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Introduction to the Principles

1.1 The 10 principles of food industry sustainability

1. *Safe and highly nutritious food is accessible and affordable to promote and support a healthy population.*
2. *Agricultural production beneficially contributes to the environment while efficiently using natural resources and maintaining a healthy climate, land, water, and biodiversity.*
3. *Use of animals, fish, and seafood in the food supply optimizes their well-being and adds to environmental health.*
4. *Producer equity and rural economy and development are strengthened with fair and responsible production and sourcing.*
5. *Safe and suitable working conditions are provided to support employees across the supply chain.*
6. *Food and ingredient processing generates resources and requires minimal additional inputs and outputs.*
7. *Packaging effectively protects food and supports the environment without damage and waste.*
8. *Food and ingredient waste and loss are prevented across the supply chain and what cannot be avoided is put to a positive use.*
9. *Food and ingredients are efficiently delivered across the supply chain and to the consumer.*
10. *The supply chain and consumers advance sustainable business and food consumption.*

1.2 Principles–practices–potential

Our food system has the potential to produce renewable energy, replenish freshwater and other natural resources, provide an effective means of developing economic capacity, and remove waste through closing resource loops while nourishing the population. Are we achieving this potential? No, we fall short. In fact, we are not able to feed our population and yet cause astounding environmental and social damage.

The Principles of Food Industry Sustainability provide guidance on what to focus on across the supply chain to meet the needs of the population while not contributing to destruction of the environment or society. This book explains these principles through examples of how the supply chain has adopted them and what approaches are working, best practices. In many cases the efforts are moving past reducing detrimental impact and toward the goal of having meaningful and positive effects.

1.3 What is sustainability in the food industry?

The world's population depends on the food industry to produce, process, and deliver safe and nutritious food every day of the year. The demands on the food industry from farm to fork continue to increase. The global population is expected to increase from the current 7 billion to nearly 10 billion by 2050, thereby increasing food needs more than 60% (Consultative Group on International Agricultural Research [CGIAR] 2014). Most of the growth will be in developing countries where improvements in standards of living are rapidly shifting the diet from grains, beans, and other legumes to more animal protein. This will increase the demand for meat and poultry about 35% by 2015 (Pew 2008).

Yet, the food system is already contributing to widespread environmental damage and compromised health and livelihoods of our global population. The amount of energy used to produce, process, package, store, and transport food is seven and a half times the amount of energy the food actually provides in return (Heller & Keoleian 2000). The food supply is thereby a significant factor in climate change, water use and pollution, and the reduction of fish stocks in the oceans; at the same time 33% of adults in the United States are obese and over 12% of the world's population is malnourished.

The goal of sustainability in the food industry is to produce and consume food in a way that supports the well-being of generations. The current system clearly falls short and, with the growing demands for food as the population surges, there is the need and the opportunity for the food industry to balance the market needs for food with its environmental and social requirements. The ten principles given in this book provide a framework in which to address

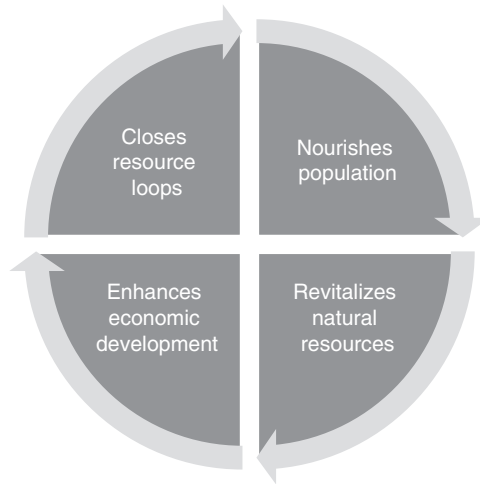


Figure 1.1 Aim for a sustainable food system.

these requirements to move toward sustainability in the food industry. Together they aim for a food system that nourishes the population, revitalizes natural resources, enhances economic development, and closes resources loops (see Figure 1.1).

1.4 The destructive course of the food system

The many activities that go into the global food system can be divided into five major parts: agricultural production, processing and packaging, distribution and marketing, consumption, and waste (see Figure 1.2). Each stage of the food life cycle has unique interactions with the environment and society, causing problems that can be reduced or avoided. This book does not go into the details of these issues but provides a concise summary of the importance and relevance of addressing these concerns. The chapters that follow describe how the supply chain is moving away from the course of destruction toward a system of sustainability that has the potential to thrive economically and benefit both the environment and society.

