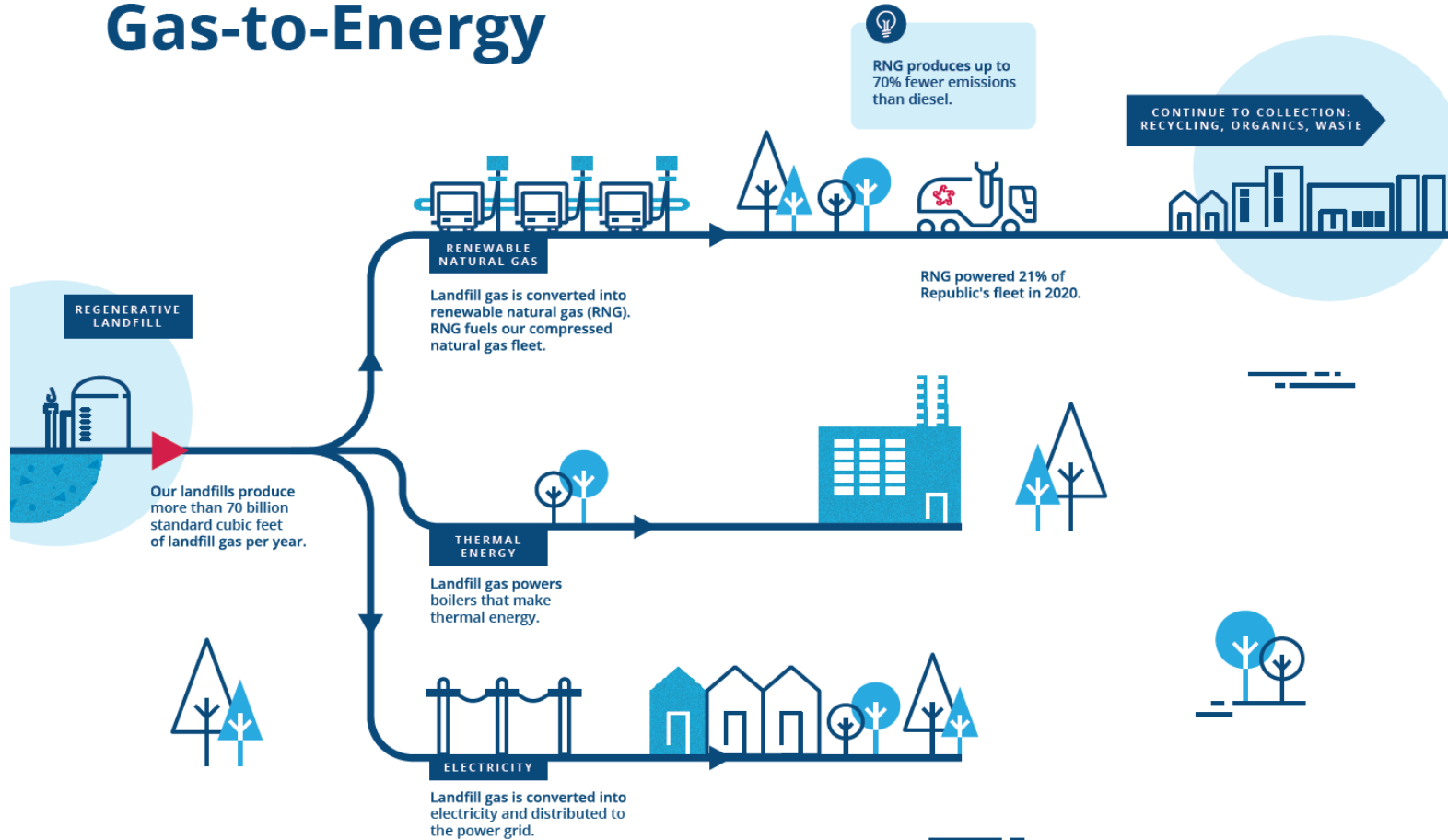
## SCOPE 1 AND 2 GREENHOUSE GAS EMISSIONS



