

PROJECT 3: SYSTEM SOLUTIONS

# Packaging Waste in the U.S. Food System

Paula Welling / Systems Thinking—Fall 2022

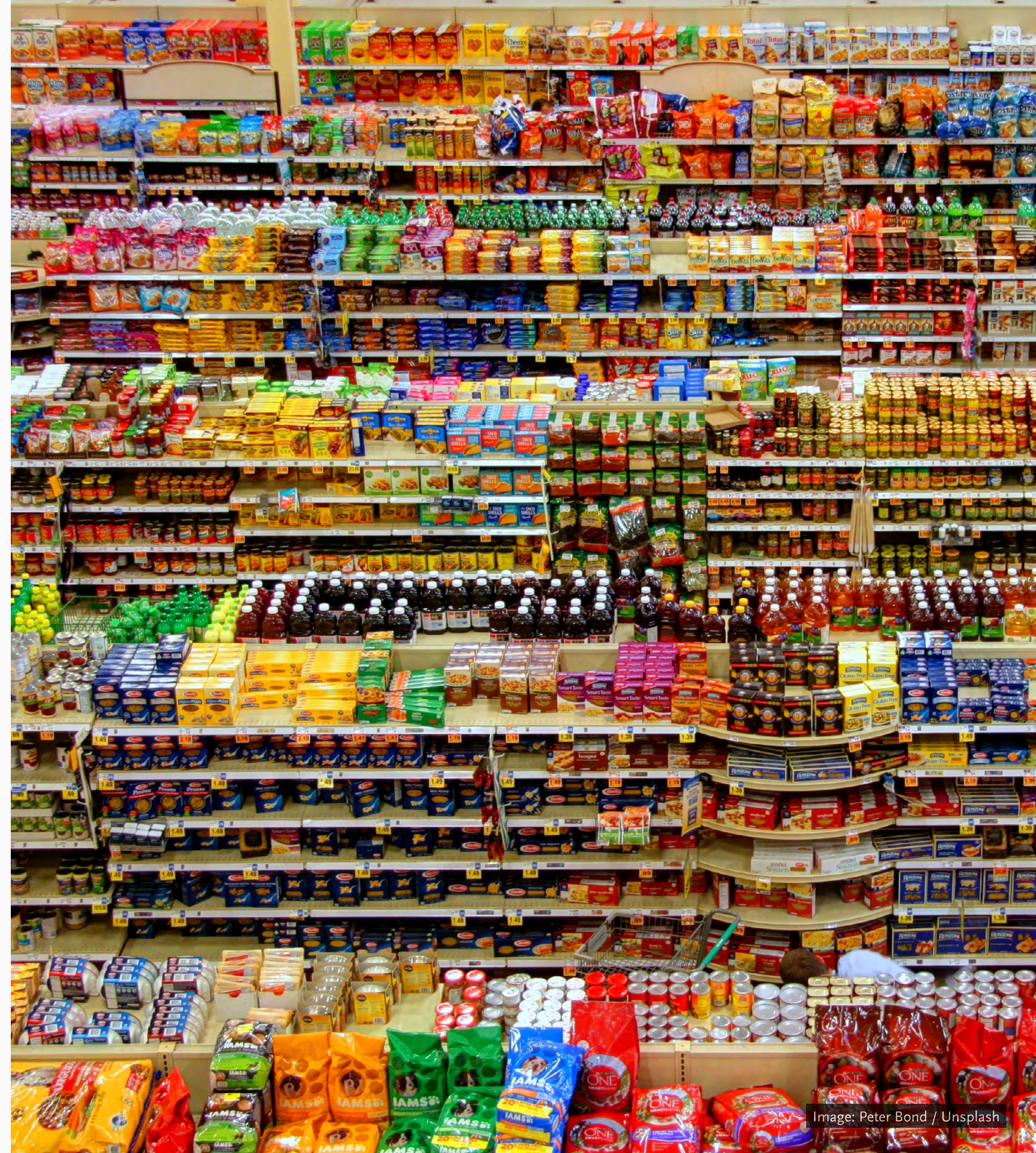


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SYSTEM OF INTEREST

# The U.S. Food System

This section explores dynamics within the system that lead to food packaging waste.



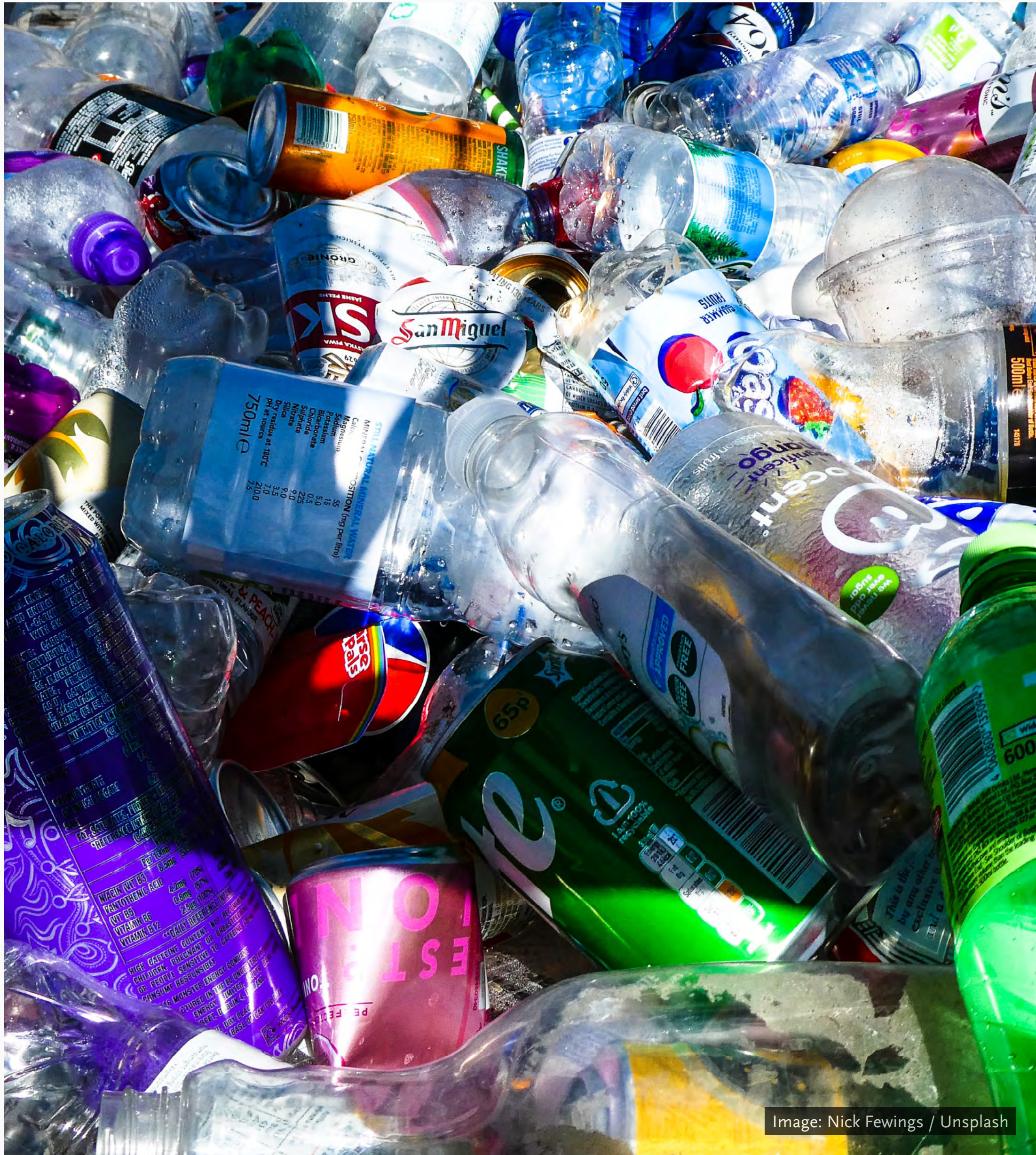


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## THE PROBLEM

# A Rise in Packaging Waste

According to the EPA, the weight of packaging sent to disposal and recycling systems tripled between 1960 and 2018.