The primary environmental and social issues of the current food system are closely related to each other and often influence each other. These include climate change, natural resource depletion and degradation, pollution and toxicity, rural economy and development, and food safety and nutrition (see Figure 1.3). These issues are not theoretical but are creating real challenges that businesses are facing today. One example of a supply chain disruption attributed to climate change was the unusually prolonged drought in Russia over the summer of 2010. By early August, more than one-fifth of Russia's wheat crop had been destroyed and the government banned all grain exports, contributing to wheat price futures reaching their highest point in nearly two

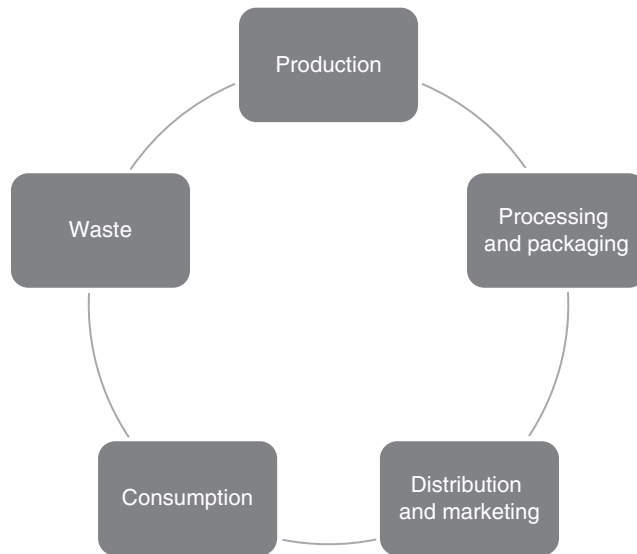


Figure 1.2 Food life cycle.

Climate change	Natural resource depletion & degradation	Pollution & toxicity	Rural economy & development	Food safety & nutrition
<ul style="list-style-type: none"> • Temperature change • Sea level rise • Extreme weather 	<ul style="list-style-type: none"> • Air • Land • Water • Biodiversity 	<ul style="list-style-type: none"> • Pesticides • Fertilizer • Runoff 	<ul style="list-style-type: none"> • Farm worker exploitation • Smallholder and women inequities 	<ul style="list-style-type: none"> • Contamination • Hunger and malnutrition • Overnutrition

Figure 1.3 Global environmental and social challenges with the food system.

years. General Mills was one of many food manufacturers that faced significant price pressure as a result and announced price increases of between 4 and 5% in September 2010 (Reed & Willis).

1.4.1 Climate change

Climate change is the shifting of global temperatures owing to various factors. A leading cause is the accumulation of heat-trapping gases in the atmosphere, called greenhouse gases (GHGs), including carbon dioxide, methane, nitrous oxide, and others. GHGs trap the sun's heat in the earth's atmosphere rather than allowing it to escape out to space. The accumulation and increase of GHGs has led to warmer atmospheric temperatures.

The food supply contributes significantly to climate change by being responsible for about 10 to 30% of global GHGs (U.S. Environmental Protection Agency [EPA] 2010a; and Bellarby et al. 2008). GHGs include the carbon dioxide emitted from electricity production and fuel use, methane

from landfills and the production of an increasing number of livestock animals, nitrous oxide from excessive fertilizer use, and other kinds of emissions. Carbon dioxide is the most prevalent GHG; however, methane and nitrous oxide are significantly more potent than carbon dioxide at warming the climate (see Table 1.1). Table 1.2 factors in this difference in global warming potential (by putting all GHGs into equivalent terms) and shows how each of these GHGs contributes to the overall emissions from agriculture.

