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DATAWATCH

Infographics And Public Policy: Using Data Visualization To Convey Complex Information

Data visualization combines principles from psychology, usability, graphic design, and statistics to highlight important data in accessible and appealing formats. Doing so helps bridge knowledge producers with knowledge users, who are often inundated with information and increasingly pressed for time.

In this issue of the journal, *Health Affairs* is launching its "DataGraphic" feature—an information graphic (infographic) summarizing key insights from one or several of the articles presented in the issue.[1] Infographics are an effective way to present complex data in a visual format that is compelling, provides rapidly available information, and is directly useful for decision-making purposes (Exhibit 1). Effective infographics are based on principles from the fields of psychology, usability, graphic design, and statistics with the aim of reducing barriers (limited time, information overload) to understanding important information. They therefore serve an important role in bridging the gap between producers and

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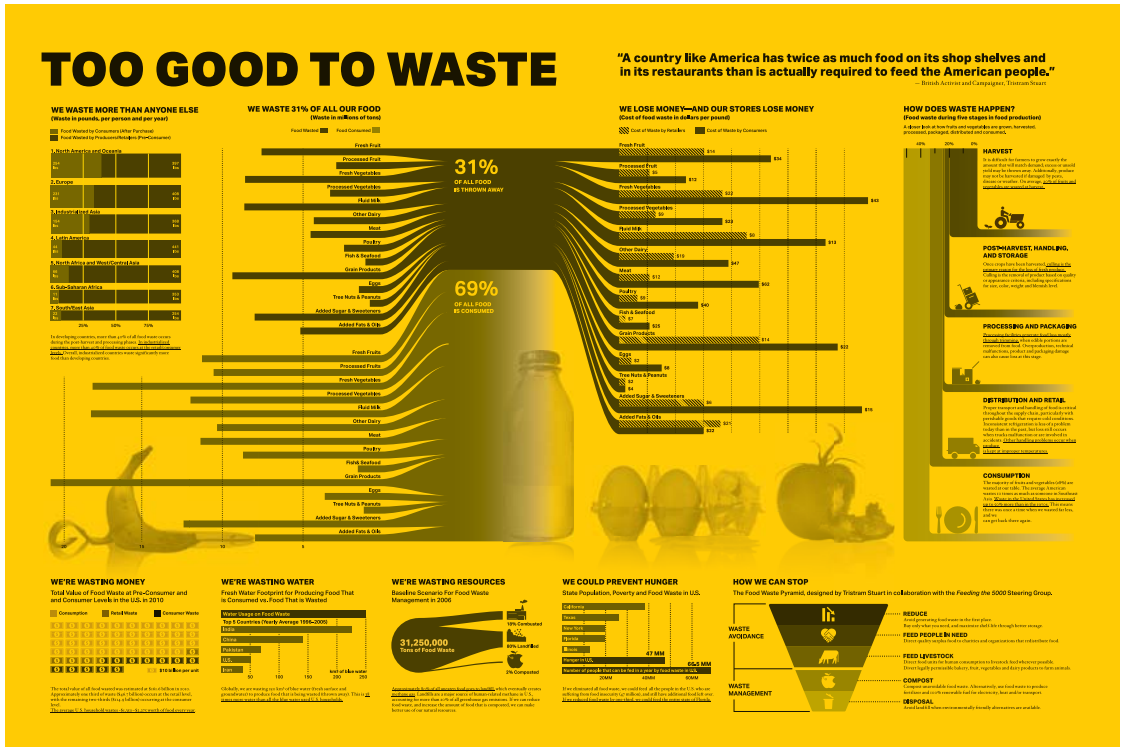
EXHIBIT 1

Infographic Example 1: A Shocking Quantity Of Food Is Wasted In The United States Each Year



SOURCE Khaito Gengo, senior undergraduate in visual communication design, University of Washington, Seattle, 2014. **NOTE** See online Appendix Exhibit A3 for a complete list of the data sources used to create this exhibit (see Note 2 in text).

consumers of information.