During that same time period, the U.S. population doubled—meaning that consumption of packaging per capita increased significantly. Plastic and paper packaging use increased at the highest rate. In total, packaging accounts for 23% of landfilled material in the United States.<sup>1</sup>

Americans' consumption of ultra-processed foods is on the rise<sup>2</sup>—and ultra-processed food is always packaged. Centralized food production increases food miles, which increases the need to package food to protect it during transit.<sup>3</sup> Crop subsidies encourage farmers to grow nonperishable crops (i.e. corn and soybeans), which are key ingredients for processed, packaged foods.<sup>4</sup>

All of these trends benefit individual actors at some level—thanks to bounded rationality, the system may seem to work reasonably well from the perspectives of farmers, retailers, and shoppers in a supermarket. But the broader impacts from the system contribute to large-scale problems. If we zoom in to food packaging specifically, we can see many impacts: overwhelmed recycling systems, health and ecosystem impacts from landfilling and incineration, microplastics and plastic pollution, and continued reliance on fossil fuels for plastic production.



# System Description

This exploration is focused on the U.S. food system—specifically, the supply chain from food producers through to consumers.

This system involves many actors: farmers of all kinds, wholesalers and distributors, food and beverage companies, retailers, and consumers. It exists within a broad context, from natural systems like climate and weather to government policy like subsidies and regulation. Consumer behavior—influenced by cultural factors—also plays a role in the system’s behavior.

Because the focus of this exploration is food packaging waste at the consumer level, this perspective does not include distribution to food service (i.e. restaurants) or food exports. And because the food system is so complex, this exploration will also necessarily exclude (or only touch on) many factors and impacts not directly related to packaging—environmental and health impacts from farming, animal and worker welfare, food insecurity, food waste, and more.

**Purpose:** To produce, distribute, and sell food to feed the U.S. population

**Boundary:** The U.S. food supply chain from producers to individual consumers. This includes food production by producers (i.e. farmers), manufacturing and distribution (i.e. processing, packaging, and wholesale), retail (i.e. supermarkets), and purchase and use by consumers

**Inputs:** Natural elements for farming (i.e. weather, energy from the sun), materials for packaging, energy use at all phases

**Outputs:** Edible food, food waste at all stages, packaging waste, CO2 emissions

**Context:** Climate (including impacts from climate change), U.S. health systems, U.S. culture, legislation and regulation, marketing and advertising, recycling and waste systems



# U.S. Food Supply Chain

## Customers

*Who are the beneficiaries, and how does the issue affect them?*

In this system, the customers are people in the United States who purchase and consume food generated by the system. Of course, food has a direct impact on health and wellbeing, and it also plays social and cultural roles.

## Actors

*Who is involved in the situation?*

The actors in this system are food producers (e.g. farmers), wholesalers and distributors, food and beverage companies, and retailers. The U.S. government is an outside actor that directly influences the system via regulations and funding.

## Transformation

*What is the transformation at the heart of the system?*

The system transforms natural inputs into food (i.e. sunlight, water, and nutrients into food crops) and makes that food available to consumers. In the current system, that transformation often involves many steps to process, package, and transport food between producers, manufacturers, wholesalers, and retailers.

## Worldview

*What is the big picture and what are the wider impacts?*

The system exists within the broader economy and must be able to offer affordable food to consumers. When considering food packaging specifically, the big picture is packaging waste, which impacts the Earth's climate via GHG emissions, ecosystems via litter, and human health via waste management and toxicity. Multiple industries, including fossil fuel producers and waste management companies, are involved, as well as governments, which can pass legislation that affects the system.

## Owners

*Who owns the process or situation, and what role will they play in the solution?*

The U.S. food system is incredibly large and complex. At the broadest level, the U.S. government owns the process because it holds strong influence over food producers via regulation and funding. It can also offer incentives and funding to new models of agriculture and retail to support systems change.

## Environmental Constraints

*What constraints will impact the solution and its success?*

The system must be able to provide affordable food to consumers, so economic constraints apply. Many actors in the current system will resist systems change (e.g. packaging companies that stand to lose business). Culture also plays a role: As explored in later influence diagrams, many cultural factors (like longer working hours, lack of paid family leave, etc.) influence increased consumption of ultra-processed, packaged foods.



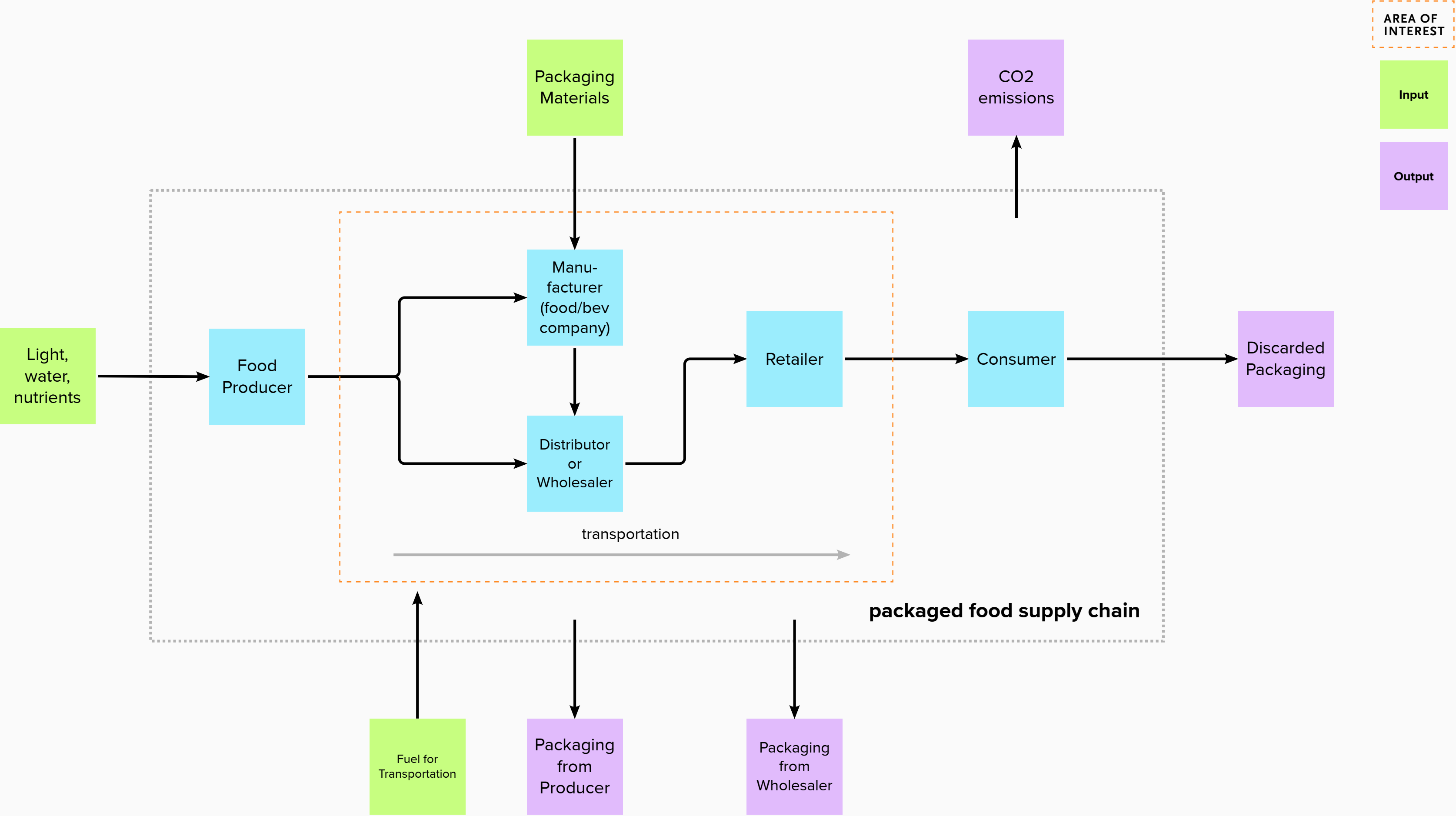
SYSTEM VIEW 1

Linear Process

This diagram shows the process that packaged food moves through from producer to the consumer within the current system.