This abnormal rise in global temperature linked to GHGs has significant consequences. Current projections indicate that if GHG emissions are allowed to continue at their current pace, a temperature increase of 2 to 4.5°C (3.6 to 8.1°F) is likely by 2100 (United Nations [UN] 2010a). This temperature change is expected to increase the global sea level by 28 to 58 centimeters (11 to 23 inches) by the end of the 21st century, lead to a 20 to 30% extinction of species, and an increased frequency of heat stress, droughts, and flooding (Intergovernmental Panel on Climate Change [IPCC] 2007a). These climate change–related impacts will be experienced in different ways across the globe, including lost homes and land from rising waters and more human deaths caused by extreme weather and high temperatures. The temperature increases will modify growing seasons and shift where crops can be grown as well

Table 1.1 Global warming potential (GWP) of a sample of GHGs (adapted from IPCC 2007b)

GHG	GWP (carbon dioxide equivalent)
Carbon dioxide	1
Methane	25
Nitrous oxide	298
Hydrochlorofluorocarbons	77–2310
Chlorofluorocarbons	4750–14400
Hydrofluorocarbons	124–14800

Table 1.2 GHG emissions from food production (adapted from Bellarby et al. 2008)

GHG and Its Source	Percentage of Total GHG Emissions (carbon dioxide equivalent)
Carbon dioxide from land conversion	47.3
Nitrous oxide from fertilized soils	17.1
Methane from enteric emissions	14.4
Methane and nitrous oxide from biomass burning	5.4
Methane from rice production	5.0
Carbon dioxide from irrigation and farm machinery	4.2
Carbon dioxide and nitrous oxide from fertilizer and pesticide production	3.3
Methane and nitrous oxide from manure	3.3

as what crops are available. Weeds and pests will proliferate, thereby increasing the demand to further control insects, diseases, and weeds. Rainfall alterations are expected to increase the frequency of droughts and floods, decreasing yields and livestock productivity. Severe storms will potentially further damage crops. It is expected that there will be some benefits to certain crops, but the result overall will be less food available and at higher costs (International Food Policy Research Institute [IFPRI] 2009).

1.4.2 Natural resource depletion and degradation

Currently more than 60% of ecosystem services are being degraded or used faster than they can be replenished (World Resources Institute [WRI] 2005). These natural resources include clean air and water, uncontaminated soil, minerals, plants, fish, animals, and the life-supporting systems they sustain. Natural resources that took billions of years to produce are rapidly being lost. With the current rates of use and degradation, there may be few natural resources left by the end of this century (Hawken, Lovins, & Lovins 1999).

Topsoil is an important component to growing food and, thus, to supporting life on earth. However, topsoil is being lost at rates significantly greater than it is being formed. Agriculture, including overgrazing of livestock, is responsible for most of this loss. Adding to this, the productivity of the land is declining with agricultural practices including monocultures, overcultivation, and over-irrigation.

Similar to topsoil, freshwater is also a natural resource in decline. It is so vital to our function and well-being that in 2010 the UN General Assembly passed a resolution stating that access to safe and clean drinking water and sanitation is a human right, noting that 884 million people cannot obtain safe drinking water and that 1.5 million children under five years old die each year as a result of water- and sanitation-related diseases (UN 2010b). It is partially as a result of wasteful, unsustainable agricultural processes that freshwater is becoming a limited resource (Horrihan, Lawrence, & Walker 2002). Worldwide agriculture is responsible for two-thirds of freshwater use, largely by irrigation, but crops only use 45% of the water applied (FAO 1995). As a result, freshwater is becoming scarce, and quality freshwater even more scarce. These changes are occurring because of both the overuse of and the pollution of freshwater supplies.

Our food system has contributed significantly to biodiversity loss by intentionally reducing the variety of species used for food production, producing food in monocultures (i.e., a single crop grown on many acres of land), and destroying diverse habitats such as prairie and rainforest for agricultural production. This has resulted in agriculture being one of the primary sources of biodiversity loss (Convention on Biological Diversity [CBD] 2010). Biodiversity is the natural and vast array of different types of plants, animals, insects, and other life on earth. This array of species keeps a balance and order on earth; conversely, the loss of biodiversity puts us at risk. Such shifting can create devastating changes

to ecosystems, including many unpredictable changes. What has been predicted, however, is that with the current rate of species losses (21 to 40% of species), plant growth will be reduced by 5 to 10% (Erickson 2012). This impact is comparable to what is expected from climate change, and yet this sizable risk is often overlooked in the discussion (Erickson 2012). For example, conversion of tropical forests to palm oil plantations has caused a loss of 73 to 83% of the bird and butterfly species (CBD 2010). Loss of pollinators such as these is already threatening food production, which relies on birds and insects for pollination. Biodiversity also helps nature cope with climate change so its loss will exacerbate the impact of global warming (Diaz, Tilman, & Fargione 2005). This may be just the tip of the iceberg as there are many consequences of biodiversity loss that are not fully understood.