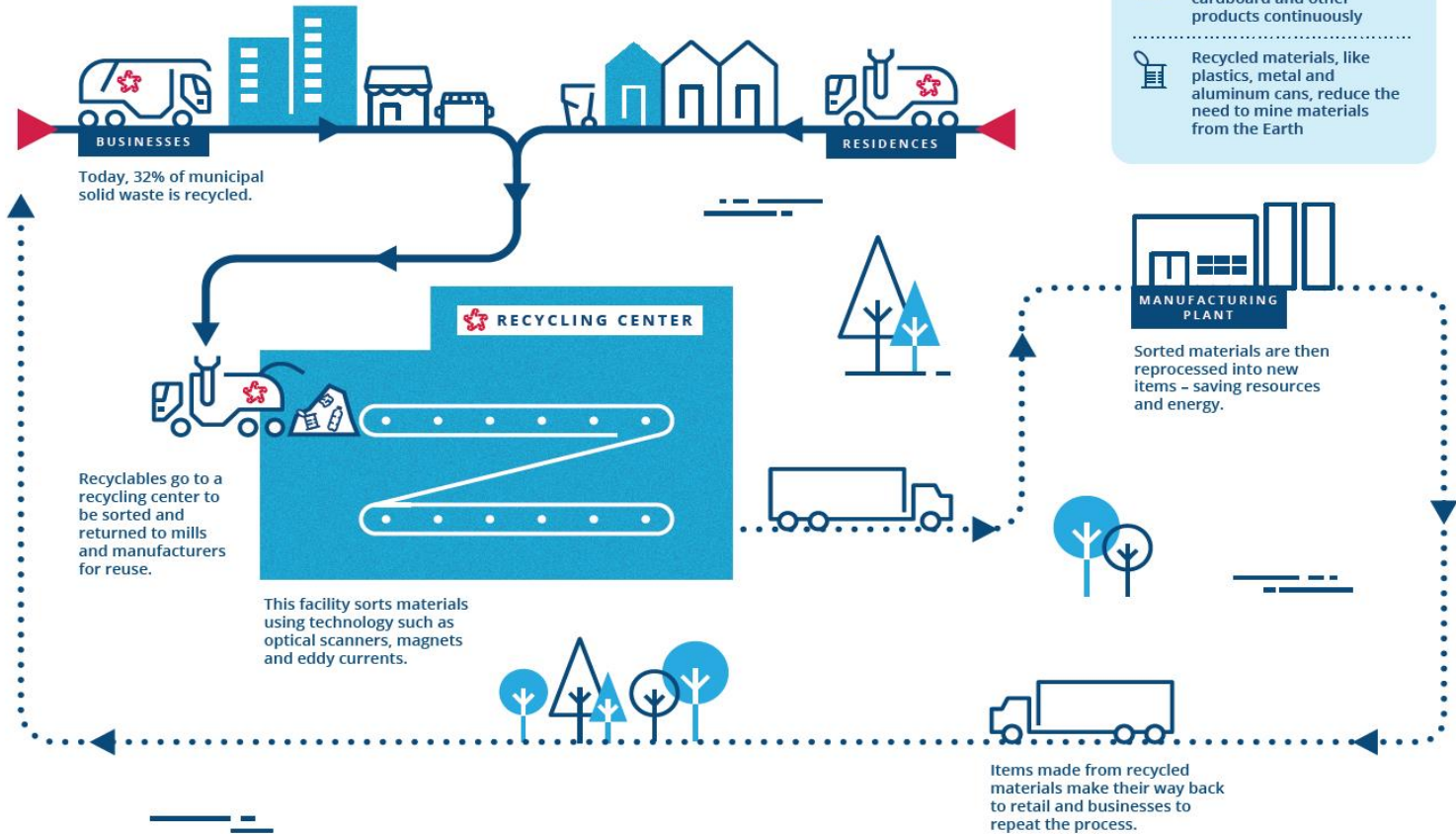
### Emission Category

- Landfills
- Fleet
- Buildings
- Goal

# Landfill Gas-to-Energy

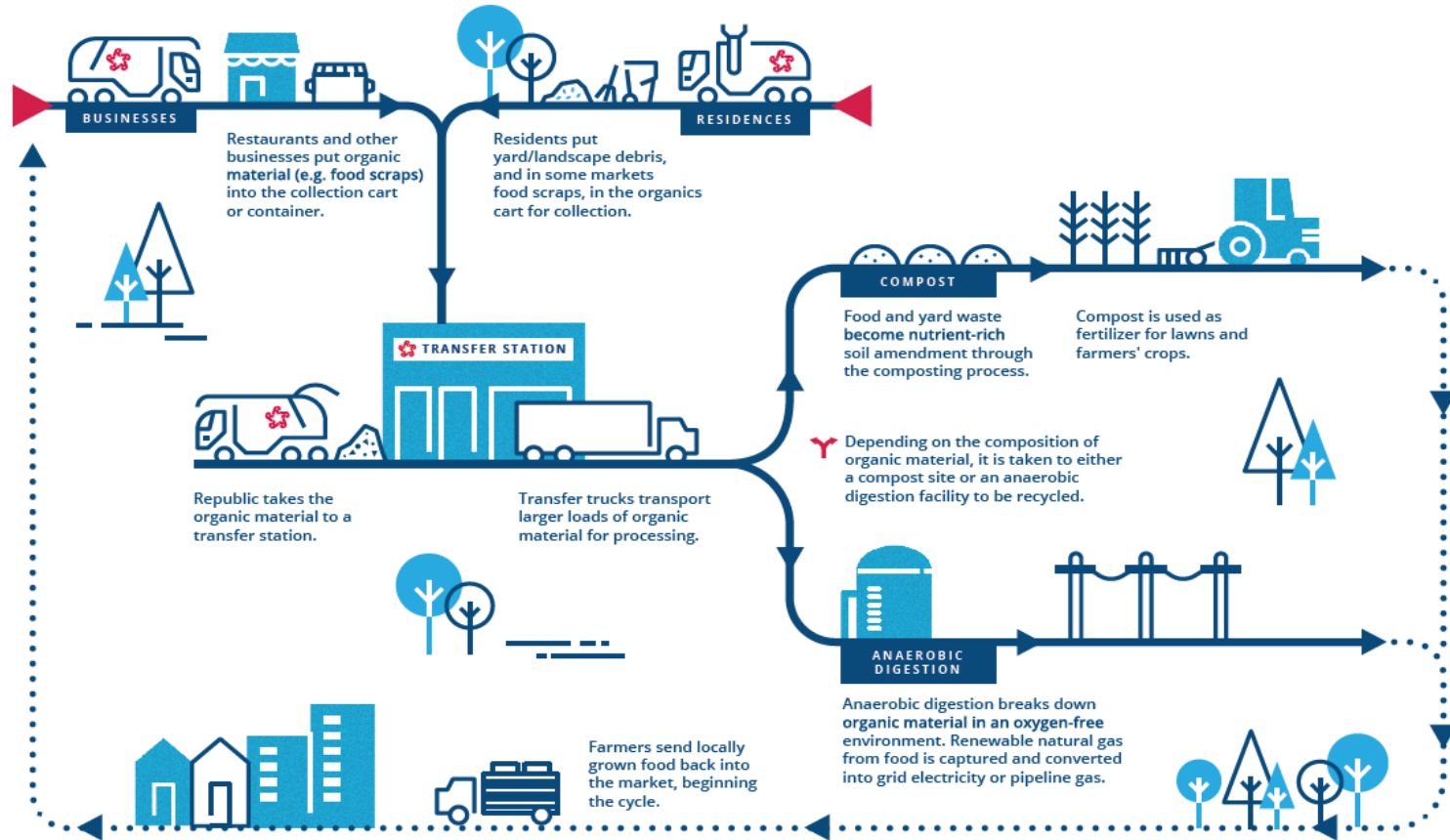


# Recycling Operations

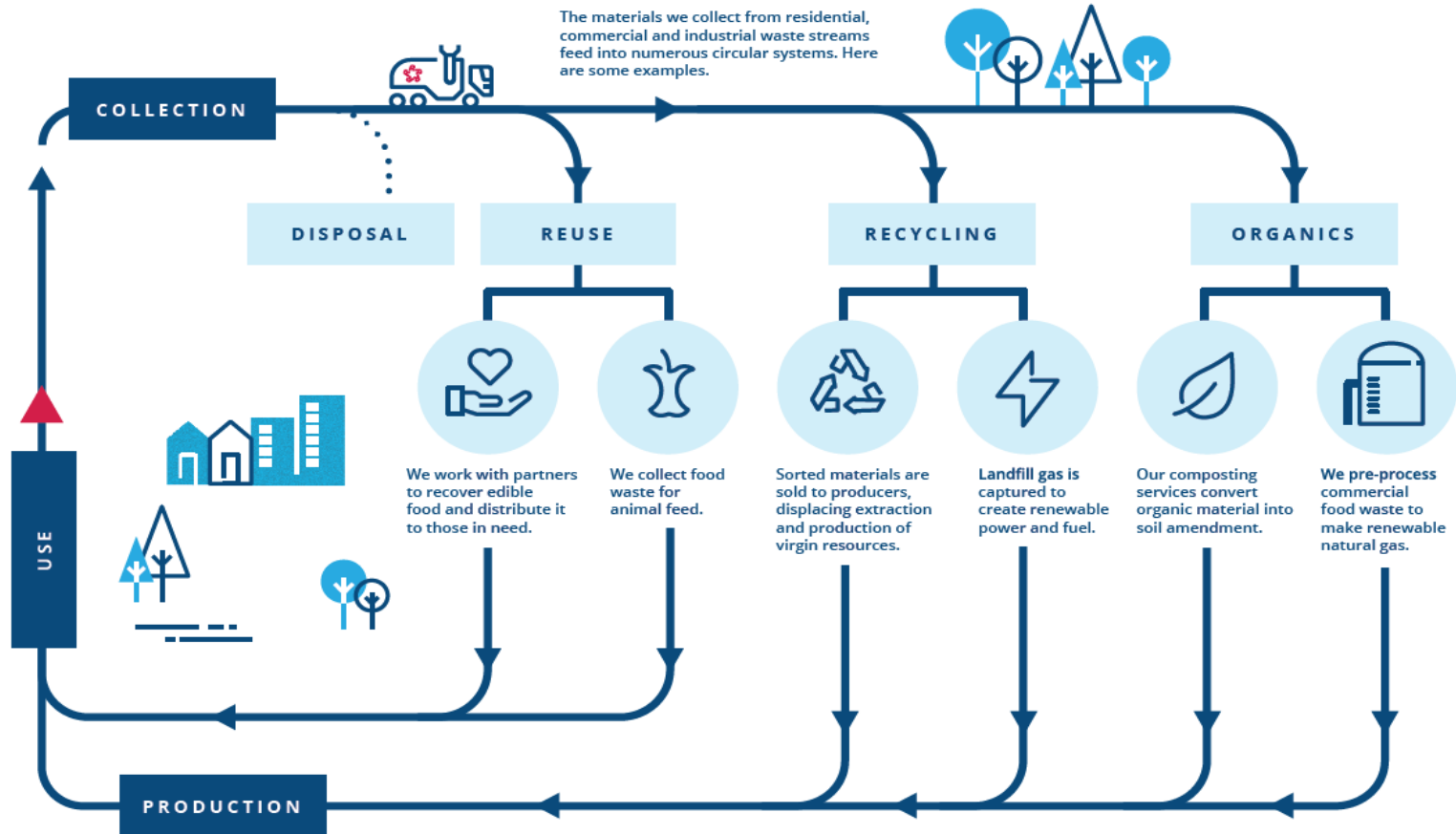


- 💡 78% of recyclables sold by Republic Services in 2020 were fiber-based (cardboard, newspapers, office paper)
- 📄 Paper can be re-pulped into new paper, newspaper, cardboard and other products continuously
- ♻️ Recycled materials, like plastics, metal and aluminum cans, reduce the need to mine materials from the Earth

