# Materials Management in Oregon

## 2050 Vision and Framework for Action

June 2012

DRAFT

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# Acknowledgments


DEQ gratefully acknowledges the valuable contributions and insights of the Materials Management Workgroup. Members are listed in **Appendix D**.

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CASCADIA CONSULTING GROUP

SUSTAINABILITY PARTNERS

**Cascadia Consulting Group** (Jessica Branom-Zwick, Marc Daudon, and Christy Shelton) and **Sustainability Partners** (Drs. Brian and Mary Nattrass) facilitated meetings of the Materials Management Workgroup and contributed to the development of this *Vision and Framework for Action*.

More information on the *2050 Vision and Framework for Action* appears on the project website: **www.deq.state.or.us/lq/sw/materialsmgmtplan.htm**

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# 2050 Vision

## for Materials Management in Oregon

***Oregonians in 2050 produce and use materials responsibly***

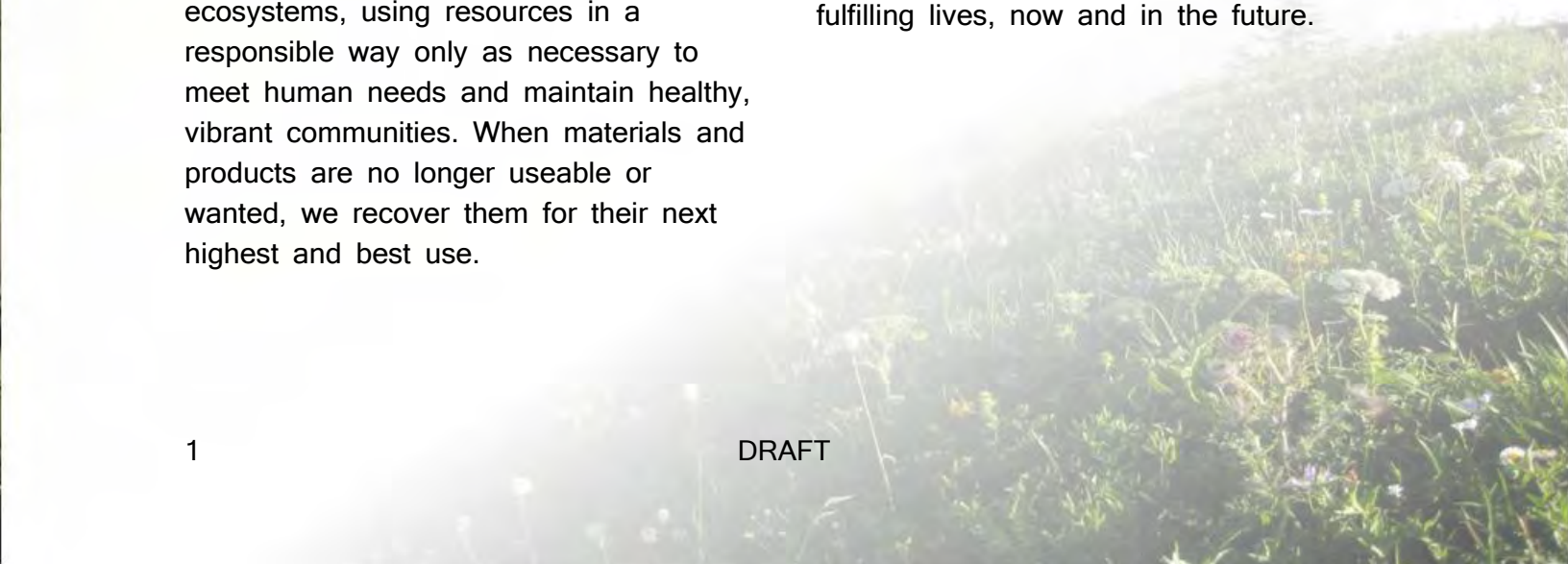
*conserving resources • protecting the environment • living well*

**Recognizing that Earth's resources are finite, Oregonians live within the limits of our sustainable share of the world's natural resources.** We make and use materials and products in a manner that maintains and restores a healthy environment and fertile soils. Materials and products minimize the use and release of toxins, the release of greenhouse gases and pollutants, the use of energy and water, and the extraction of nonrenewable materials.