Infographics can take various shapes and forms but may be grouped into three main types: data graphics, maps, and diagrams. They also can be static (for print or screen use), animated (for screen use), or interactive (for screen use). Multiple data visualizations, maps, or diagrams can be combined into an overall visual composition with illustrations and selected text to convey a larger story or narrative. Such large posters, panels, or scrolling images are commonly considered to be infographics, although they might also be called "storygraphics" because they impose a narrative flow on the data. These narratives can be explanatory (seeking to objectively educate or inform), editorial (suggesting value judgments), persuasive (seeking to influence or sway), or exploratory (testing multiple alternative hypotheses). Online Appendix Exhibit A1 provides more details on types of infographics.[2]

Infographics are not a new concept. Their history can be traced back to William Playfair, an eighteenth-century Scottish engineer and economist who invented the line chart, bar graph, and pie chart.[3] Two centuries later, statistician Edward Tufte defined best practices for communicating quantitative and qualitative information in his authoritative books on information design,[4–7] drawing examples from a portrayal of Napoleon's invasion of Russia in 1812[8] to the early interface design for the Apple iPhone.[9]

Newspapers were among the first media outlets to popularize infographics. *USA Today* is known for its "Snapshots" feature, which uses simple graphics to depict public opinion on contemporary issues.[10] While *USA Today* has been questioned about the accuracy and analysis methods of "Snapshots," it did lead the way for other publications, such as the *New York Times*, to develop practices supporting more complex yet accessible information visualizations.[11,12]

The Power Of Images

The broad accessibility of data and digital tools has dramatically increased the quantity of information directed toward policy makers and the general public. By some estimates, the average person is inundated with the information equivalent of 147 newspapers daily.[13] Because infographics leverage the brain's most dominant capacity—visual processing—they can be a faster and more effective way of communicating information than text alone. Studies estimate that nearly 50 percent of the brain is involved in processing vision; the human visual system is so well developed that people can get the sense of a visual scene in less than one-tenth of a second.[14,15] Taking advantage of the rapidity of visual processing, well-designed infographics allow viewers to quickly find patterns and trends and easily compare groups and quantities.

All of this provides a vital opportunity for researchers and visual designers to work together to create infographics that can convey key issues of complicated public and policy interest. By integrating quantitative charts with explanatory text and illustrative diagrams, for example, researchers can communicate their findings as engaging, persuasive, or memorable narratives of discovery. In this way, infographics take advantage of the power of stories—our oldest and most natural form of sense-making.

Designing Effective Infographics

Creating a compelling narrative infographic from primary research is not a trivial undertaking. There is the potential for oversimplification when condensing a large report of advanced scientific research into a single visualization. Additionally, infographic design typically involves interpreting numerical data, which can easily be distorted or made misleading (unintentionally or otherwise). Numbers can also be made to appear more precise than they really are.

Research investigations and design activities follow parallel paths. For example, it is critical for both activities to focus on specific investigative questions, to conduct rigorous analyses, and to communicate the most important and actionable results to a specific audience in ways that are appropriate to their level of knowledge. (See Appendix Exhibit A2, which depicts the parallel processes of research and design.)[2] As a viewer or user of information, it is critical to evaluate the credibility of data sources, to examine structural manipulations (such as the omission of zero), and to be aware of common ways in which statistics can be used to mislead.[16]

The most effective infographics help viewers think critically about a particular subject or data set in terms of individual measurements and broader patterns.[17] The least effective infographics tend to be visually overwhelming, using excessive or extraneous data or "noise," or present information in a way that is confusing or makes it appear insignificant.[17]

Infographic design should also be informed by the communication setting. For example, infographics that are part of a presentation are typically accompanied by spoken explanation. Accordingly, they should be made bold for visual impact and succinct for quick comprehension. Infographics in a printed publication can convey far more detail and may need additional annotation compared to those used in an oral presentation.