# Organics Operations



# Circular Economy





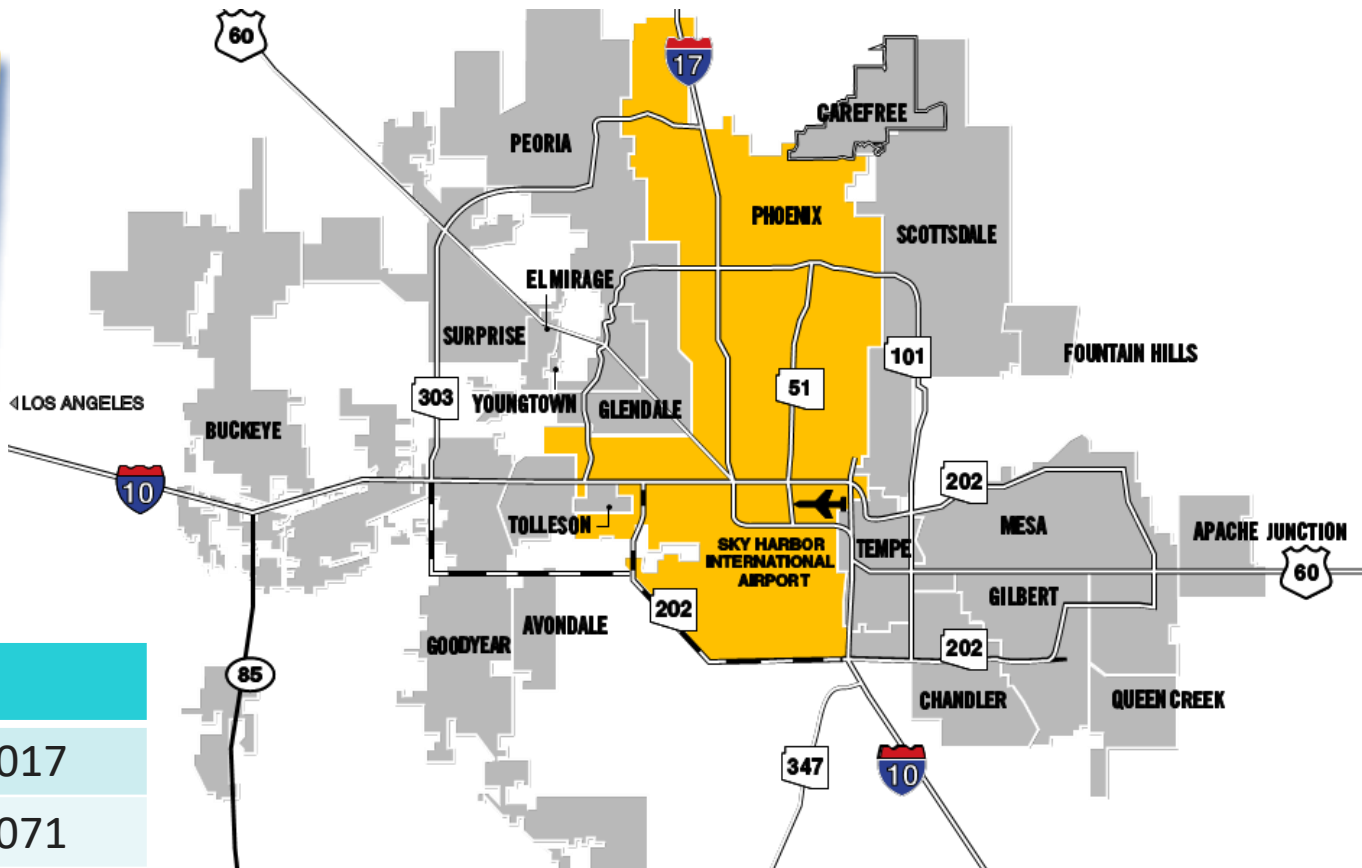
# Current state of waste: Public Sector Perspective