**We take into account the full impacts of materials throughout their life cycle.** We minimize harmful disturbance of land and natural ecosystems, using resources in a responsible way only as necessary to meet human needs and maintain healthy, vibrant communities. When materials and products are no longer useable or wanted, we recover them for their next highest and best use.

**We use renewable resources at levels that can be sustained in perpetuity while maintaining the resiliency of natural systems.** Wherever they are made, the materials and products we purchase in Oregon similarly are made in a manner that supports human health, wellbeing, and healthy, resilient environments and communities.

**All Oregonians have access to the knowledge, capabilities, resources, and services required to use materials responsibly.** This Vision provides for a prosperous and clean economy that allows all people to live fulfilling lives, now and in the future.

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# Executive Summary

Global demand for materials and products is increasing rapidly, bringing significant impacts to Oregon residents, businesses, communities, and the environment. Oregon law cites the need to conserve resources and energy and acknowledges limits in the environment's ability to absorb the impacts of increasing consumption. Oregon is recognized as a leader in conserving resources through recycling and proper management of wastes. Yet this focus on managing discards has limited potential to address the full impacts of materials and the challenges they present for Oregonians and the environment. To guide state policy and programs and to achieve the best environmental results at the lowest cost to society, DEQ convened a Workgroup to help develop this *2050 Vision and Framework for Action*.

## What is Materials Management?

The **materials management** approach includes waste prevention and discard management, while seeking to reduce environmental impacts by managing materials through all stages of their life. It identifies impacts and actions to address those impacts across the full cycle of materials and products as they move through the economy—from raw material extraction to product design and manufacture, transport, consumption, use, reuse, recycling, and disposal.

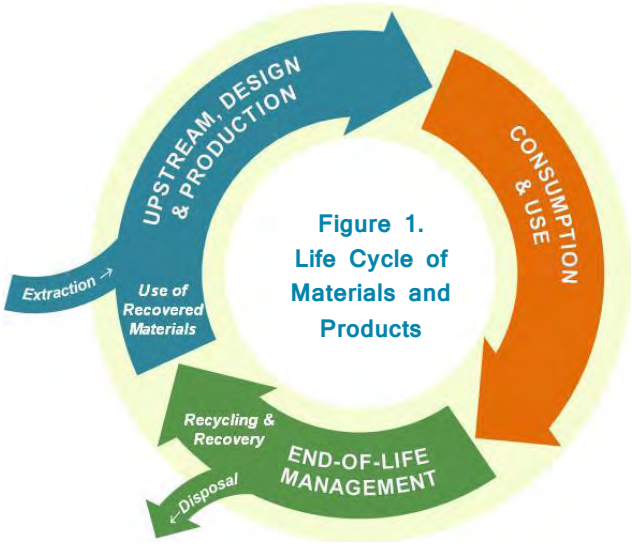


**Figure 1. Life Cycle of Materials and Products**

A more holistic materials management approach will help DEQ shape state policies in a changing world with new jobs, new opportunities, and new challenges.

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# Creating a Vision for Materials Management

In 2011, DEQ convened a **Workgroup** to help develop this long-term *Vision and Framework for Action*. DEQ applied the process of "backcasting"—starting with a future vision and then looking back to identify steps needed to achieve it. The resulting *2050 Vision and Framework for Action* also serves as an update to Oregon's *State Integrated Resource and Solid Waste Management Plan (1995-2005)*, which guides statewide policy.

The *2050 Vision* describes a desired future where Oregonians live within the limits of their sustainable share of the world's natural resources:

> ***Oregonians in 2050 produce and use materials responsibly***
> *conserving resources • protecting the environment • living well*

Materials and products—both made in Oregon and used in Oregon—support human health, wellbeing, and healthy, resilient environments and communities. Sustainable use of materials allows all people to enjoy a prosperous, clean economy and fulfilling lives, now and in the future.