1.4.3 Pollution and toxicity

The use of materials that are toxic to humans, animals, and the environment are widespread and come from packaging, agricultural inputs (fertilizer, pesticides, herbicides), fuels, and cleaning products. Toxic materials present both short-term and long-term threats. For example, the long-term effects of pesticides include cancer and disruption of the body's reproductive, immune, endocrine, and nervous systems (Horrigan et al. 2002). The use of such toxic chemicals has had mixed results and yet the application of pesticides is increasing (Malakof and Stokstad 2013, Hawken et al. 1999). The long-term effects of nitrogen fertilizer are also deadly. Plants absorb one-third to one-half of the nitrogen fertilizer applied, which means that at least half of the fertilizer finds its way into the soil and waterways as toxic runoff. Aquatic plants grow faster when fertilized by such nutrient-rich run-off. When they die, extra oxygen is required for their decomposition. If this process continues long enough, areas of the ocean suffer depleted oxygen stores. This results in dead zones that cannot support fish or any other marine life. Excessive use of chemical fertilizer is also detrimental to the soil by making it more acidic or less fertile (Horrigan et al. 2002). Adding to this, agriculture is estimated to be responsible for 70% of the pollution of rivers and streams (EPA 1998). With freshwater supplies along with other natural resources declining, this pollution compounds other problems.

1.4.4 Rural economy and development

The global food demand is estimated to increase 60% by 2050 (CGIAR 2014). To meet this demand more production will be needed from developing countries and small-scale producers, who already supply about 80% of the food (Fan 2011). However, these producers are the poorest and have little resources

to make farming improvements. To add to this, in many regions women contribute the bulk of farm labor but are not allowed access to the same resources as men. Women receive only about 1% of all agricultural financing or credit (Fraser 2009). This inequity compromises their agricultural productivity and earning potential. Agricultural jobs also are characterized by high risks and low wages. In the United States, the fatality rate for farm workers is seven times higher than that of other private industry jobs (McCluskey, McGarity, & Shapiro 2013). Even today there remain instances of agricultural laborers being exploited, enslaved, and abused. Our food system cannot survive if those on whom we rely on to grow the food are so unfairly treated.

1.4.5 Food safety and nutrition

The fundamental purpose of our food supply is to provide safe and nutritious food for the population. Despite notable advances in food safety, contamination with pathogens and chemicals remains a concern. Even in developed countries such as the United States food-borne illness is widespread, causing nearly 50 million illnesses and 3,000 deaths annually (U.S. Centers for Disease Control and Prevention [CDC] 2012). The nutritional status of the population needs to be improved. Globally nearly a billion people are hungry, over a billion are overweight, and another half a billion are obese (FAO 2012). These health conditions compromise the ability of our population to prosper. And yet, much of this unbalance is preventable as enough food is currently produced to feed the population.

1.5 Reasons for principles for sustainability in the food industry

The Principles for Sustainability outlined in this book bring together the leading issues that need to be addressed to advance toward sustainability. Too often there is a focus on just a few areas of concern, such as a limited set of environmental issues. Although working on priorities is critical for companies to get started, material issues can get overlooked, or worse, there may be unintended consequences or burden-shifting because there was not a holistic view of the issues. Sustainability requires a broader perspective: The Principles provide this view. They concisely outline each of the leading issues that, if advanced, would take us closer to sustainability in the food supply.

The Principles were intentionally positioned with a positive perspective. Instead of stating what should not be done, they articulate what needs to be done. This provides motivation to see what is possible and to aim beyond doing less harm and rather move to delivering an overall benefit.

The Principles outline the leading hotspots across the supply chain that address climate change, natural resource depletion, pollution and toxicity,

rural economy and development, and hunger and nutrition. The issues are so widely applicable to the food supply that the Strategy for Sustainable Farming and Food in the United Kingdom and other organizations have developed a similar set of key principles for a sustainable food chain (Department for Environment, Food and Rural Affairs [DEFRA] 2006).