Collection, processing, facilities, and the future of CE in Phoenix



**City of Phoenix**

# Phoenix, AZ



**519** Square Miles

Pop.	2016
Phoenix	1,615,017
AZ	6,931,071



# Public Works Department



# Transfer Stations





**SR 85 Landfill**



**Materials Recovery Facility**



**27<sup>th</sup> Ave. Compost Facility**



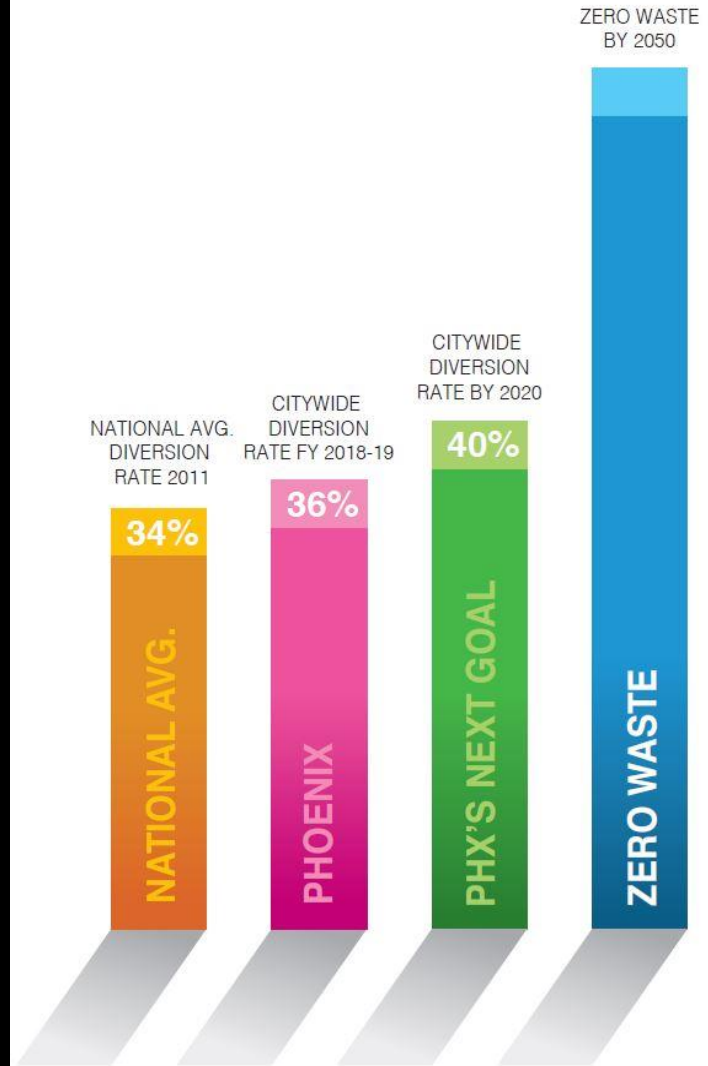
# 40 x 2020 Initiative



Reimagine Phoenix



# Phoenix Diversion Goals



# Environmental Benefits of Phoenix's Diversion



**36%  
Diversion**

=



**512,007  
MT CO2e**



**578,182  
acres**

or



**102,146  
cars**



**1.8 billion  
kWh\***

&

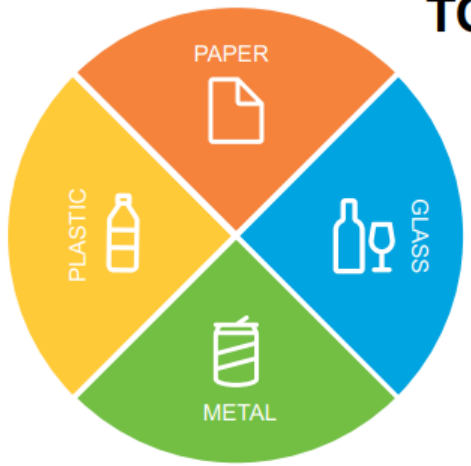


**76 billion  
gallons\***



# Circular Economy Opportunities

## TOTAL POTENTIAL IMPACT



 **\$124 million**  
6-year additional contribution to  
Gross State Product

 **34,000 tons**  
recycled materials diverted

 **55 new jobs**  
at new or extended facilities

### Recommendations based on material source:

**PLASTIC:** Establish a PET processing facility in the City of Phoenix

input: **\$ 10-12 million**  
capital expenditure investment

potential outputs:  **\$113.5 million**  
annual additional contribution to GSP

 **9,100 tons (PET)**  
volume of recycled materials (87% Increase)

 **50 jobs**  
annual employment at new facility



**GLASS:** Extend current 50,000 ton cullet processing operation in City of Phoenix

input: **\$ 1.5 million**  
capital expenditure investment

potential outputs:  **\$11.4 million**  
annual additional contribution to GSP

 **14,100 tons**  
volume of recycled materials (48% increase)

 **5 jobs**  
annual employment at facility



**PAPER:** Adopt a multi-state approach where newspaper is shipped out of state but OCC is processed in-state

input: **\$ 60 million**  
capital expenditure investment


potential outputs:  **\$437.4 million**  
6-year additional contribution to GSP


 **156,000 tons (OCC needed)**  
Only 22.5K available in Phoenix municipal waste stream

 **140 jobs**  
annual employment at facility

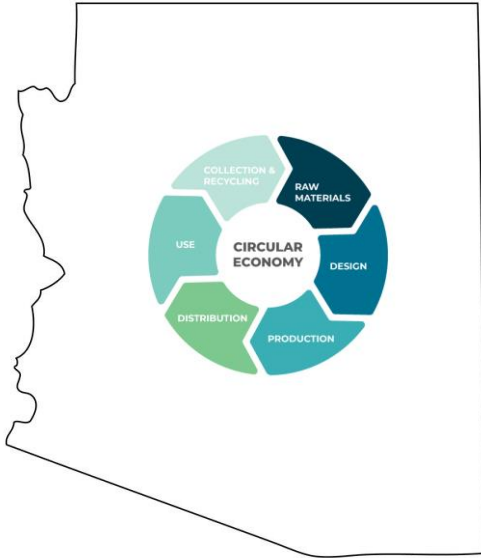


**METAL:** Utilize existing scrap metal network in City of Phoenix

potential outputs:  Based on the utilization of the existing scrap metal network, no additional economic impact will be created.



# Future of Circular Economy in Phoenix



## Location & Facility Developments

- Resource Innovation Campus
- 27<sup>th</sup> Ave MRF

## Business Development

- RFPs
- Education and Engagement
  - Workforce Training and Development
  - Green Business Leaders Program
- Entrepreneurial Incubation/Acceleration Opportunities

## Internal Policies, Programs & Plans

- Sustainable Purchasing Policy
  - Circular Public Procurement
- Climate Action Plan
- Zero Waste 2050
- Oops/Shine On Pilot

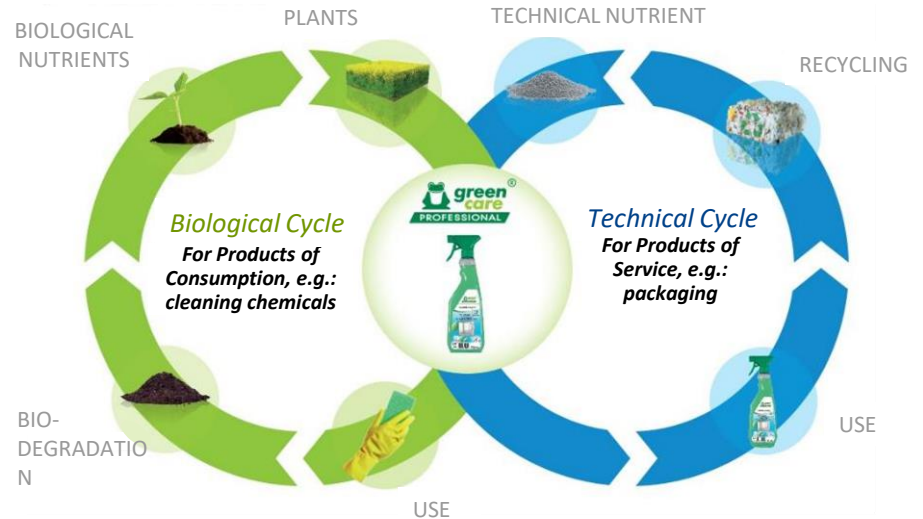
# **Circular Economy Overview**

Principles, Business Models, Case Studies

# Cradle to Cradle (2002)

**Cradle to Cradle** design perceives the safe and productive processes of nature's 'biological metabolism' as a model for developing a 'technical metabolism' flow of industrial materials.

- **Eliminate the concept of waste.** "Waste equals food."
- **Power with renewable energy.** "Use current solar income." Maximize the use of renewable energy.
- **Respect human & natural systems.** "Celebrate diversity."