This document envisions an Oregon in 2050 where:

- **Producers make products sustainably. Every option is a sustainable option.**
- **People live well and consume sustainably.**
- **Materials have the most useful life possible before and after discard.**

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**Oregonians in 2050 will produce and consume much differently than today. We will produce less waste and recover more materials in a smarter way.**

Together, we will manage materials wisely, while strengthening economies at the local, regional, national, and global levels.

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# Framework for Action

Taking action early in the life cycle—in design and production—offers the best opportunities to realize the *2050 Vision*. While producers shift to more sustainable actions, consumers also have important roles to play in the types of products they demand and how they use them. Effective management of materials at the end of their lives redirects resources back into productive use.

To help achieve the *2050 Vision* in Oregon, DEQ must take several different types of actions. The *Framework for Action* includes pathways to lead Oregon to desired outcomes, including the following:

- **Foundations**. This work will create infrastructure necessary to achieve the *2050 Vision*. Foundational work includes setting goals and measuring outcomes, supporting and performing research, and securing stable funding.
- **Policies and regulations**. DEQ will evaluate and develop policies and regulations that put Oregon on the path toward achieving the *2050 Vision*.
- **Collaboration and partnerships**. Coordination throughout the life cycle of materials and products will support innovative solutions. DEQ will collaborate with other state agencies, businesses, local governments, and nongovernmental organizations.
- **Education and information**. DEQ will share information it develops with partners for distribution to appropriate audiences.

This *2050 Vision and Framework for Action* document is available online at **www.deq.state.or.us/lq/sw/materialsmgmtplan.htm**.

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# Creating a Materials Management Vision

## What is Materials Management?

The **materials management** approach seeks to reduce environmental impacts by managing materials throughout all stages of their life cycle. Materials management includes **waste prevention** and **discard management**. More broadly, it identifies impacts and actions to address those impacts across the full life cycle of materials and products as they move through the economy—from raw material extraction to product design and manufacture, transport, consumption, use, reuse, recycling, and disposal.


Figure 2. Life Cycle of Materials and Products

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"It is becoming increasingly clear that how we use materials is a large factor in energy use, climate change, and the economy, and an important issue in its own right."

U.S. Environmental Proection Agency, *Sustainable Materials Management: The Road Ahead* (2009)

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# Why use a Materials Management Approach?

Managing materials holistically is important because life-supporting resources are declining globally, while consumption of these resources is increasing.

**Materials matter.** Global demand for materials—from rare earth metals to agricultural products—is increasing rapidly, with significant economic impacts to Oregon businesses and households.[1] At the same time, the types of materials are also changing, with most materials coming from nonrenewable—and ultimately, unsustainable—sources.[2]

Demand for these materials has led to significant environmental impacts, including toxic chemicals in the air and water; damage to ecosystems; unsustainable use of energy, water, and other natural resources; and global warming. Making, transporting, selling, and disposing of the materials consumed in Oregon contributes between 35 and 48 percent of Oregon's **consumption-related greenhouse gas emissions**—on par with the state's emissions from the direct consumption of electricity and fuels combined.[3] For an excellent overview of the growth in materials use—and associated impacts—see the U.S. Environmental Protection Agency's 2009 report, ***Sustainable Materials Management: The Road Ahead***.