Specific Examples Of Food Systems Infographics

Three food-related infographics were developed by graduate and undergraduate students of the Visual Communication Design program in collaboration with researchers at the Center for Public Health Nutrition at the University of Washington, in Seattle. These large printed panels, which primarily employ Sankey or flow diagrams, examine a variety of issues within the US food system, including an analysis of the series of steps a given food item takes on its complex journey from farm to plate and the factors that influence postconsumer food waste.[18] (The sources used to create these exhibits can be found in Appendix Exhibit A3.)[2]

Exhibit 1 exemplifies a persuasive infographic that seeks to draw attention to the important problem of food waste and suggest potential policy solutions. Graphics and photography create a powerful and compelling narrative explaining the shocking amount of food that is wasted in the United States.

Exhibit 2 is an explanatory infographic that shows the three main methods by which fish are harvested in the United States: wild fishing, extensive fish farming, and intensive fish farming. The Sankey diagram shows the relative quantities of fish harvested by each method while presenting a general overview of fishing and farming practices. The narrative presents facts in as neutral and objective a manner as possible, with the goal of providing easily digestible information in order to set the stage for further discussion.

Exhibit 3 is an editorial infographic that traces the use of corn in America. The Sankey diagram shows the relative quantities of corn at each of their final destinations in the food supply chain. At the center is a color-coded choropleth map that uses shading to identify the principal locations where corn is grown. Text and illustrations at the periphery of each end node provide brief educational snapshots that help the viewer understand the advantages and disadvantages of each end use of the corn harvest. The combination of the main flow diagram with annotations suggests how viewers should think about the corn supply chain and the policy decisions that affect this crop.

Exhibit 4, which is a subset of Exhibit 1, illustrates how critical pieces of the story are detailed in specific visual subsegments. Other subsegments of Exhibit 1 illustrate regions of the world that are responsible for the most food waste, the types of food that are most frequently wasted, how and why food is wasted at specific points in the food supply chain, and the monetary value of wasted food. These visual subsegments simplify the complex story of food waste by breaking it down into more easily understandable segments. Each subsegment is distinguished by descriptive subtitles that guide the viewer through it in logical sequence. Importantly, the lower portion of the panel includes a hierarchy of evidence-backed solutions that call viewers to action.[19]

The Food Waste Pyramid depicted in Exhibit 4 is a conceptual diagram originally created by environmentalist Tristram Stuart.[20] The pyramid organizes evidence-backed solutions to food waste into two distinct categories: waste avoidance and waste management. Within each category, beneficial behaviors are prioritized, with more effective and desirable actions at the top of the pyramid.