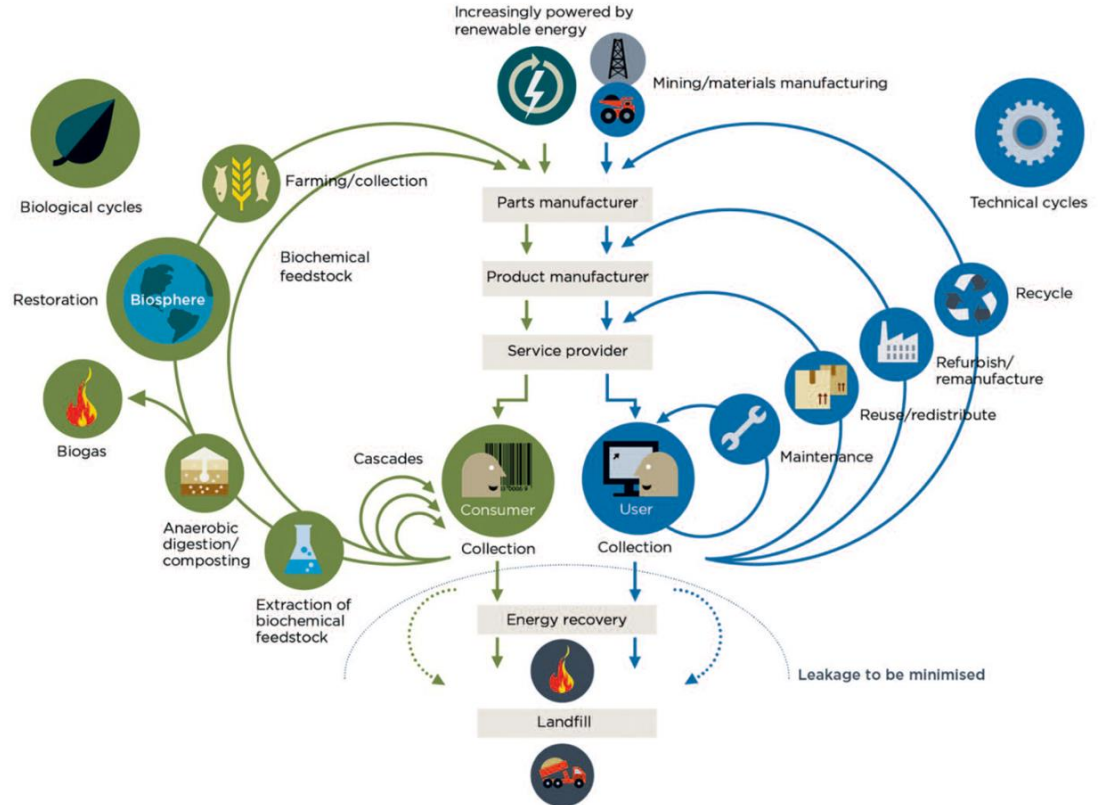


# Circular Economy (2010)

**Principle 1: Preserve and enhance natural capital**

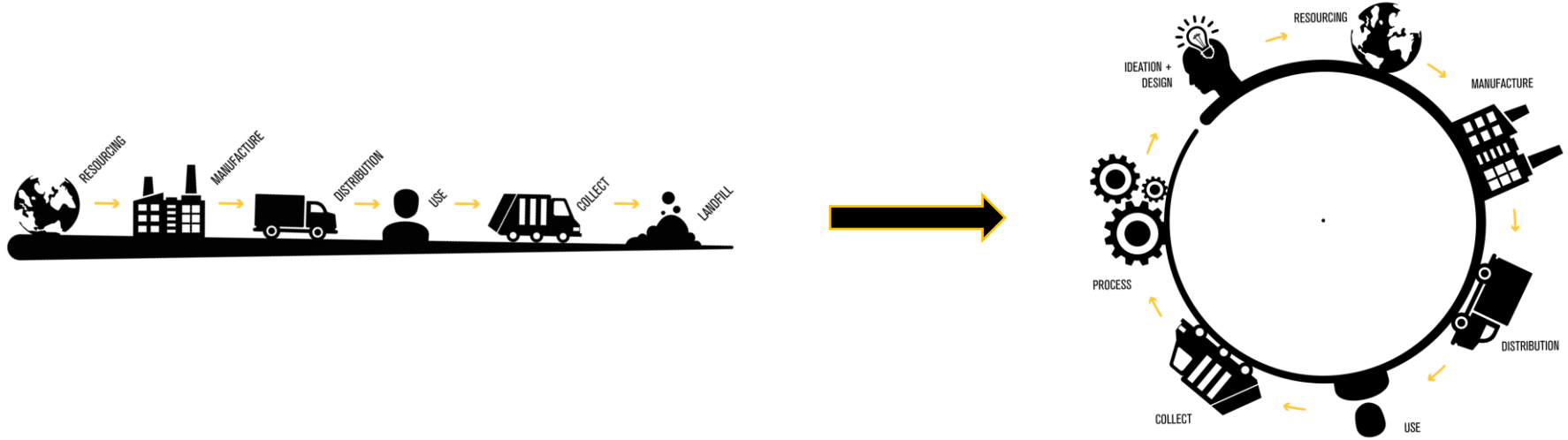
**Principle 2: Optimize resource yields**

**Principle 3: Foster system effectiveness**



# Linear to Circular

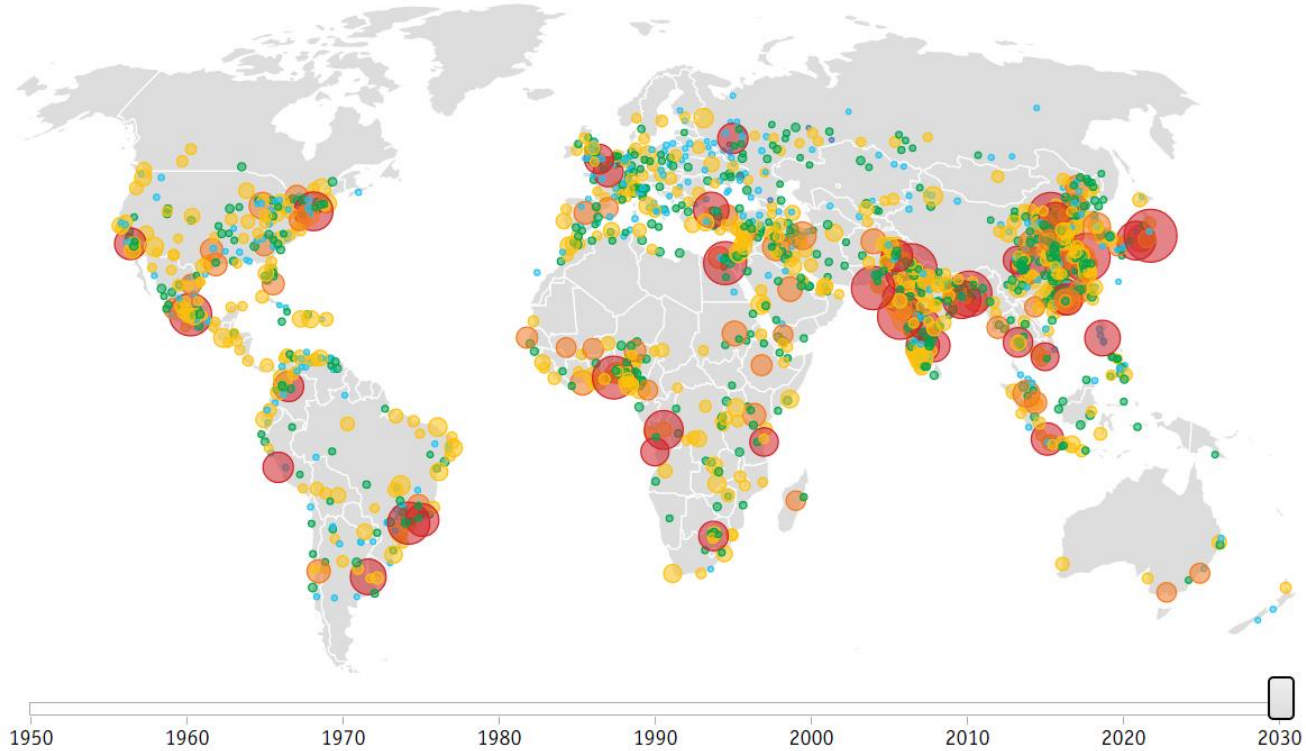
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Need to shift the way we think about:  
DESIGN, PRODUCTION & BUSINESS MODELS