Area of interest:

While much packaged food is also ultra-processed (i.e. cereals, chips), many fresh or staple foods are packaged to withstand long journeys between producers and retailers and/or to be sold on shelves in conventional supermarket settings. By eliminating or reducing steps between producers and retailers (or consumers) and by expanding access to innovative “zero waste” shopping models, we can reduce or eliminate packaging.





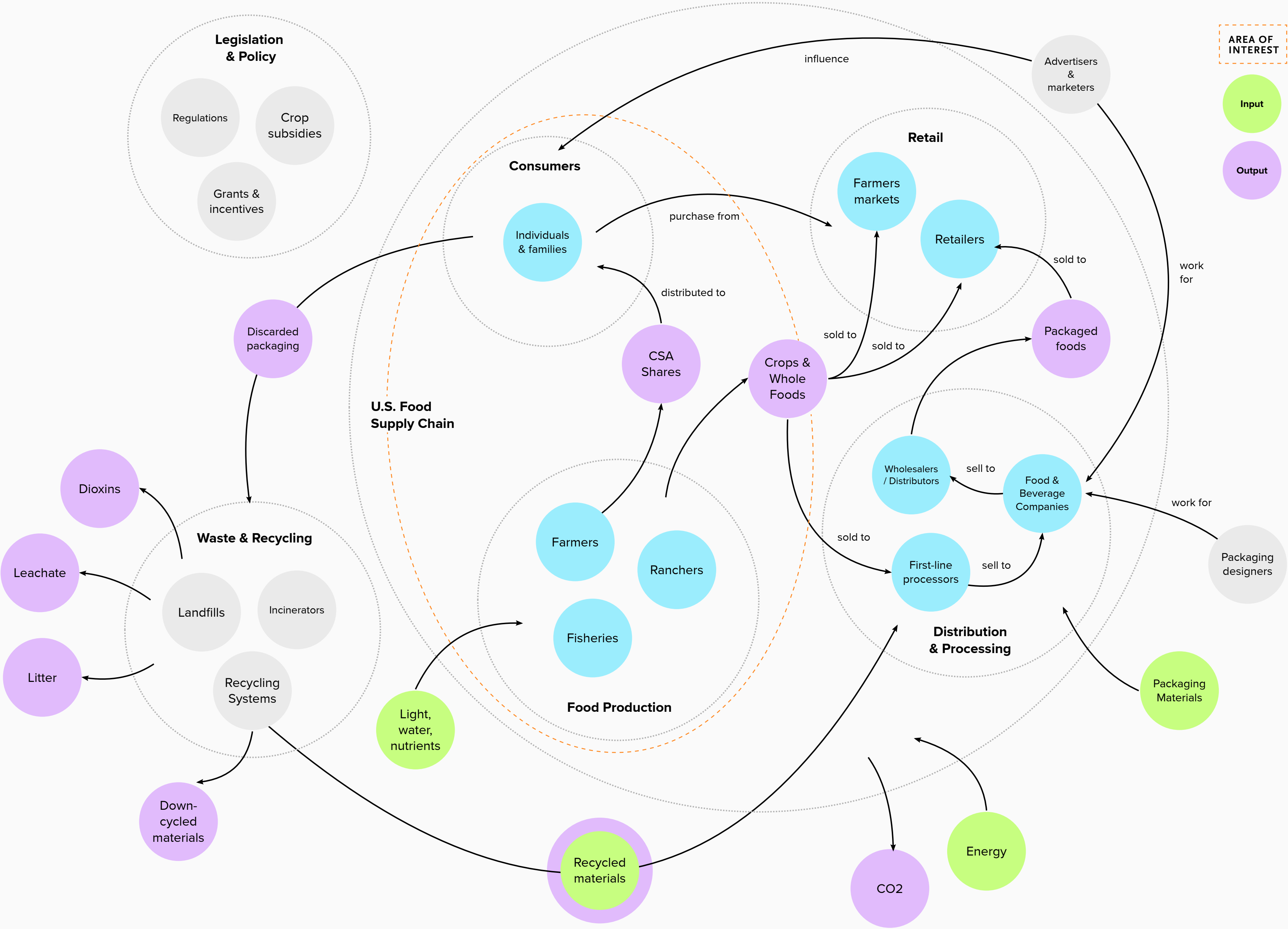
SYSTEM VIEW 2

# System Relations

This diagram explores the relationships between the actors within the system, along with key actors surrounding the system and system inputs and outputs. This diagram broadens the view to include fresh foods, including distribution via CSAs and farmers markets.

Main takeaway:

Strengthening connections between food producers and consumers can reduce the steps in the supply chain