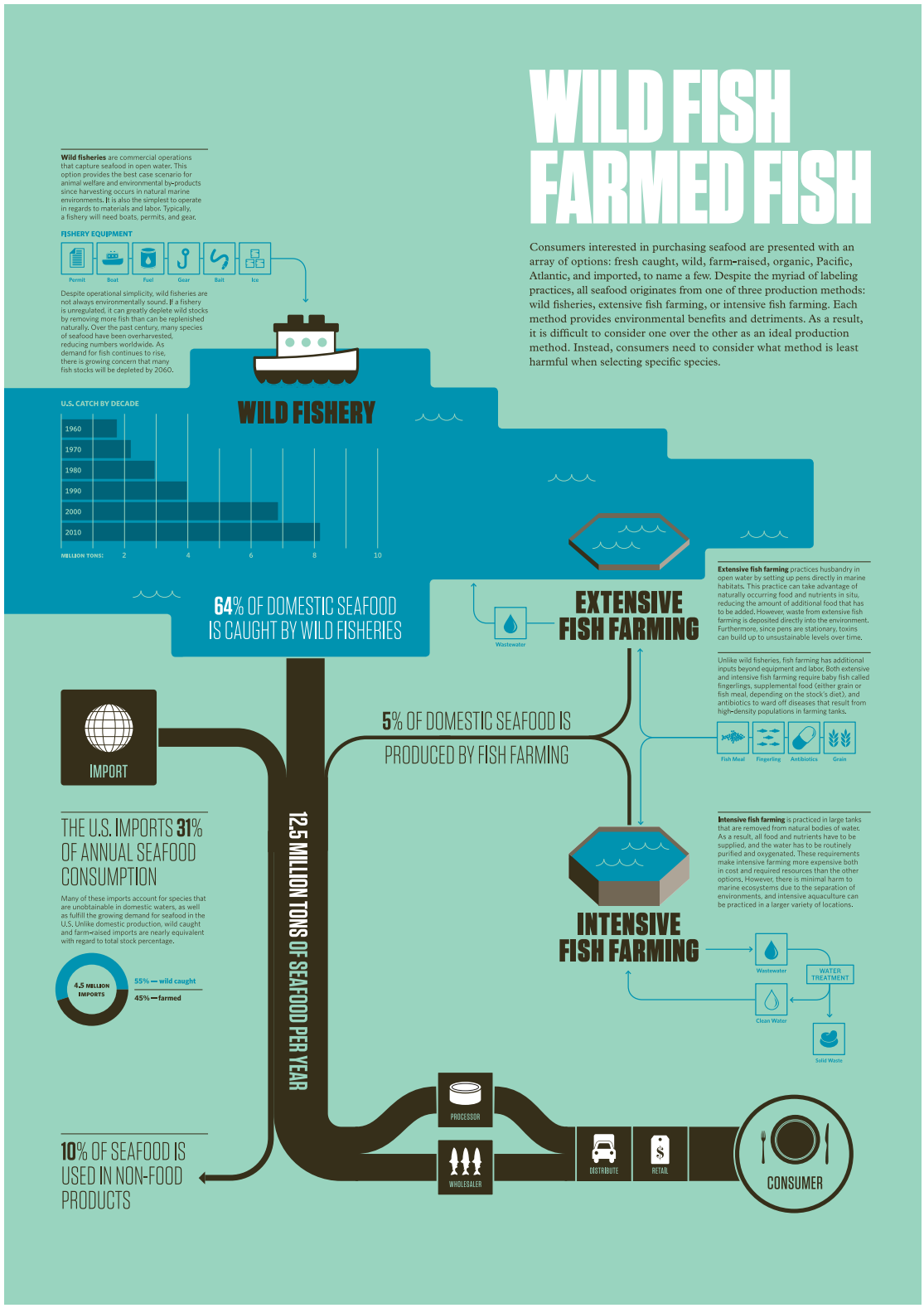
Conclusion

Infographics are a powerful way to distill and convey complex scientific information as a visual narrative. Infographics provide an effective means to communicate health and nutrition data to decision makers, who need high-quality information but in bite-size and readily accessible forms. Developing the relationships needed to create data-sourced infographics, which are not currently common, requires time and commitment—not only to develop the final product but also to develop the level of cross-expertise that is needed for interdisciplinary teams.[21] Funding will be needed to bring the data-driven community into the world of visual communication design and vice versa. While designing an information graphic is the initial step, more effort is required to promote its effective use. Researchers and policy makers must still actively engage in ways that bring science by design into the right decision-making pathways at the right time to ensure their use.[22]

As societal problems demand more interdisciplinary and collaborative approaches, visual communication design as applied to food and nutrition science offers a number of advantages. First, the collaborative design process requires that all participants contribute to decisions as the visual representation of data evolves.[23] Multiple inputs reduce the possibility that data will be ambiguous or inaccurately represented. Another factor in the success of these efforts is the formation of interdisciplinary teams that are necessary for the collaboration to work. Finally, collaborative visualization is dynamic and iterative because the result is subject to evaluation and revision at any point in the process. These advantages represent exciting possibilities for getting important research findings into the hands and minds of decision makers. ■