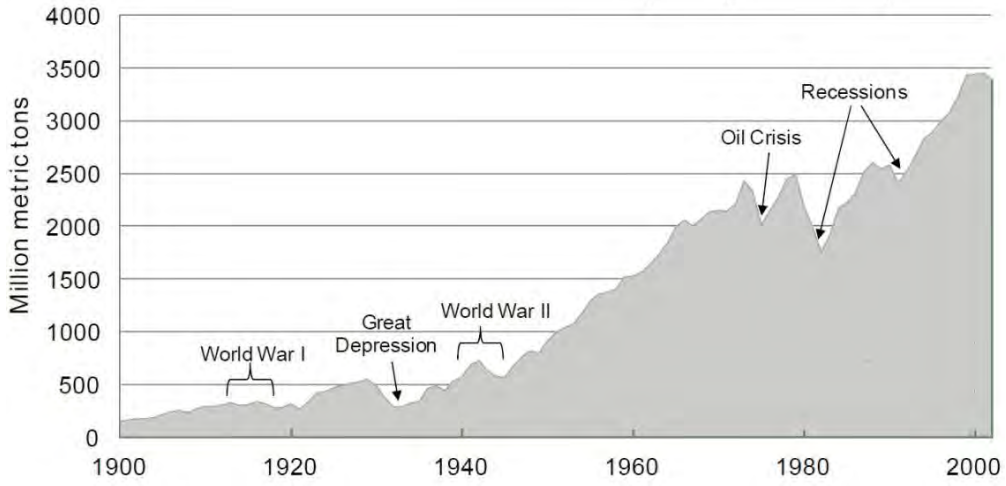


**Figure 3. Use of Materials in the United States, 1900-2002.**
*Modified from Center for Sustainable Systems, University of Michigan (2011), based on Matos and Wagner, 1998, and Wagner, 2002.*[4]

Great progress has been made in discard management in the last 20 years, yet Oregon can do even better.[5] It is now clear that the vast majority of environmental impacts result from decisions made in design, production, and consumption—not **end-of-life management**.[6] Accordingly, producers and consumers have important roles to play.

## From Managing Discards to Managing Materials

DEQ's historic focus on materials management at end-of-life is largely a consequence of problems that were identified—and legislation passed—20 to 30 years ago. At that time, many landfills were poorly located, operated, and regulated, and new federal standards made the closure of many landfills imminent. These factors added to a perception of a "garbage crisis"—that we were running out of places to dispose of our waste. The 1970s energy crisis and growing environmental concerns also led to public support for resource conservation through recycling.

Oregon today looks much different in some ways. We now have an abundance of disposal capacity, in landfills that are better operated and less polluting than their predecessors. Recycling programs are firmly established, conserving resources, reducing pollution, and providing green jobs.[7] Some producers are sharing responsibility for managing their products at end-of-life and for reducing the presence of toxic chemicals in products that enter consumers' homes and eventually become solid waste. Recycling is now second nature for many Oregonians, and interest in "reduce" and "reuse" is growing.

But the limits of this solid waste management framework are becoming more apparent, even as our overall consumption of resources continues to grow and our **environmental "footprint"** becomes more globally dispersed.[8] We have learned much in the past 25 years. We now understand that smart decisions—ones that are good for the environment, economy, and society—require thinking about impacts across the full life cycle of materials. Focusing on only the management of discards limits options to protect the environment and can lead to decisions that are penny-wise but pound-foolish.[9,10] In contrast, materials management offers a framework to address the integrated nature of materials, guide state policy and programs, and achieve the best results at the lowest cost to society.

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**Materials management:**

**Identifies impacts throughout the life cycle**

**Focuses on high-impact actions across the life cycle**

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Existing policy also points in the direction of materials management. *Oregon Revised Statutes 459* calls out the need to conserve resources and energy, and it acknowledges limits in the environment's ability to absorb the impacts of increasing consumption.[11] These issues transcend the narrow framework of solid waste management. Even the so-called "**waste management hierarchy**" emphasizes practices that have little to do with the management of discards. "Reduce" and "reuse" primarily involve the consumption and use of materials, not the management of wastes. And while recycling is commonly thought of as a method for managing discards, the economic and environmental value of recycling lies primarily in the provision of lower-cost feedstocks that industry can use to make new products and the reduced need for extracting and processing virgin materials.[12]

Although progress has been made, all stages of the life cycle of materials are currently unsustainable. While improvements are needed in end-of-life management, starting as far **upstream** as possible—in resource extraction, design, and production—offers the best opportunities to realize the vision of a sustainable society, economy, and environment. As producers shift to more sustainable actions, consumers also have important roles to play—in the types of products they demand, how they use them, and how items are managed once they are discarded. Effective management at end-of-life redirects resources back into productive use, while helping to reduce the negative impacts of disposal.

The world is changing, and Oregon will be different in 2050. Materials management offers a holistic approach that will help DEQ shape state policies—and help Oregon thrive—in a world with new jobs, new opportunities, and new challenges for government, businesses, and the public.