The Principles are based on the body of literature available on food, environmental, and social issues. This includes life-cycle assessment, hotspot analysis, work by companies and the industry, and other resources. Discussion of economic issues is generally limited to social development in this book because other financial considerations are well understood by companies managing their risks and costs every day – however, economic sustainability of businesses is important to be able to deliver on the other needs and as a result it is included in the principles. This book fills the need of providing a practical view of how to bring environmental and social considerations into the supply chain through business actors. In many cases the actions are more heavily weighted to companies further down the supply chain, such as manufacturers and retailers, but there are roles for each stage of the supply chain.

The Principles outline the basic needs for the food supply to be safe and nutritious—this is the fundamental purpose of the system. Meeting this need requires improvements in farming and downstream activities, including manufacturing, distribution, food service, and retailing, such that they support a healthy environment and demand fewer resources and even generate resources such as energy and water. Animal-based production systems and harvesting of fish and seafood have unique considerations because these products have significantly greater life-cycle impacts than other products and the treatment of the animals is critical to the effectiveness and sustainability of the system.

To ensure the long-term food supply and provide for needed economic advancement, diversification of sourcing with development support for growers and suppliers should be practiced to provide fair-market access for producers, especially for small-scale operators and women in agriculture. It is also important to address worker safety and treatment at the farm and throughout the supply chain.

There is far too much waste in the supply chain. Food waste is particularly egregious with about 30% of what is produced being wasted (Gustavsson, Cederberg, Sonesson, van Otterdijk, & Meybeck 2011). This futile use of resources needs to be fixed to help reduce the demand for more production and feed the population. Packaging waste is a unique challenge as it provides an important function of protecting the food. Packaging already has been a consistent area of focus for sustainability initiatives, but there is significant room for improvement to minimize material impacts and eliminate waste. More emphasis is needed to ensure that packaging waste has a useful purpose, such as through recycling, to close the resource loop and make the most out of the material.

The Principles end with the role of the consumer and the opportunity the supply chain has to ensure its economic viability and to assist the consumer in moving to sustainable consumption and supporting each of the other Principles to nourish the population, revitalize natural resources, enhance economic development, and close resources loops.

1.6 The business benefit

The concept of sustainability includes economic considerations along with environmental and social ones. There are business benefits for effectively engaging in the environmental and social issues. The World Business Council for Sustainable Development has found that businesses that incorporate sustainable practices benefit by increased financial success, including more resilience. Organizations committed to sustainability financially outperformed industry averages by 15% during the economic downturn of 2008 to 2009 (Mahler, Barker, Belsand, & Schultz 2009). This is because sustainability helps reduce internal costs of operating, address reputational risks and risks in the supply chain that can threaten the business, meet customer and consumer demands to enable growth, and improve organizational effectiveness and business relationships (see Figure 1.4). For example, companies that have supply-chain disruptions experience an average share-price decline of nearly 20%, higher share-price volatility, and lower return on sales and return on assets (International Finance Corporation [IFC]). Sustainability efforts can alleviate some of these risks. Cost savings are a common benefit, such as a 1 to 3% savings being typical with facility operations improvements through sustainability programs (Strandberg 2009). Additionally, sustainability enhances employee productivity by about 2% and has become a critical factor for employees when considering what company to work for (Industry Canada).

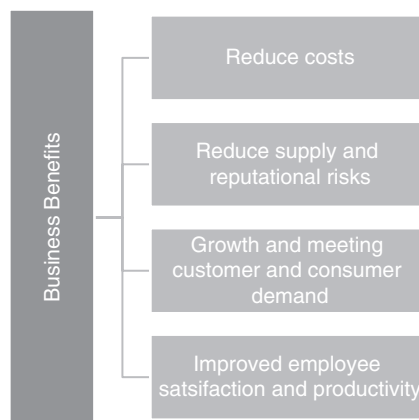


Figure 1.4 Business benefits of sustainability.

Multiple business benefits are to be gained by integrating sustainability into company efforts. Some of the benefits have a clear payoff, such as energy conservation and reduced utility bills. Other opportunities may present longer-term value, such as building farmer capabilities and a more resilient supply. The business cases discussed through the chapters are not detailed with specific dollar amounts to instead bring the focus to the best practices that companies are leveraging to realize the combination of intended benefits: economic, environmental, and social.