EXHIBIT 2

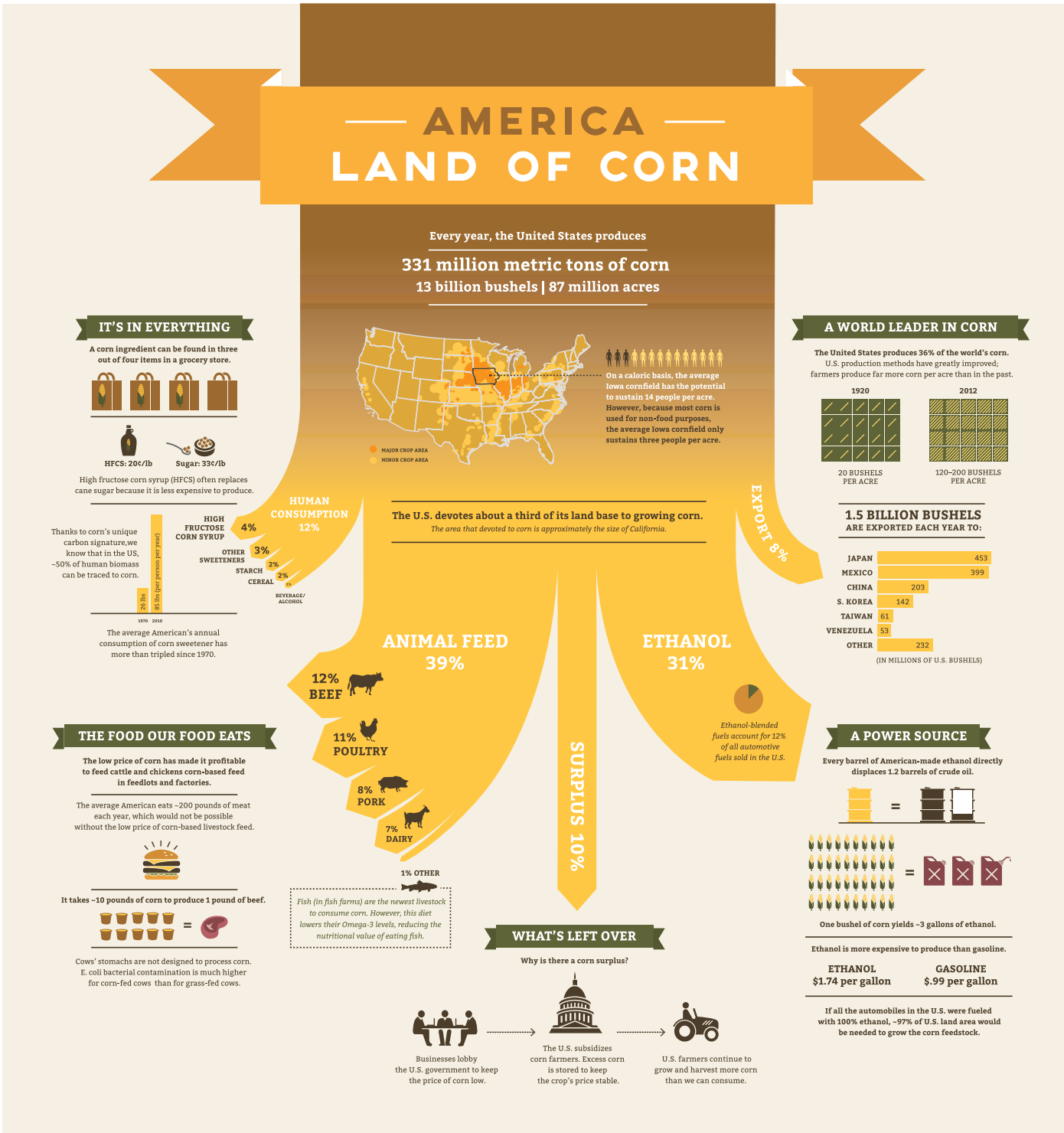
Infographic Example 2: There Are Three Main Methods By Which Fish Are Harvested In The United States: Wild Fishing, Extensive Fish Farming, And Intensive Fish Farming