## The Business Case for Materials Management

Rising commodity prices, increasing global population, pollution, and the depletion of natural resources all pose significant threats to businesses and the historic model of economic growth. But with these challenges come new opportunities.

For example, representatives of adidas, Coca-Cola, General Motors, Nokia, Philips, Procter & Gamble, Sony, Weyerhaeuser, and other businesses—working through the World Business Council for Sustainable Development—recently concluded that "current global

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consumption patterns are unsustainable." These businesses recognize the importance of industry being more efficient and less polluting, and they go further, noting that "efficiency gains and technological advances alone will not be sufficient to bring global consumption to a sustainable level." They observe that "changes will also be required to consumer lifestyles, including the ways in which consumers choose and use products and services." They call for businesses to play a leadership role in fostering more sustainable levels of consumption, through practices such as innovation, communications, and working in partnerships with consumers, governments, and stakeholders. These businesses call for governments to provide the right policies and regulations, fiscal structures and incentives, infrastructure and services, guidance for businesses and consumers, monitoring, and enforcement.[13]

DEQ's *2050 Vision* calls for the responsible production and use of materials. In a world bumping up against limited resources and other constraints on growth, businesses that produce responsibly—and help consumers live responsibly—will enjoy the greatest viability and reap the highest rewards. The path forward is not fully mapped, but the *2050 Vision* is clear. DEQ is committed to working with businesses—both producing in Oregon and selling into Oregon—to achieve a prosperous and clean economy that allows all people to live fulfilling lives, now and in the future.

## The Vision Process

To address the changing world of materials management, DEQ convened the 2050 Vision for Materials Management Workgroup in 2011. With input from the Workgroup's members, DEQ developed this long-term vision for sustainable materials management in Oregon. This *2050 Vision* and *Framework for Action* also serves as an update to Oregon's *State Integrated Resource and Solid Waste Management Plan (1995-2005)*, which guides statewide policy.

The broader approach focusing on the full life cycle of materials requires a breadth of knowledge and a variety of experience, skills, and perspectives. DEQ invited a diverse group of stakeholders representing businesses, nongovernmental organizations, local governments, state agencies, and individuals to participate in the visioning process. Workgroup members met for five facilitated day-long workshops between fall 2011 and spring 2012 to identify ways to make our design, production, use and management of products and materials more sustainable. Workgroup members were engaged and

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provided input on draft documents throughout the process. **Appendix D** provides a list of Workgroup members.

## Developing a Vision

To develop the *2050 Vision*, DEQ applied The Natural Step approach, which involves a science-based definition of sustainability and a strategic planning framework to help make choices that advance sustainability. A key element of the Natural Step framework involves "**backcasting**"—starting with a future vision and then looking back to identify the steps needed to achieve it. The framework provides the tools to look at the big picture, understand the rules of the game, define success, and move toward it together.

This scientifically rigorous framework has been used in strategic decision-making by organizations such as the U.S. Army, Nike, H.J. Heinz Company, and Amazon.com. DEQ adopted The Natural Step approach in 2008 and identified it as a robust process for developing a *2050 Vision for Materials Management in Oregon*. DEQ worked with Cascadia Consulting Group and Sustainability Partners to facilitate workshops and integrate The Natural Step framework into this visioning and action-planning process.

## Considering Sustainability Principles

DEQ's *2050 Vision and Framework for Action* develops a platform to bring materials management in Oregon into closer alignment with **sustainability** principles. The *2050 Vision* sits within the larger context of future economic, social, and environmental systems. These three systems affect DEQ's work, and DEQ's policies and programs also influence these systems to some degree. During the Workgroup process, DEQ identified **systems and capabilities** broadly needed to achieve the *2050 Vision for Materials Management in Oregon*. **Appendix C** summarizes that work.

In 2001, the Legislature adopted the Oregon Sustainability Act (**ORS 184.423**), which established the state's overall sustainability policy. Among other efforts, the legislation created the Oregon Sustainability Board and set legislative goals for sustainability.

DEQ has an agency-wide sustainability vision: **We live in a way that balances our actions with nature's ability to maintain a healthy environment.** The *2050 Vision for Materials Management in Oregon* supports DEQ's agency vision, through a specific focus on materials.