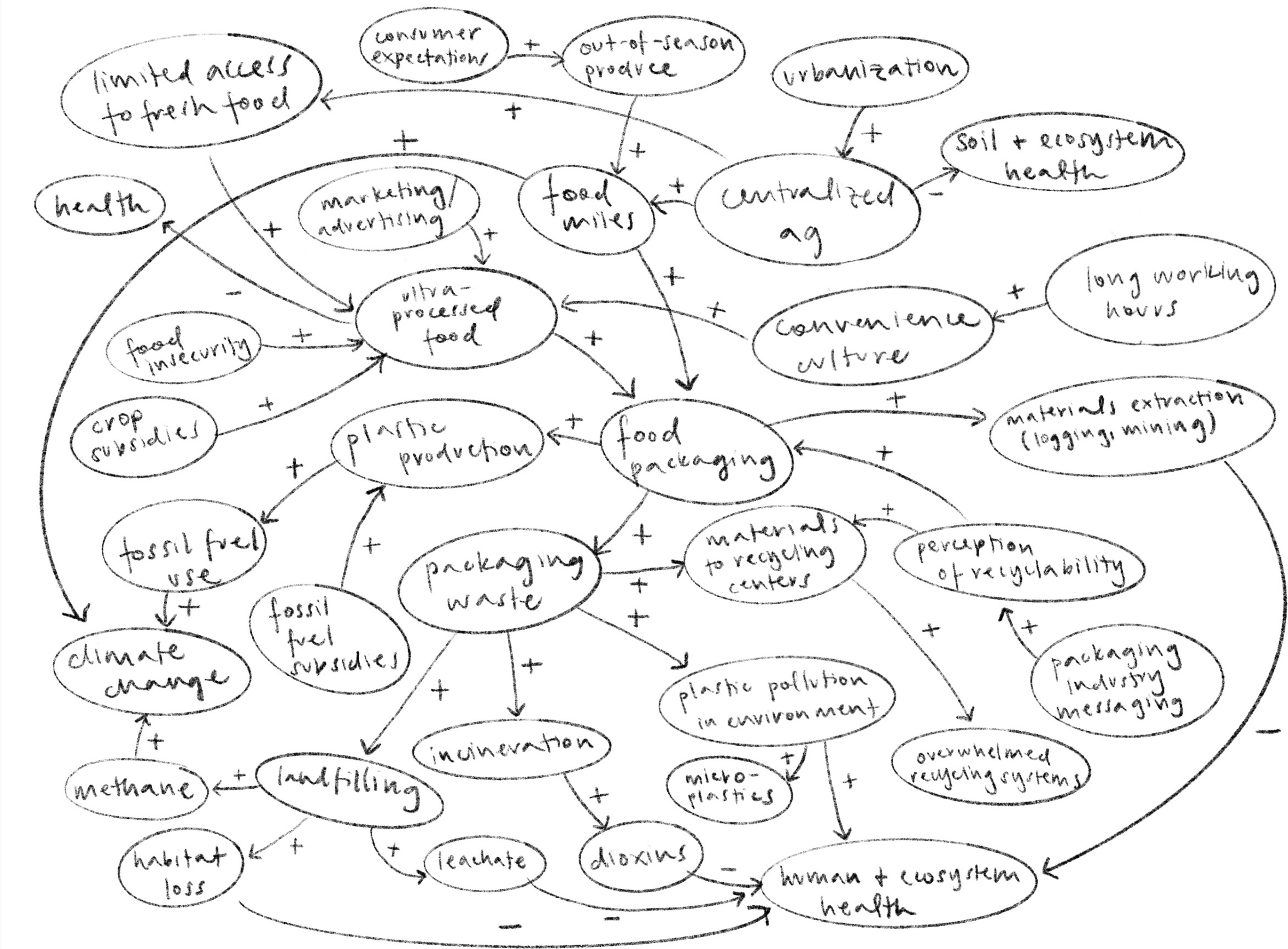
INFLUENCE DIAGRAM

# Food Packaging Waste

This diagram explores the influences that have led to a proliferation of packaging in U.S. food systems, as well as the negative impacts of packaging waste.

**Main takeaway:**

The problem of food packaging cannot be separated from issues in the current U.S. food system

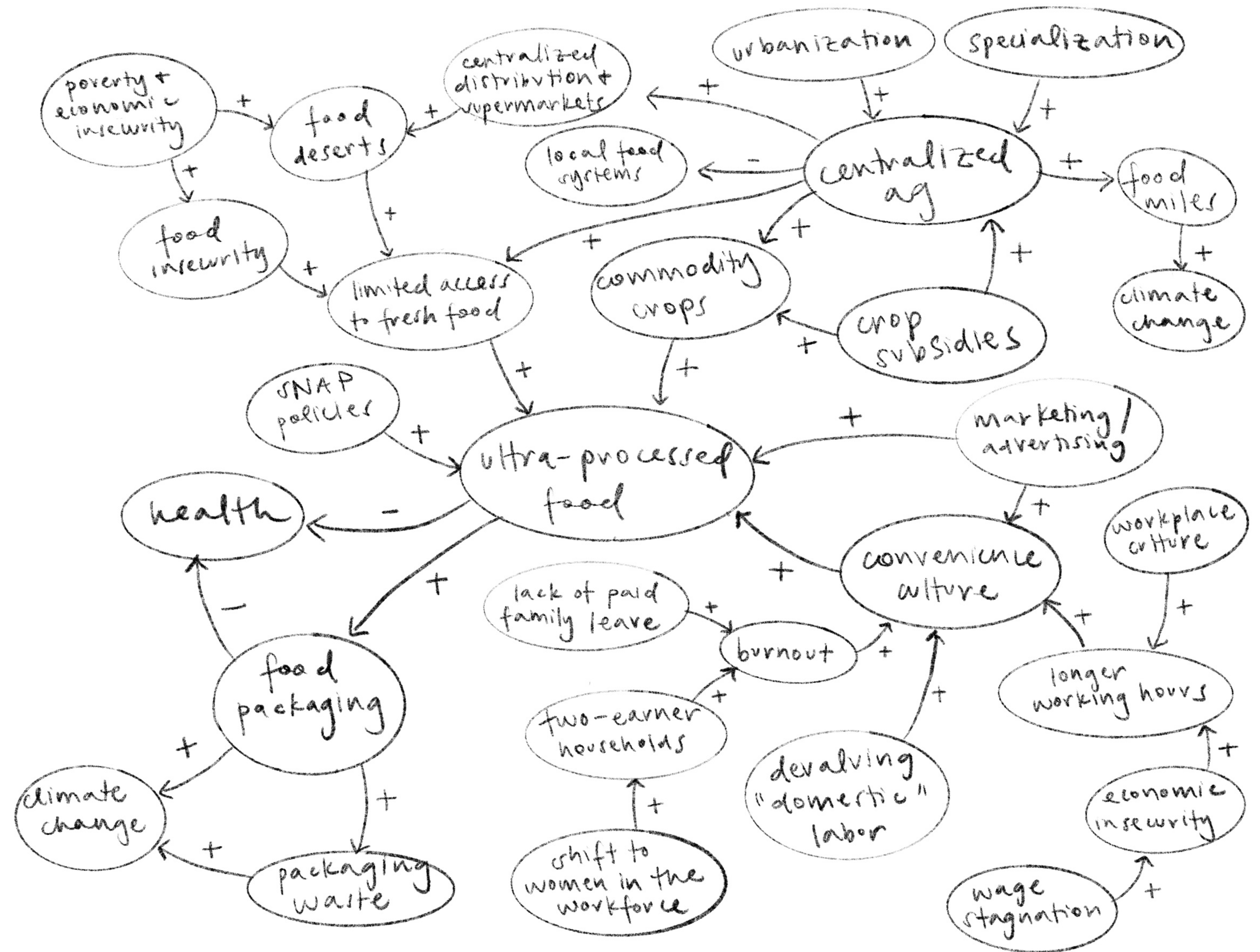




# Ultra-Processed Foods

## Main takeaway:

Consumption of ultra-processed food is influenced by cultural and economic factors, along with dynamics in our food system