***Why Circular Economy?***

GLOBAL CITY POPULATIONS\*

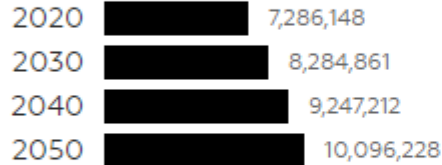


Source: <http://www.economist.com/node/21642053>

# Arizona's Projected Population Growth

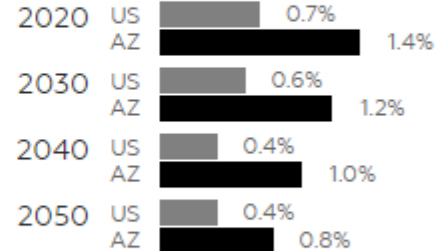
## PROJECTED TOTAL POPULATION

### Projected total population by year



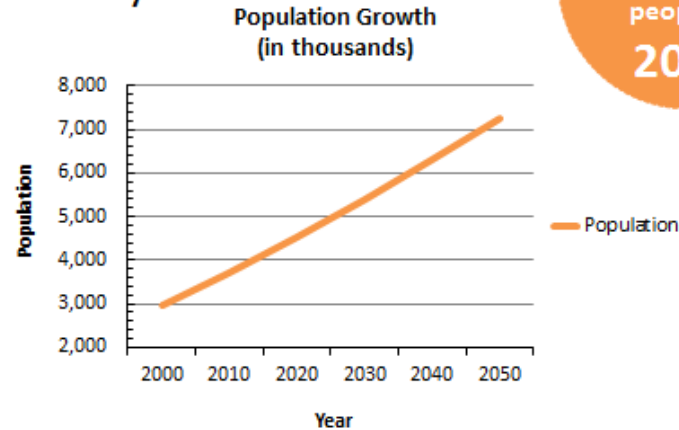
## PROJECTED POPULATION GROWTH

### Projected annual population growth rate



# Maricopa County's Projected Population Growth

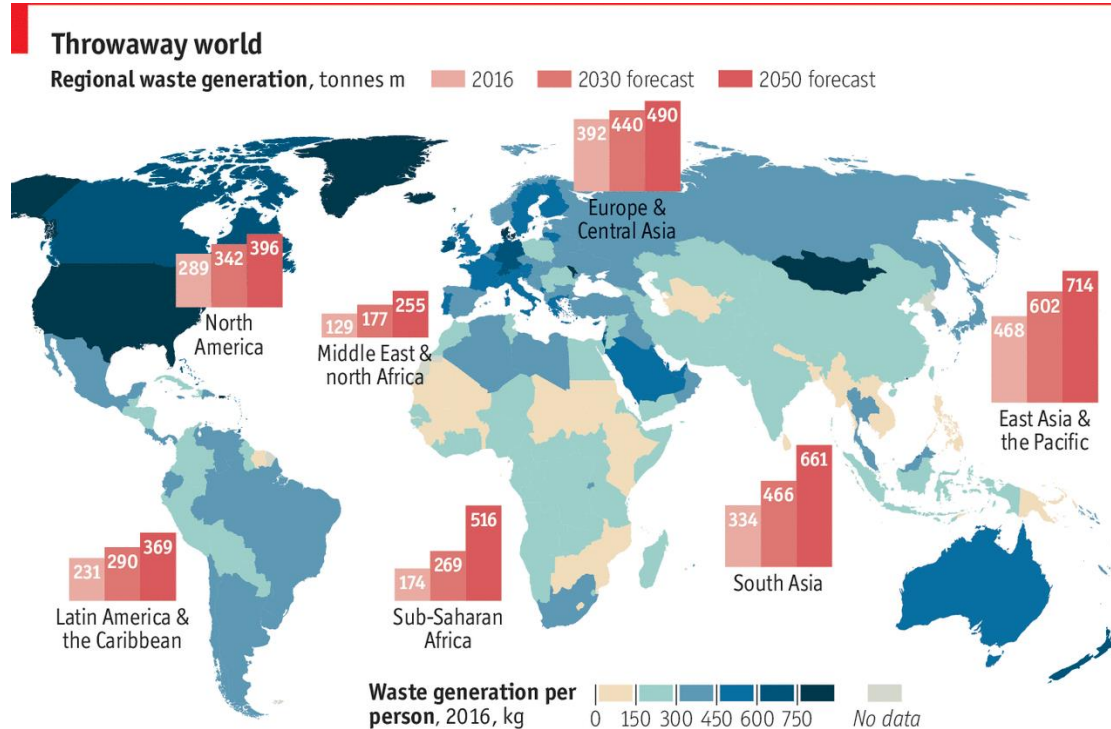
Projected population growth for Maricopa County



7.3  
Million  
people in  
2050

# So...why does this matter?

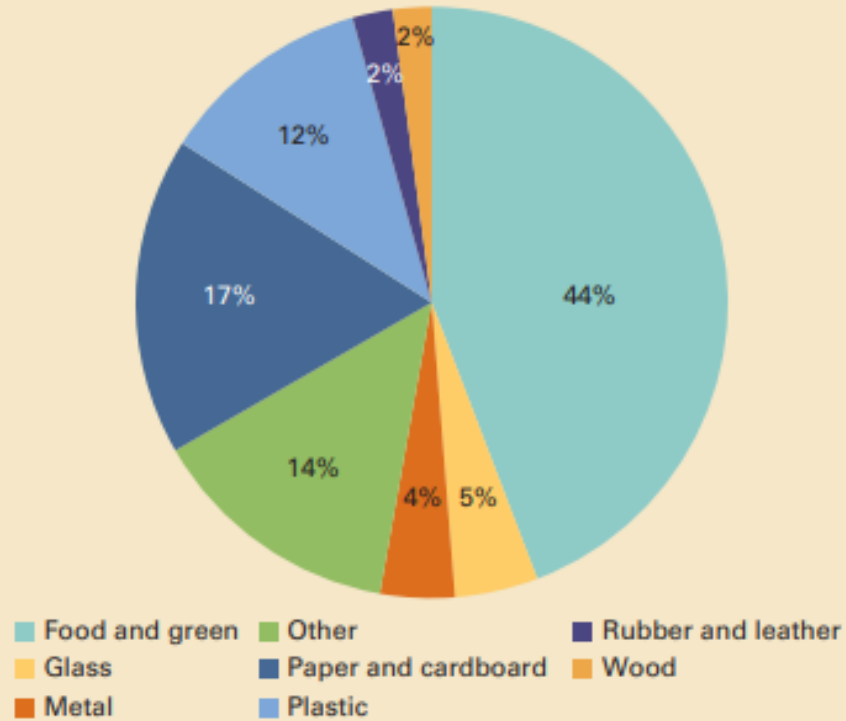
**MORE PEOPLE = MORE CONSUMERS = MORE WASTE**



Source: World Bank

The Economist

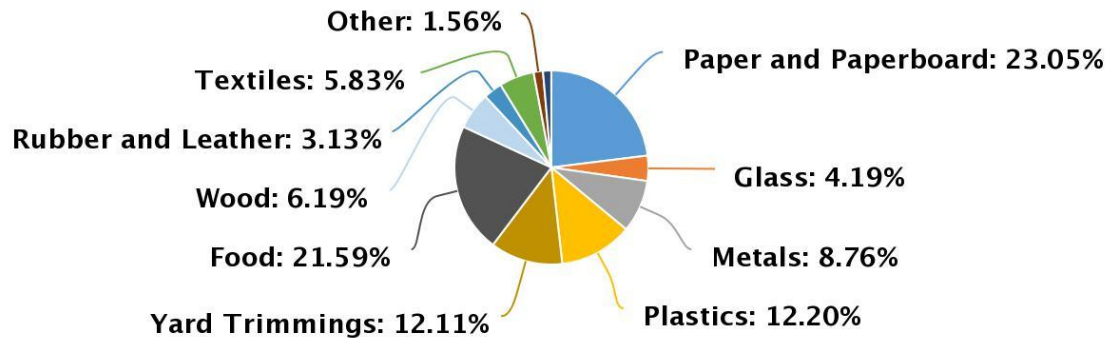
**Figure 2.8 Global Waste Composition**  
*percent*



Source: Worldbank.org

# Total MSW Generated by Material, 2018

292.4 million tons



# **Case Studies in Circular Economy**

# Case Study: City of Phoenix



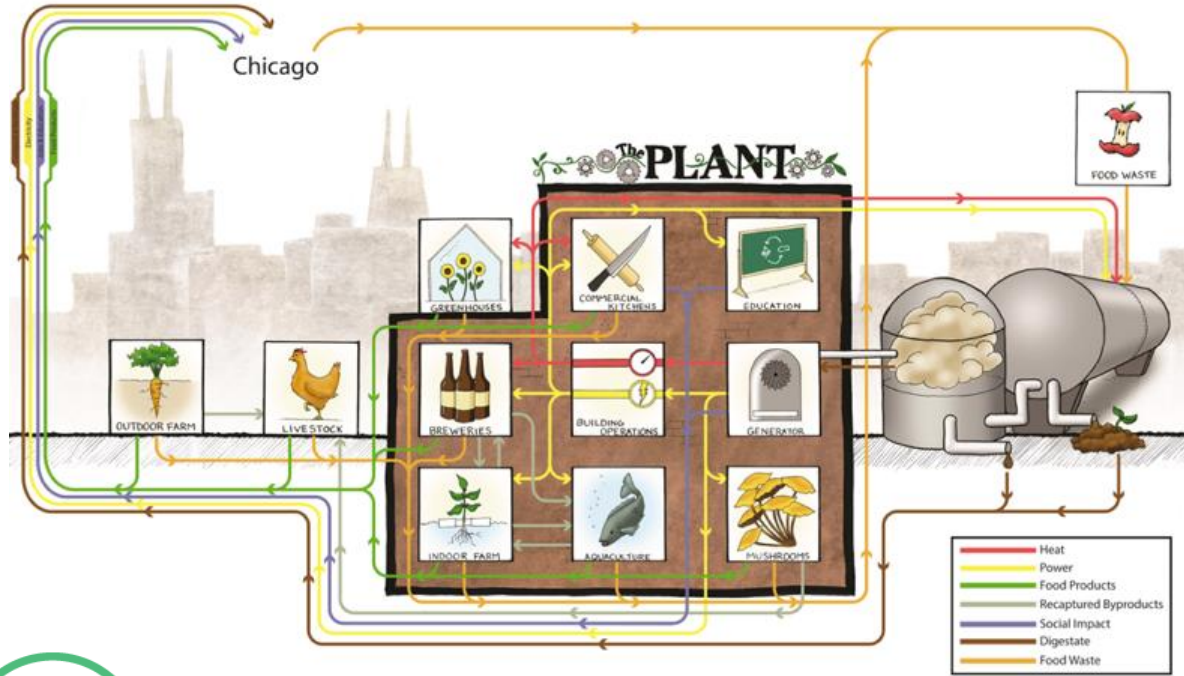
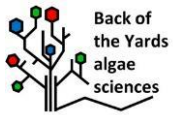
Reimagine Phoenix  
Transforming Trash Into Resources