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**The *2050 Vision* for sustainable materials management sits within the larger context of economic, social, and environmental systems.**

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# Implementing the Framework for Action to Achieve the *2050 Vision*

The *Framework for Action* lists about 50 actions without prioritization. DEQ will begin to prioritize actions in fall 2012 and will begin work on the highest priorities within the first five years as resources allow. Implementation of other actions will follow. The framework includes both foundational work needed to achieve the *2050 Vision* as well as actions specific to the different stages of the life cycle of materials.

The Framework is intended to serve as a flexible platform for action to guide progress toward the *2050 Vision*; it is not designed as an implementation plan for specific actions. For specific actions, DEQ will scope projects, work with stakeholders as appropriate, and develop project plans. The actions are focused on areas of DEQ's potential influence and control. Implementation of many actions will include ongoing opportunities for stakeholder involvement, and actions may be conducted by both DEQ and others.

DEQ will reevaluate the entire *Framework for Action* regularly to foster continuous improvement and adaptive management, to ensure it effectively guides actions found in the *2050 Vision*. DEQ will update actions and may identify new actions over time.

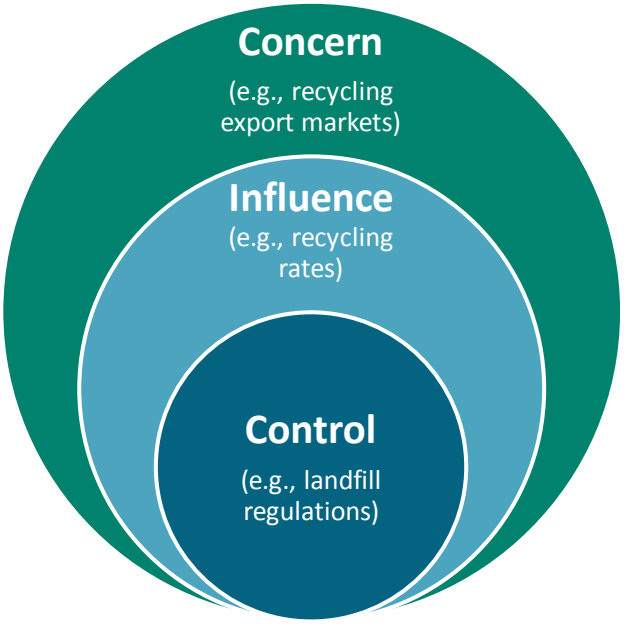


**Figure 4. Spheres of Control, Influence, and Concern**

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## DEQ's Guiding Principles for Materials Management

**When prioritizing, planning, and implementing actions, DEQ will consider the following guiding principles:**

- **Develop and implement policies and programs based on robust research.**
- **Lead when appropriate.**
- **Coordinate and collaborate with partners.**
- **Ensure that actions complement one another.**
- **Build on what's already working, such as using existing infrastructure when possible.**
- **Focus on high-impact materials and processes.**
- **Be flexible and adaptable.**
- **Continuously use the *Framework for Action* and update as necessary.**
- **Consider environmental and other impacts of policy options, including the following:**
    - **Social equity**
    - **Quality of life**
    - **Economic viability**
    - **Potential unintended consequences**

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# Welcome to 2050

***Oregonians in 2050 produce and use materials responsibly***
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In the ***2050 Vision***, Oregonians live within the limits of their sustainable share of the world's natural resources. Materials and products should support human health, wellbeing, and healthy, resilient environments and communities—whether those goods are made in Oregon, used in Oregon, or both. Sustainable use of resources allows all people to enjoy a prosperous, clean economy and fulfilling lives, now and in the future.

### Desired Outcomes for 2050

- **Producers make products sustainably. Every option is a sustainable option.**
- **People live well and consume sustainably.**
- **Materials have the most useful life possible before and after discard.**

The **materials life cycle** begins early in the process before the consumer (**Upstream, Design, and Production**), with designers and manufacturers making products and using materials in a sustainable way. In 2050, every product is made to be a sustainable option.

For materials to be fully sustainable, people need to use them in a sustainable manner. The **Consumption and Use** element addresses decisions related to the materials and products people acquire, how they obtain them, and how they use them.