SOURCE Jason Petz, "Supporting Environmental Conservation with Information Visualization," Master of Design Thesis at the University of Washington, Seattle, 2014. **NOTE** See online Appendix Exhibit A3 for a complete list of the data sources used to create this exhibit (see Note 2 in text).

EXHIBIT 3

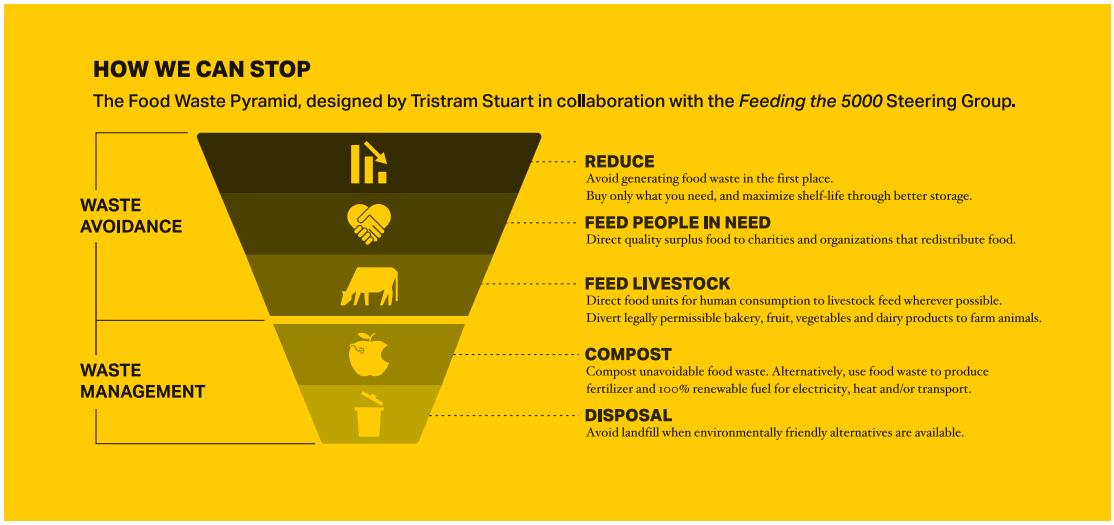
Infographic Example 3: The Corn Supply Chain And The Policy Decisions That Affect This Vital US Crop



SOURCE Suzanne Boretz and Allison Weir, senior undergraduates in visual communication design, University of Washington, Seattle, 2014. **NOTE** See online Appendix Exhibit A3 for a complete list of the data sources used to create this exhibit (see Note 2 in text).

EXHIBIT 4

Infographic Example 4: The Food Waste Pyramid Organizes Evidence-Backed Solutions To Food Waste Into Two Distinct Categories: Waste Avoidance And Waste Management



SOURCE
Khaito Gengo, senior undergraduate in Visual Communication Design, University of Washington, Seattle, 2014. **NOTE** See online Appendix Exhibit A3 for a list of the data sources used to create this exhibit (see Note 2 in text).

The authors acknowledge Suzanne Boretz, Khaito Gengo, Jason Petz, and Allison Weir, University of Washington students in visual communication design in the School of Art, Art History, and Design, for the creation of the infographics shown in Exhibits 1–4.

NOTES

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18 The infographics in this article are included as illustrations only. The subsegments of Exhibit 1 are not intended here to be readable in size. The online Appendix (see Note 2) contains versions that may be enlarged to enable reading of the various component information sections of Exhibits 1–4.
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