**RISN** Resource  
Innovation and  
Solutions Network



# Case Study: Plant Chicago



Kombuchade



PLANT CHICAGO

BUBBLY DYNAMICS LLC

# Case Study: The Materials Marketplace

## materials marketplace



Create Value



Reduce CO2



Do Good for the Environment



Stimulate & Inspire Local Jobs



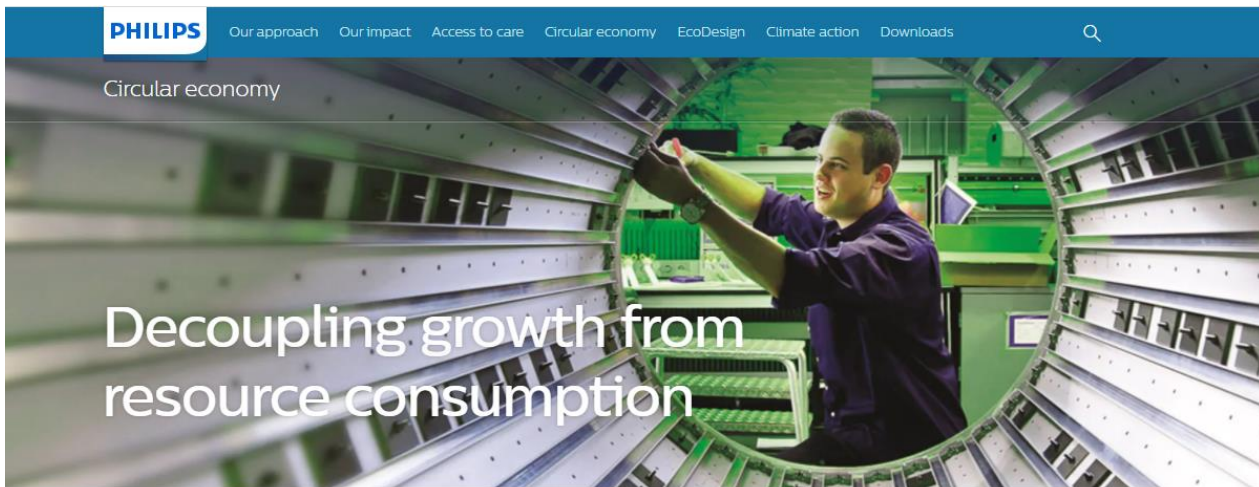
*austin*  
**materials marketplace**

*michigan*  
**materials marketplace**

*tennessee*  
**materials marketplace**

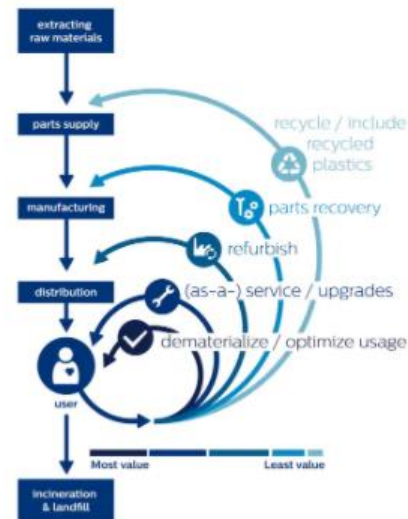


# Case Study: Phillips



[The circular imperative](#) | [How we practice circular economy](#) | [Our ambitious circular economy objectives for 2025](#)  
[Our circular products and services](#) | [Refurbished systems](#) | [In the spotlight](#) | [Partnering to drive circularity](#)

# PHILIPS



## Our circular products and services

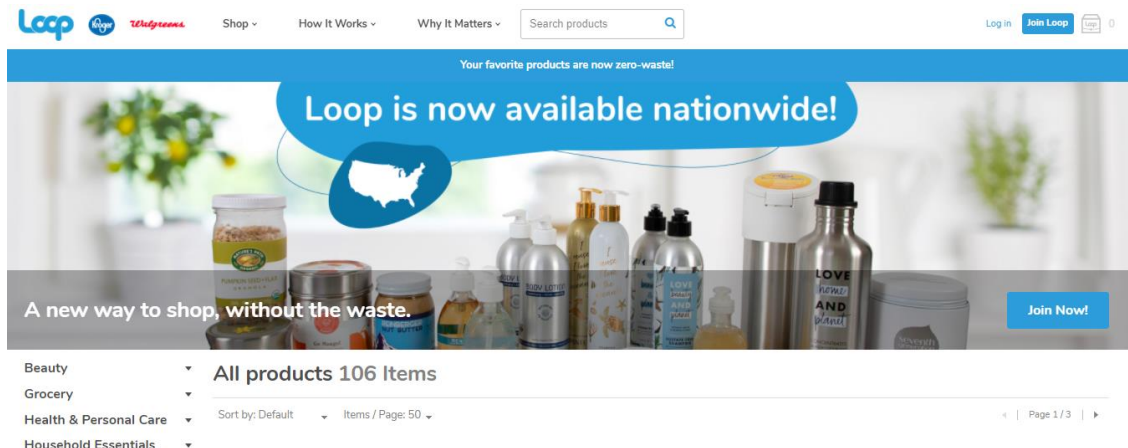
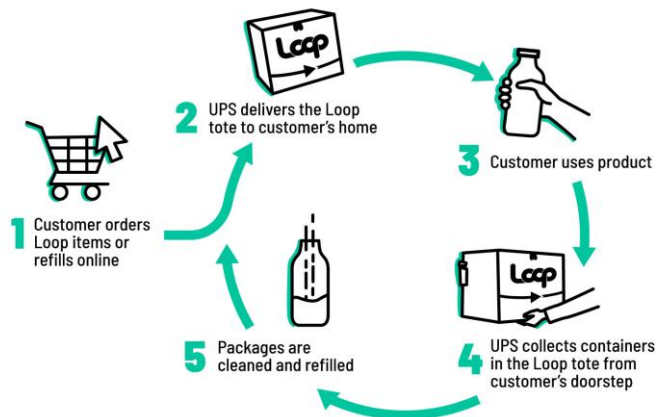
Circular business models – such as offering customers access to, rather than ownership of, products – open up new opportunities for growth and cost savings, reduce resource risk, and facilitate smart asset management.