Even in a more sustainable future, both producers and consumers will continue to discard unwanted materials. Accordingly, the **End-of-Life Management** element aims to direct these materials to their next highest and best use.

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This process is iterative throughout the life cycle of materials—from upstream, through use, through recovery and end-of-life management, and back into production. Each element builds on success in the previous elements.

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### Oregon in 2050

- **We are wiser. Knowledge and innovation brought us here.**
- **We are connected. Coordination and communication make the system work.**
- **We invest resources wisely.**
- **We share responsibility. Everyone has a part.**
- **We are accountable. We set goals, measure success and learn from experience.**

Achieving this vision means that Oregonians in 2050 will produce and consume much differently than today, and we will recover more materials in a smarter way. Together, we will manage materials wisely, while strengthening economies at the local, regional, national, and global levels. We will have tackled our materials challenge together, and everyone will be part of the solution.

The next sections of this chapter provide more information on desired outcomes for materials management and where we are today. The following chapter, *Framework for Action*, outlines pathways forward from our current reality to the desired outcomes for 2050.

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# Upstream, Design, and Production in 2050

**Producers make products sustainably**—from design and production through packaging, intended use, and end-of-use management. Design minimizes environmental impacts across the product's life cycle and considers the highest and best use of materials. Cradle-to-cradle or closed-loop design, which addresses full life cycle impacts, is common practice. Products are designed to be durable, repaired, disassembled, or recycled, and single-use products are obsolete or used only as absolutely necessary.

**Materials are not used at a rate faster than can be renewed or recovered**, and dematerialization has reduced the impacts of products and services. Risks of chemicals are fully assessed before they are used. Products and production do not contain toxic chemicals, or when necessary, toxics are minimized and then recaptured for their highest and best use. Packaging is limited to what is necessary, and environmental impacts of packaging are minimized. During use and after discard, materials leach little or no toxins and emit few greenhouse gases. In 2050, green building is the norm.

**Research and innovation fuel unprecedented technological advances and economic vitality in Oregon.** Our state is a leader and a national center for green businesses and jobs. Oregon makes and exports sustainable products, goods, and services—creating sustainable jobs here at home. Businesses use unwanted materials from other businesses as inputs for new products. Our educational system supports and drives this success: Oregon universities are vital in supporting the green economy through pioneering research and technology transfer. Our universities are recognized leaders in green chemistry and technology, and the private sector values the critical role of research institutions in supporting innovation.

**Coordination throughout the life cycle of products leads to innovative solutions.** Producers, retailers, and government work together to support sustainable product choices. Innovation exchange and cross-sector cooperation between producers and suppliers expand the opportunities for sharing resources and ideas.

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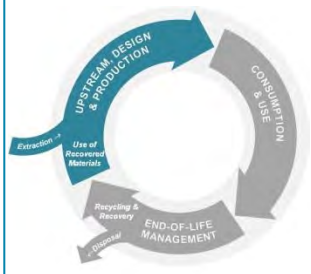


**Producers make products sustainably.**

**Every option is a sustainable option.**

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**Complete and transparent information on product contents and life cycle impacts is readily available.** Producers know the impacts of their products and processes both upstream and downstream in the supply chain. Information on impacts of products and processes is accurate, transparent, and readily shared throughout the supply chain. Information disclosure and accounting standards simplify make it easy to compare impacts across products.

**Responsibility is shared for full life cycle impacts.** Those involved with a product across the life cycle share responsibility for all impacts. Prices reflect environmental and social costs, and incentives and regulations support sustainable producers and products. Oregon businesses and our global competitors share a level playing field.

## Upstream, Design, and Production Today

About 40 percent of domestic greenhouse gas emissions result from producing and transporting materials and products.

**Reuse and repair of products is often difficult and discouraged.** Planned obsolescence is part of the design for some products. Lack of infrastructure or financial incentives for repairing and recycling products discourages design for repair and recycling. Toxics and mixed materials in products and packaging can impede recycling and harm public health.