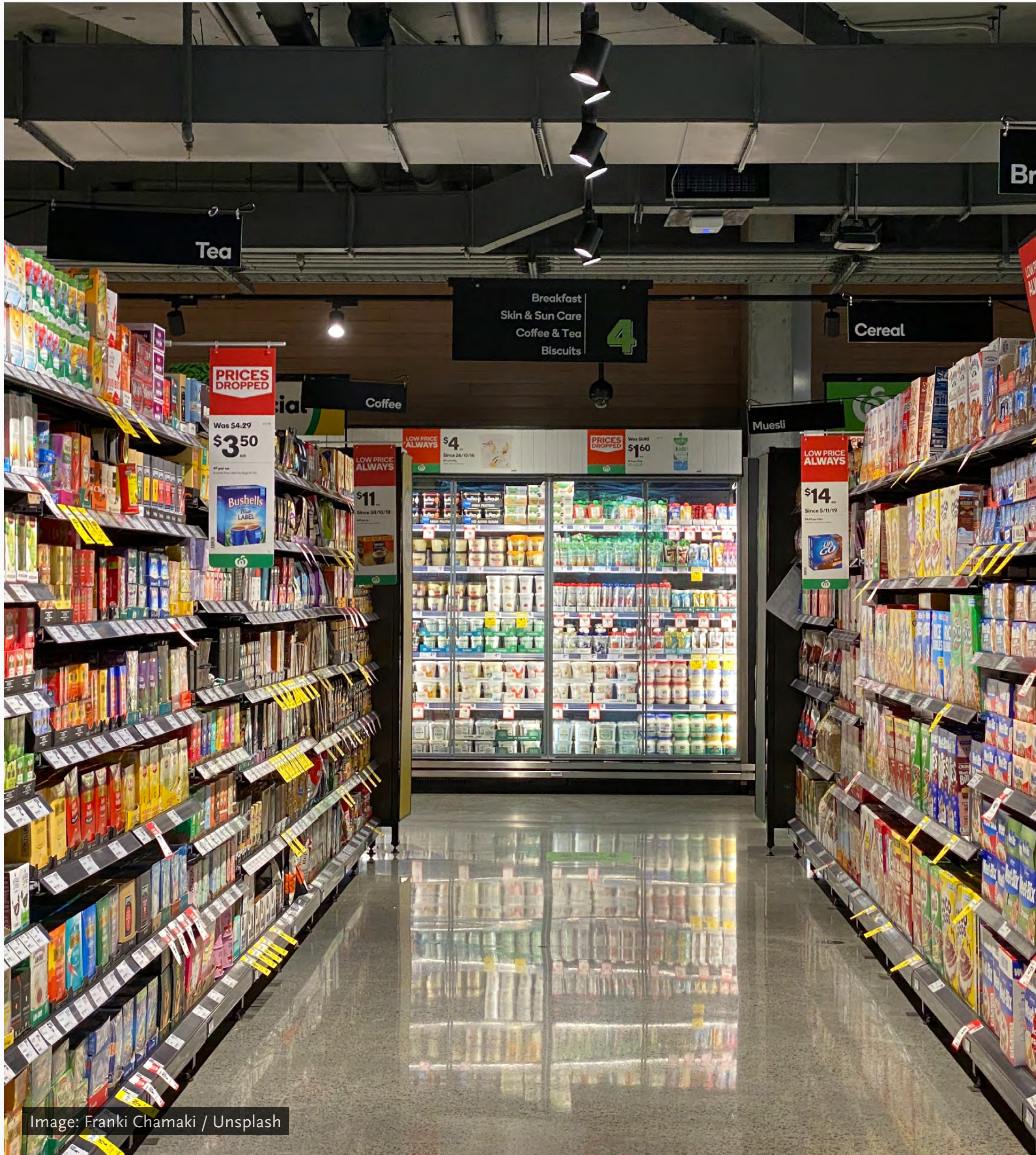


Image: Franki Chamaki / Unsplash

## SYSTEM ARCHETYPE

# Seeking the Wrong Goal

The U.S. food system prioritizes centralization, efficiency, convenience, and price.

The influence diagrams show that the problem of food packaging cannot be separated from issues in the current U.S. food system. To solve packaging waste, we need to question the goals that incentivize the broader food system: centralization, efficiency, convenience, and price. The negative impacts of the current system—on health, climate, and ecosystems—are ignored, so the system is working to produce many unintended results.

Crop subsidies, which encourage centralization and commodity crops, may help create lower prices, but the foods and production methods that they encourage create significant health and environmental impacts (i.e. a rise in diabetes, packaging waste, and soil erosion).

When we prioritize convenience in our food system, we lose sight of the fact that “convenient,” ultra-processed foods come with real costs, like packaging waste and negative health impacts.

Prioritizing low prices may help reduce hunger at first glance—but when the only foods low-income communities can access or afford are highly processed, the health impacts are profound.<sup>5</sup> Low prices also come at the cost of animal and worker welfare and environmental degradation.



A person is holding a large bunch of fresh leafy greens, likely chard, against a blurred green background. The person's hands are visible at the bottom, holding the stems of the greens. The greens are vibrant green with some reddish-purple veins. The background is a soft, out-of-focus green, suggesting an outdoor setting like a garden or field.

# System Solutions

This section explores potential interventions to shift the U.S. food system away from packaging waste.





Image: Kenny Eliason / Unsplash

## SYSTEM INTERVENTION

# A New System Goal

In order to transform the system, we need a new system goal: Affordable, accessible food that is healthy for people and the planet.

*Three solutions to move the system toward this goal are proposed on the following pages.*



## SOLUTION 1

# Shift crop subsidies to regenerative, local, and regional agriculture

### Human and ecosystem health impacts:

- Reduced commodity crops, leading to less ultra-processed food and less packaging waste.
- Expanded access to fresh food reduces packaging waste and improves health.
- Local and regional food systems reduce food miles and decrease transport emissions and packaging.
- Regenerative agriculture reduces carbon emissions and increases soil and ecosystem health.





## SOLUTION 1: SHIFT SUBSIDIES

# Solution Impacts

*How does this solution support the new system goal to provide affordable, accessible food that is healthy for people and the planet?*

### A Move Away from Ultra-Processed Foods

The U.S. government should question their current system of agricultural subsidies, which encourage farmers to grow large amounts of commodity crops (e.g. corn and soy). These crops are used heavily in packaged, ultra-processed foods—and subsidies artificially increase supply and reduce price.<sup>6</sup> By supporting regenerative local and regional food networks instead, the government would be working to support the new system goal by increasing access to healthy foods and limiting or eliminating negative health and environmental impacts from food production and packaging.

### Increased Access to Fresh, Healthy Foods

The government should shift crop subsidies to local and regional agriculture in support of the new system goal. Doing so would expand access to fresh, healthy food and reduce food miles, thereby reducing or eliminating packaging and emissions from transport. Produce that doesn't have to stand up to long transport times is more nutritious<sup>7</sup>—and it usually tastes better, which may encourage people to buy fresh, local food once they're aware of the difference in quality.

### A More Efficient System = Fewer Emissions and Less Packaging

Expanding local and regional food networks could also create more efficiency in the supply chain by eliminating or deemphasizing the role of wholesalers, manufacturers, and distributors. For example, local produce that is sold at a farmers market moves directly from the grower to the consumer, and local food sold at a retailer can be sold by the grower directly to the retailer. This more direct supply chain would create fewer emissions from transportation and reduce the need for packaging.

### Support for Climate- and Ecosystem-Friendly Agriculture

The government could also provide additional subsidies or incentives to farmers who incorporate regenerative practices, like cover crops, crop rotation, reduced or no tillage, and organic production. These practices reduce carbon emissions, help the soil store carbon, and support healthy ecosystems.<sup>8</sup> Regenerative practices also support healthy soil, air, and water and help farmers build resiliency and community<sup>9</sup>—and therefore help to create a food system that is healthy for people and the planet.