Addressing this customer need, we offer a wide variety of circular propositions:

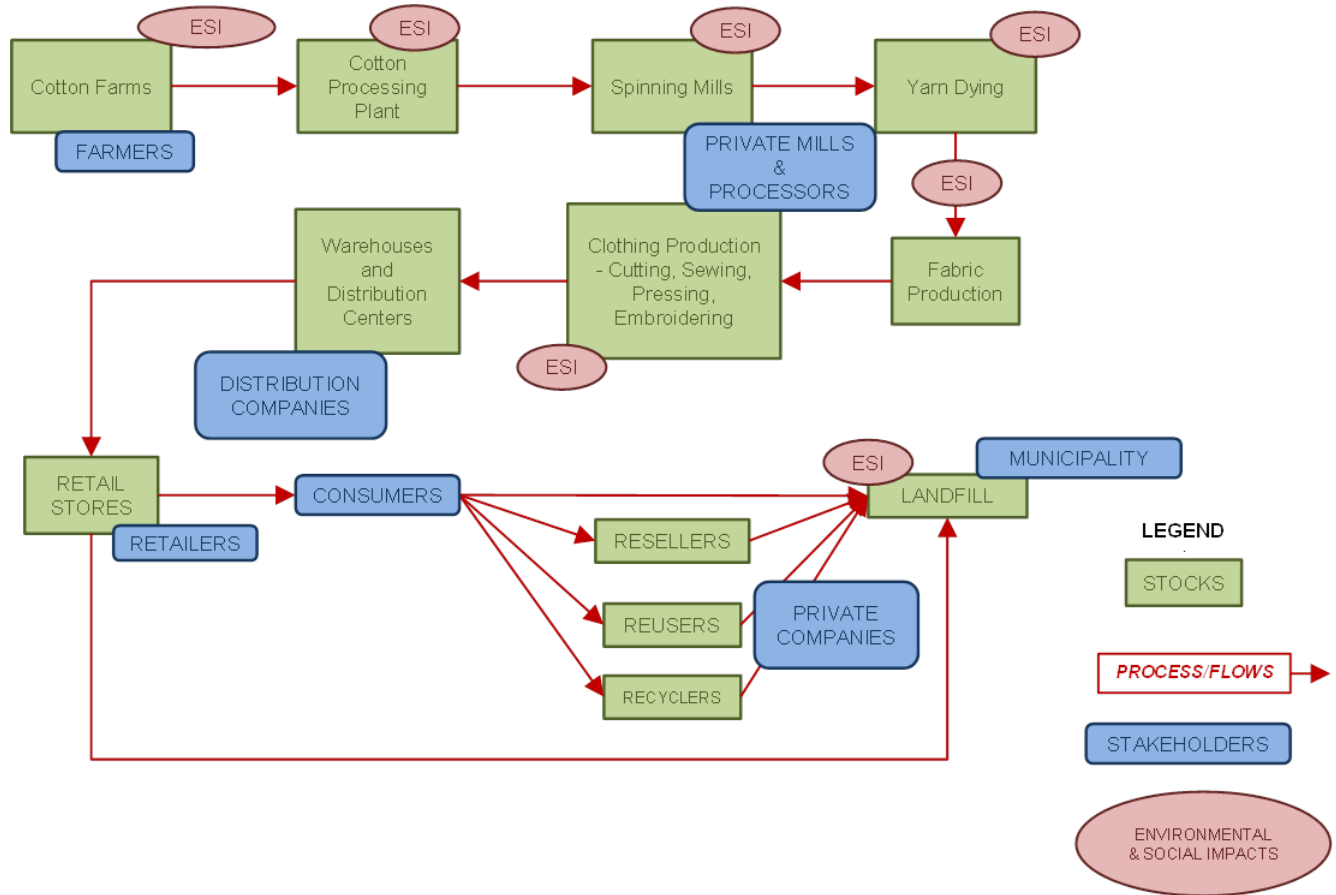
- Periodic, usage- and outcome-based business models
- Refurbishment and parts recovery
- On-site or remote circular services, including upgrades
- Recycled materials
- Software

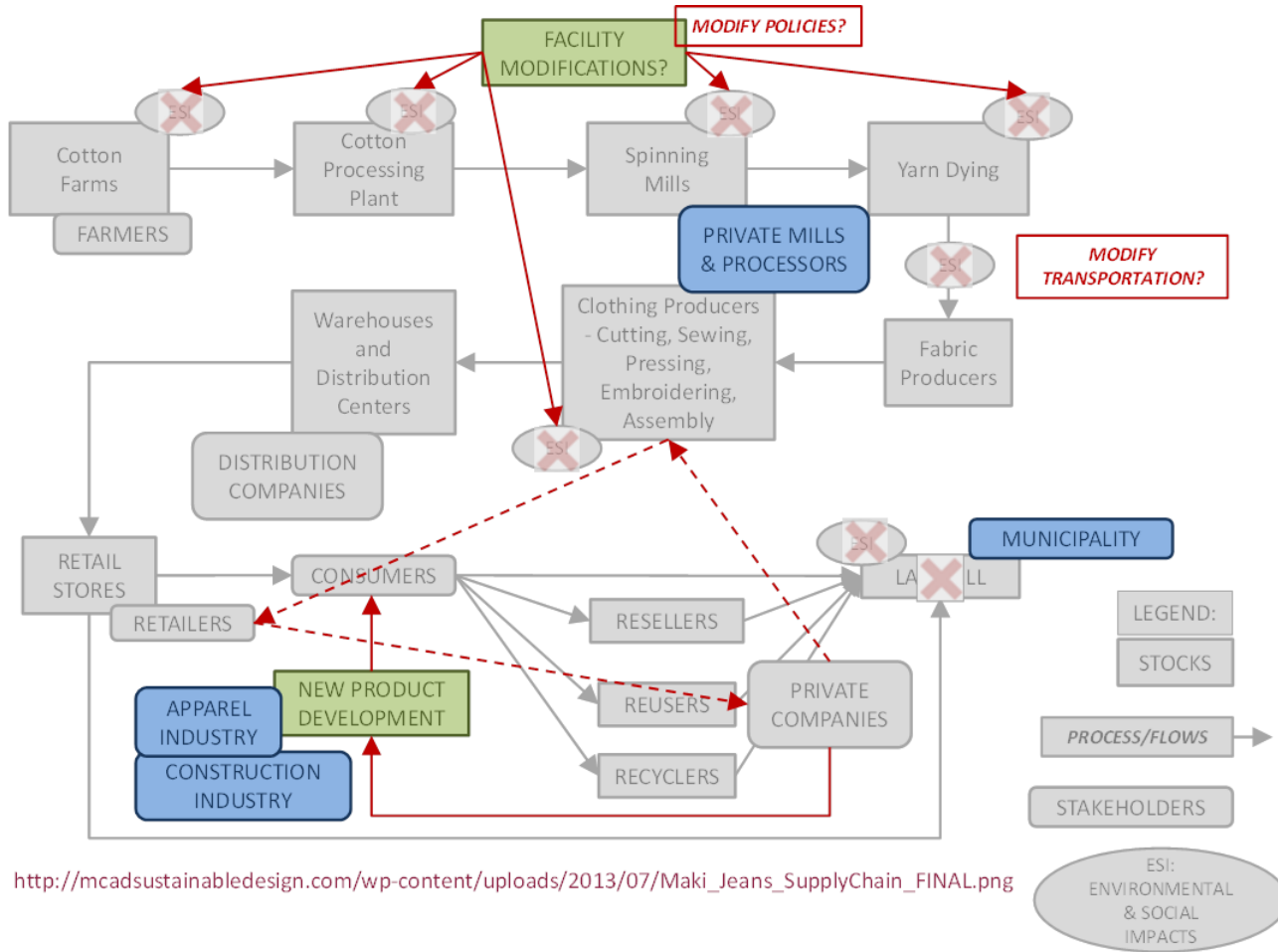
[Read more](#) ▾

# Case Study: LOOP



# **Group Activity Part 2**





[http://mcadsustainabledesign.com/wp-content/uploads/2013/07/Maki\\_Jeans\\_SupplyChain\\_FINAL.png](http://mcadsustainabledesign.com/wp-content/uploads/2013/07/Maki_Jeans_SupplyChain_FINAL.png)

# **Group Share Out**



# Thank you!

Emerging Sustainability Leaders

Circular Economy Session

March 25, 2022