1.7 What needs to be done

We can no longer rely on business as usual. Companies need to adopt best practices and explore innovations across the supply chain to begin to realize not just a more sustainable food supply that feeds the population but also one that provides an overall benefit to the economy, environment, and society.

If this vision is not compelling enough to see the need for change, there are several drivers pushing companies to take action (see Figure 1.5), including emerging regulations, customer demands, and escalating costs and risks. Remember, the business benefits are very real and are a big motivator. In addition to industry action, there is a need for significant adjustments to governmental policy and consumer behavior. These topics are beyond the scope of this book's discussion but are important for reaching the vision.

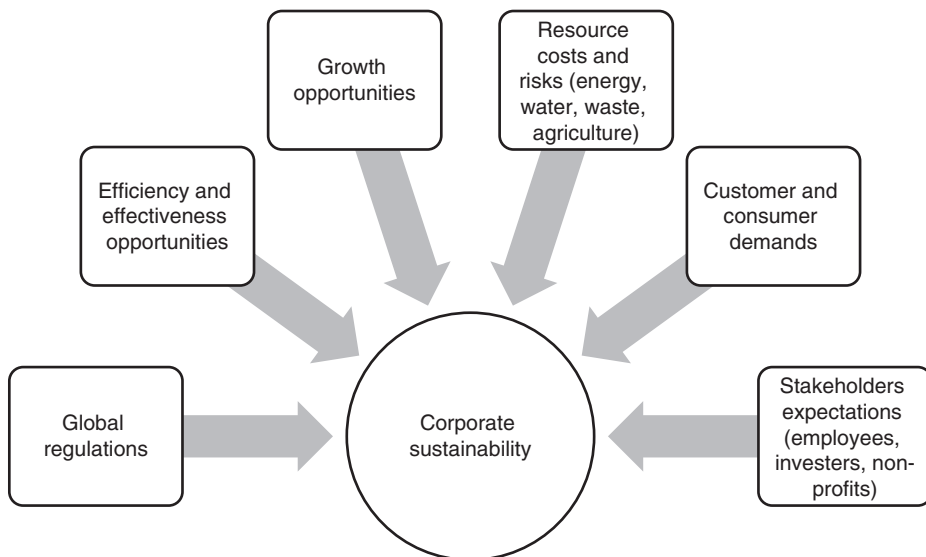


Figure 1.5 Business drivers of sustainability.

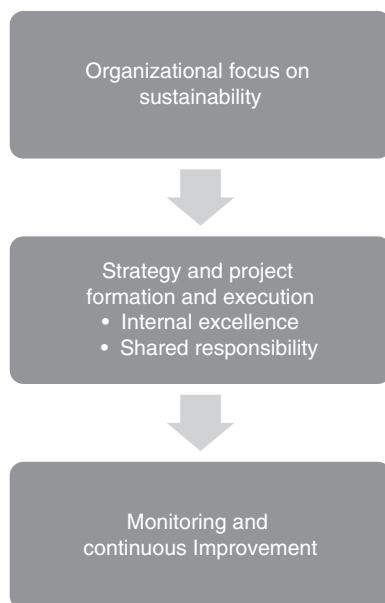


Figure 1.6 Business sustainability approach.

Companies looking to get started begin by committing to a focus on sustainability, set appropriate goals, assess needs and priorities, and address opportunities by incorporating sustainability into business practices and tracking progress (see Figure 1.6). Every one of the Principles cannot be worked on right away nor all at once. The best way to begin is to select a few areas of focus and achieve some successes before taking a broader approach (i.e., crawl before you walk and walk before you run). Do this with a view to all of the issues and Principles to ensure problems are not shifting from one place to another. Companies will often start with an internal focus on operational efficiencies or start with pilot projects. Then after their initial approach, they realize some success and more opportunities are identified, and the effort typically expands. Part of the evolution includes addressing areas of shared responsibility and value. As more companies reach beyond their four walls and work collaboratively through the supply chain, exciting progress and innovation can occur for shared value. Many of the best practices described in this book are illustrated with examples from companies engaged in advancing sustainability both internally and externally. Some of the examples, however, include companies just getting started; they demonstrate that every step forward is an important part of the journey as long as they keep the destination in mind—nourishing the population, revitalizing natural resources, enhancing economic development, and closing loops in resources.

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