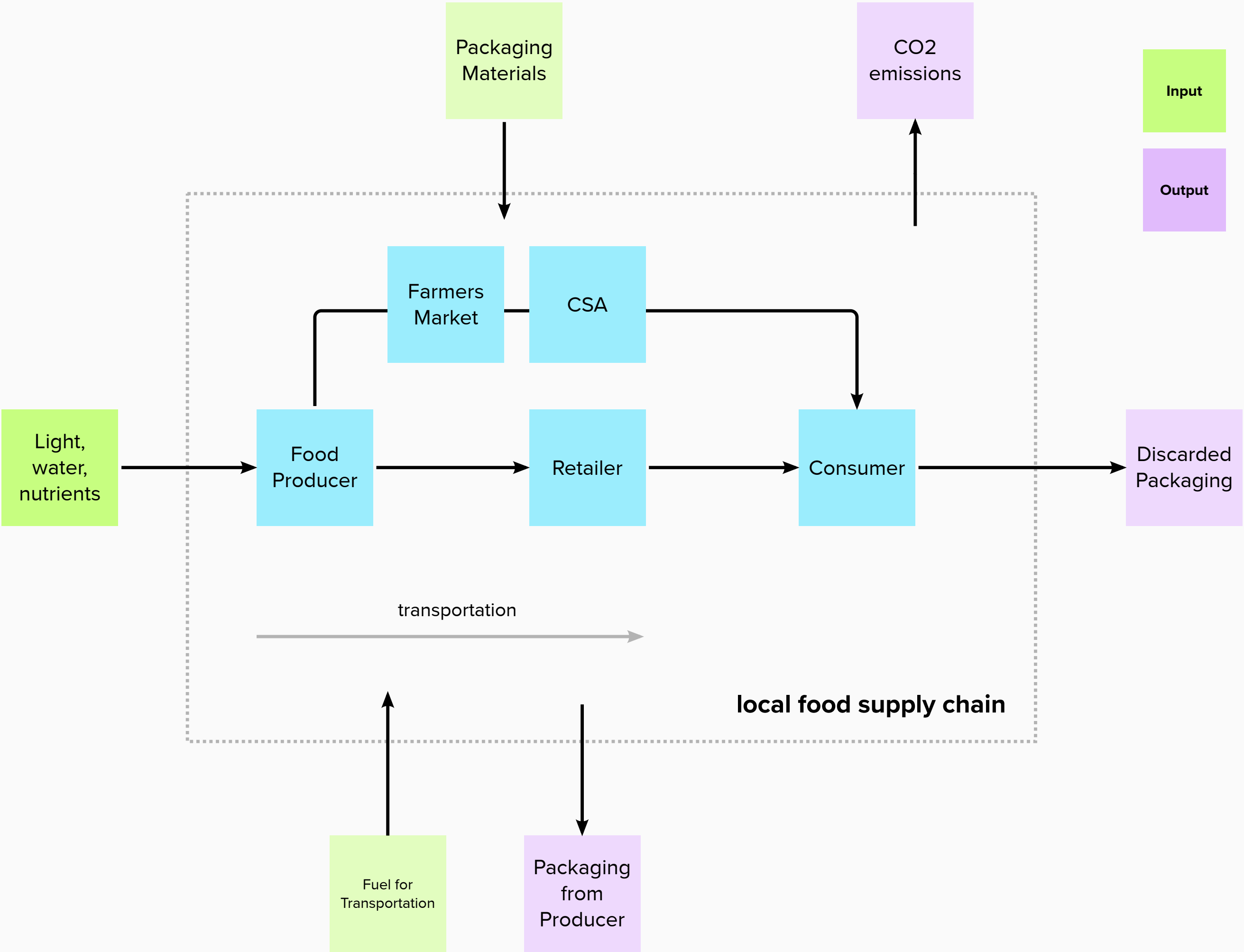


SOLUTION 1: SHIFT SUBSIDIES

# Linear Process: Local Food

This updated process diagram shows the change in the food supply chain created by local food (compared to packaged and/or ultra-processed food in the current system, p. 6).

Local food systems create a more efficient supply chain, with direct relationships between food producers and retailers or consumers. This more efficient supply chain reduces or eliminates key inputs and outputs (indicated in light green and light purple in this updated diagram).

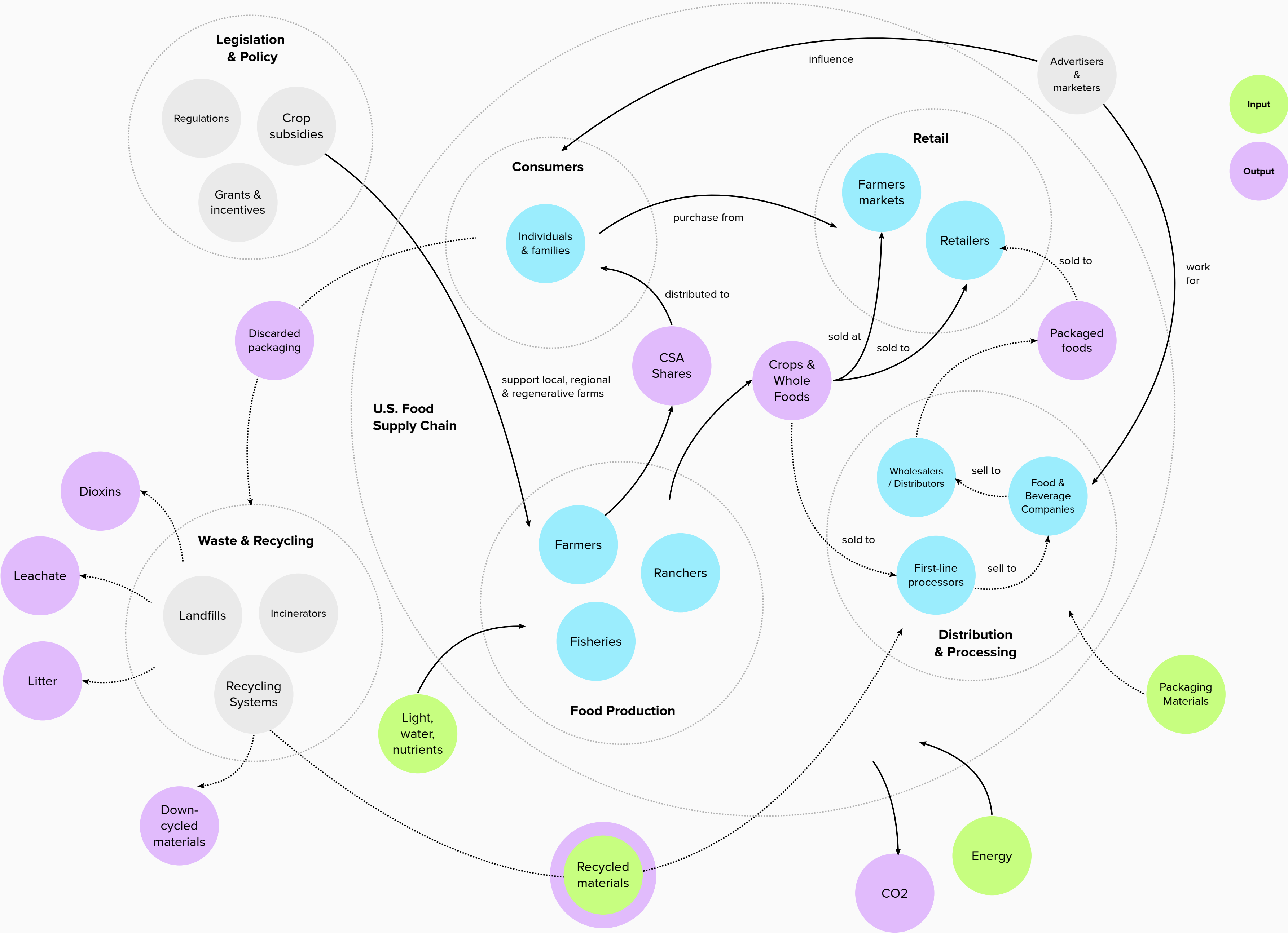




SOLUTION 1: SHIFT SUBSIDIES

System Relations

This updated system relations diagram shows the change in relationships between actors that subsidies for local, regional, and regenerative farms would create (compared to the current system, p. 7)—weakened relationships between producers and distribution and processing, and strengthened ties between producers and consumers. Weakened relationships and inputs/ outputs are indicated by dashed lines.





## SOLUTION 2

# Grants to support local grocers and innovative retail models

### Human and ecosystem health impacts:

- Equitable food access eliminates food deserts, reducing people's dependence on ultra-processed foods.
- Expanded access to fresh food reduces packaging waste and improves health.
- Innovative retail models, like zero waste stores, reduce or eliminate packaging waste.



Image: Raul Gonzalez Escobar / Unsplash



# Solution Impacts

*How does this solution support the new system goal to provide affordable, accessible food that is healthy for people and the planet?*

## Equitable Access to Healthy Food

Food deserts are defined as “areas with no or distant grocery stores and limited access to nutritious food options.” The current food system’s focus on centralization has exacerbated the expansion of food deserts because supermarkets are easier and cheaper to develop in suburban areas. Federal, state, or local grants or other economic incentives that support new local grocery stores in underserved neighborhoods could help expand access to healthy food—and, in doing so, reduce peoples’ reliance on packaged, ultra-processed foods. This would also have a direct and measurable impact on health: Sadly, people living in food deserts are “statistically more likely to suffer or die prematurely from diet-related disease.”<sup>10</sup>

## Innovative, Reduced-Waste Models for Shopping

Grants that support innovative, reduced-waste retail models, like “zero waste” stores or stores with significant bulk/refill-based sections, would reduce packaging waste. These stores currently exist and are expanding, which shows the model can work—but we need expand access to the model for it to be adopted at a meaningful scale. Government grants other incentives could be the boost that zero waste stores need. Because these stores help reduce packaging waste, and therefore alleviate strain on recycling systems, supporting them could actually offer savings to governments that operate overburdened recycling and waste programs.<sup>11</sup>

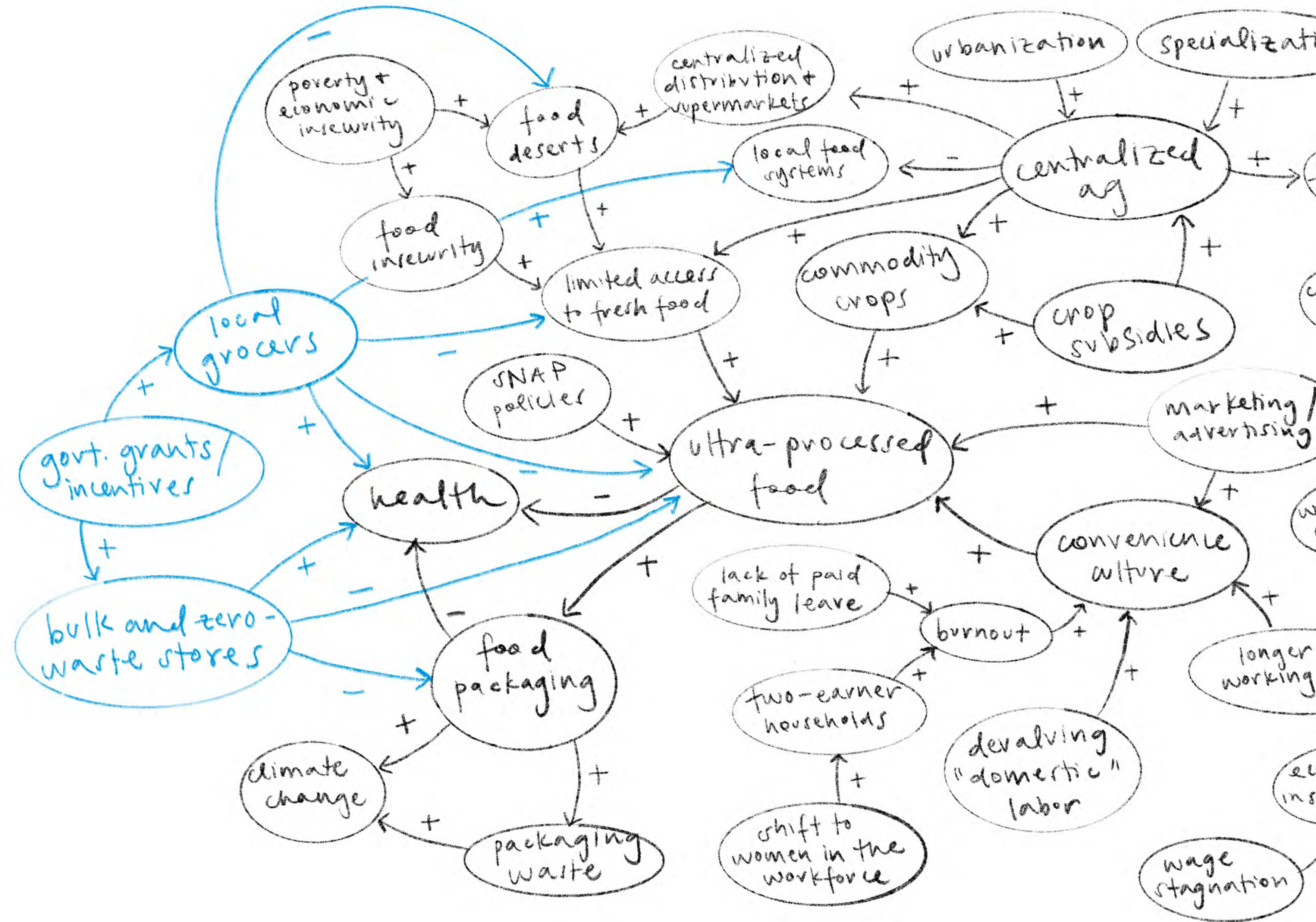
## Cutting Carbon Emissions and Toxic Pollution

This solution would reduce packaging waste by reducing consumption of ultra-processed foods and by expanding access to innovative, package-free food shopping. That means fewer impacts from packaging waste, like leachate and dioxins from landfills and incinerators, microplastics and plastic pollution, continued reliance on fossil fuels for plastic production, and methane emissions from landfilled waste.<sup>12</sup>



# Influence Diagram

Supporting local retail would help to build stronger local and regional food systems. In doing so, it would foster a more direct relationship between consumers and food producers by making local and regional food available in local grocery stores. Supporting innovative retail models, like zero waste, would expand consumer access to those stores.





SOLUTION 3

# Industry-wide packaging design sustainability framework

Human and ecosystem health impacts:

- Reduced packaging waste limits health and ecosystem impacts from recycling, landfilling, incineration, and litter.
- Eco-effective design encourages non-toxic and/or fully recoverable materials to feed biological and technical nutrient systems.
- Labeling increases consumer awareness, potentially shifting attitudes and encouraging more sustainable behaviors (e.g. shopping at zero waste stores).

Lumi Sustainability

Search sustainability properties...

Life-cycle stage

Design

Distribution

Materials

Production

Recovery

Pr

Print reduction

Minimizes the amount of printed surface.

Mr

Material reduction

Minimizes the amount of raw material used in production.

Cr

Component reduction

Minimizes the number of components produced.

Wr

Weight reduction

Reduces overall weight in transit.

Vr

Volume reduction

Reduces the amount of space necessary for transit and storage.

Re

Renewable energy

Uses energy collected from resources that naturally replenish on a human timescale.

Lp

Local production

Can be produced within 250 miles of delivery to reduce energy use and freight emissions in transit.

Rm

Renewable materials

Made from materials that can regenerate on a human timescale and be responsibly managed.

Rc

Recycled content

Contains a significant proportion of recycled material.

Plastic-free

Sustainability framework created by design studio Guacamole Airplane for Lumi, a platform that streamlines packaging supply chains. Lumi wanted their customers to be able to more easily understand the sustainability impacts of their packaging decisions. The framework is composed of 20 definitions and corresponding labels that allow users to easily see the key sustainability characteristics of a particular package.



SOLUTION 3: SUSTAINABLE PACKAGING FRAMEWORK

# Solution Impacts

*How does this solution support the new system goal to provide affordable, accessible food that is healthy for people and the planet?*

## Shifting the Burden from Designers via Resources for Sustainable Packaging Design

While the most effective system solutions arguably focus on eliminating packaging entirely, we can assume that packaging will remain a part of the system to some degree. Though designers exist outside the system boundary as defined here, they can create impact within the system by applying sustainable design principles to packaging design. These approaches could range from eco-efficiency (e.g. reducing weight or ink coverage) to true eco-effectiveness (e.g. designing food packaging that can be safely and completely composted to support future crops). However, designers often don’t have support from their clients or managers to pursue eco-effective design—instead, budget, timeline, and status quo goals are the priority. Designers also may not know how to implement sustainable solutions, even if they’re aware of the issues created by packaging waste. A packaging sustainability framework created by a core industry group, like AIGA or the Dieline, could serve as an accessible reference for designers and could help popularize sustainable design principles.

## A Move Toward Eco-Effective Packaging

While a realistic sustainability framework would include solutions that tend toward eco-efficiency (e.g. reducing weight or ink coverage), it should also encourage eco-effective designs—and could perhaps reward those designs with a higher “score” for the consumer-facing label. In *Cradle to Cradle*, Michael Braungart and William McDonough describe an ideal for materials that feed fully and safely back into biological or technical systems. This would mean, for example, an end to “monstrous hybrids” (e.g. multi-layer bags) and to materials that must be downcycled (e.g. printed aluminum cans and most plastics).<sup>13</sup> It could also encourage materials innovation—for example, incorporating non-toxic, fully biodegradable materials like mushroom-based packaging or fiber-based alternatives to plastic. The framework could also encourage designers to look to nature for solutions or to follow Life’s Principles for sustainable design—and ultimately to question and reenvision when we need packaging and what form that packaging takes.

## Increased Consumer Awareness and Behavior Change

The framework would serve as a resource for designers, but it could also communicate the importance of sustainable packaging to consumers. If the framework certified packaging, designs that meet the framework’s criteria could include a logo that served as a meme to communicate packaging impact to consumers. The framework could also create consumer-facing resources (social media, a microsite, etc.) to help people learn more about the impacts of packaging. By raising awareness of packaging waste—especially by making sustainable choices more visible in stores—this solution could help shift attitudes and encourage more sustainable behaviors, like shopping in zero waste stores.



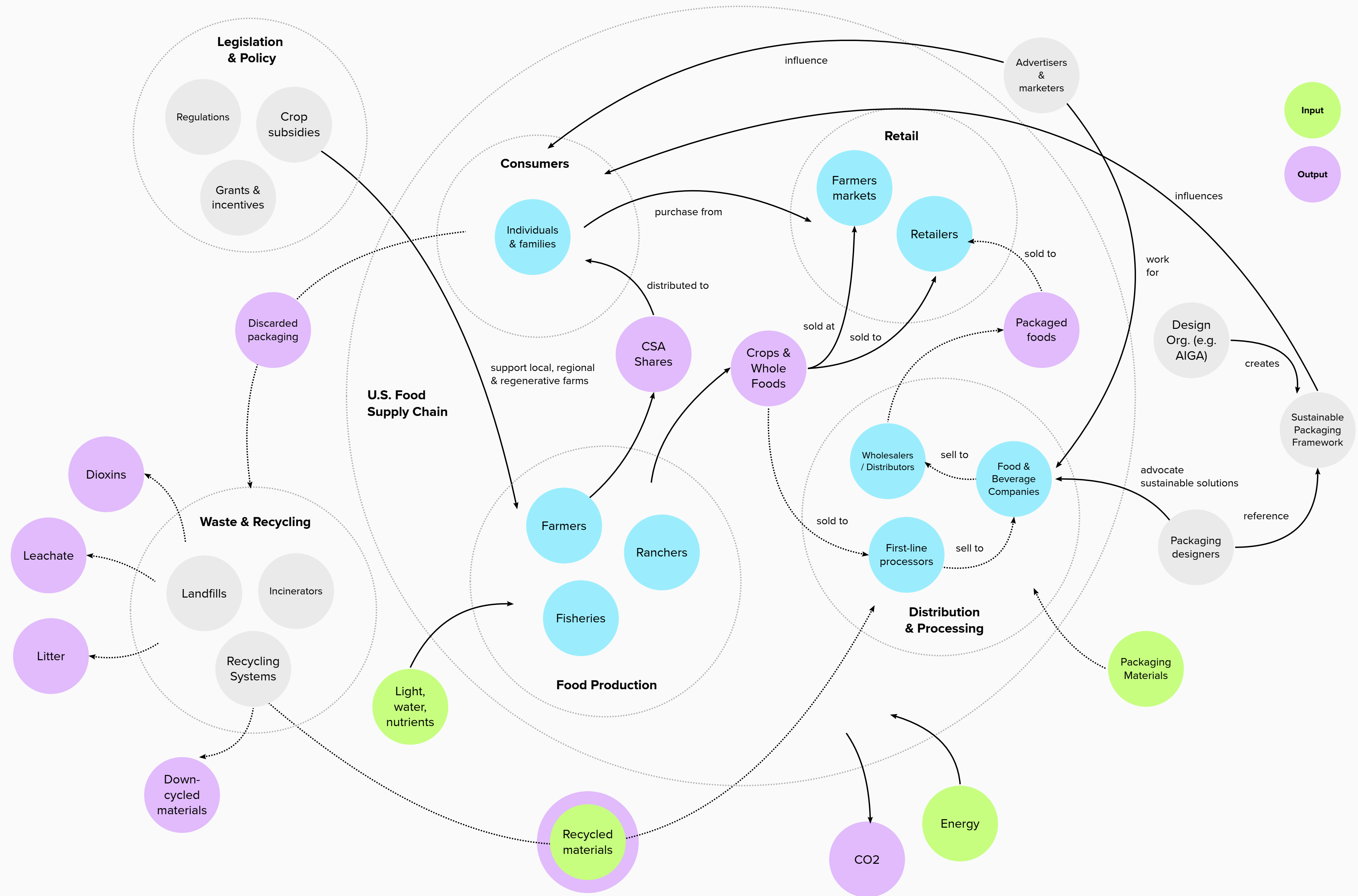
FSC, Equal Exchange, and Fair Trade are all examples of consumer-facing marks that communicate social and environmental features



SOLUTION 3: SUSTAINABLE  
PACKAGING FRAMEWORK

System Relations

This updated system relations diagram shows the change in relationships between actors that a sustainable design framework would create (compared to the current system, p. 7). This diagram shows a more meaningful connection between designers and food manufacturing clients and between consumers and the packaging design industry. Weakened relationships and inputs/outputs are indicated by dashed lines. This view also includes impacts from Solution 1 (a shift in subsidies).





# Reflection

I started this course with an interest in food packaging waste, and I began my explorations at the retail level—I wanted to explore zero waste and other bulk models as solutions to the problems created by packaging. While I do think that those models can play an important role, working through this course and particularly this project helped me see that the problem of packaging waste is impossible to separate from the full picture of the food system in the United States. The proposed solutions in this project attempt to shift that broader system—with results that touch packaging waste and also many other spheres, including health, agricultural systems, and equitable food access. I was influenced in my thinking by Oran Hesterman’s *Fair Food*, and many of the arguments and ideas in his book are cited here.

This project only touches on the cultural factors that influence our food system (under the broad umbrella of “convenience culture”). But, I do think culture will play an important role in system change—how do we encourage behavior change, what other systems might need to shift for people to have time to slow down and cook with whole foods, etc.—and so that is an area for future exploration.

This final draft takes into account feedback from my classmates. I emphasized that the burden for designing sustainably should not fall on individual designers but instead should be supported by the design industry as a whole, included examples of innovative materials, and emphasized the benefits of regenerative agriculture for people and the planet.



Image: Sarah Chai / Pexels



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