**Products sold in Oregon are produced globally.** Production standards, regulations, and environmental impacts vary nationally and globally. Supply chains are complex and may cross numerous borders.

**Prices do not reflect all environmental impacts, and full information is not available on environmental impacts.** Extraction of raw materials is often subsidized, and the public bears the "external" costs of environmental impacts.

**Sustainability is not clearly understood or uniformly defined.** Environmental impacts are not commonly understood, especially by small and medium-sized businesses. Many "green" claims involve some form of greenwashing.[14]

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**Complete information is not available on environmental impacts.** Producers are not required to investigate and disclose impact data—such as toxic chemical use—to government, the supply chain, or the public. While data are available for permitted and reported emissions, information on the impacts of product use is lacking. Relevant knowledge resides in the private sector, academia, and in Europe.

**Government lacks some tools to identify, prioritize, and take action to reduce the health and environmental effects of toxic chemicals**, and product stewardship is limited. Many environmental policies were written 20 to 30 years ago. Regulations mainly address production processes, rather than products. Investment in green chemistry research, development, and education is limited.

**Some market leaders are innovating to reduce impacts during production.** Design and innovation tools are becoming more common. Product design involves trade-offs in life cycle impacts such as toxicity, greenhouse gas emissions, and water use. Green building has growing support in the commercial and public sectors.

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**People live well and consume sustainably.**

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# Consumption and Use in 2050

**All Oregonians live well in communities where materials are used sustainably.** Oregonians of all backgrounds and experiences enjoy high-quality lives, including rich social and community relations, without requiring high levels of acquisition of material goods. Oregonians see themselves first as community members, rather than mainly as consumers. Social norms, infrastructure, and communities—neighborhoods, regions, families, friends, and social groups—make low-impact consumption easy and rewarding. Collaboration, sharing, repair, and reuse are all normal, and sustainable consumption is a social norm that is easy to live by.

**Oregonians actively seek to live "within the limits of our sustainable share of the world's natural resources"** and engage other community members, including producers, to do the same. Oregonians are meeting their needs, and quality of life is high, with a minimal environmental footprint. All choices are good choices; highly unsustainable products are no longer sold. Public agencies lead by example and build capacity through model practices for sustainable procurement and use of materials.

**Sustainable product and material choices are desired and readily available.** Sustainable products, materials and services—including renting, sharing, collaboration, reuse, and repair—are easily accessible and affordable. Products sold in Oregon are sustainable choices, regardless of where they are made. Environmentally superior products perform as well as or better than their higher-impact alternatives. Public, private, and nongovernmental systems support access to sustainable choices. Full life cycle costs are internalized into prices, so lower cost is yet another benefit of greener products.

**Complete product and environmental information is accurate and readily available.** Accurate information on the environmental impacts of products is available to consumers in a meaningful way. Oregonians share a common understanding of sustainable consumption, including the "limits of our sustainable share of the world's natural resources" and whether we are living within them—both individually and collectively.

# Consumption and Use Today

**Many factors influence consumption.** People make consumption choices to fill physical, emotional, and recreational needs and to signal their social status. Reduced durability, reduced product quality, and planned obsolescence drive increases in consumption. Cultural norms involving reuse, repurposing, repair, renting, sharing, and buying are also influential. Subsidies encourage some consumption, and product prices do not reflect their full costs, including environmental impacts.

Increases in work hours tend to result in increased consumption, while work decreases lead to lower consumption. The United States has a long-term trend of increasing house sizes with fewer people per home. Regulation of advertising, including marketing to children, is limited.

Research suggests that Oregon's population in general may be less materialistic, more egalitarian, and more "anti-materialistic" than the United States as a whole.

**A sustainable level of consumption and how to achieve it are typically not well-understood** by policymakers, business leaders, or the general public. Demand for sustainable product choices is moderate, but options are not always equitably available or affordable. Once basic needs are satisfied, more consumption (of "wants") does not lead to commensurate increases in wellbeing for households with higher incomes, on average.

**Information on environmental impacts is rarely accessible, easy-to-use, or trusted.** Consumers are confused about product impacts, and greenwashing makes it more difficult to discern accurate product information.

**Some impacts of consumption, such as greenhouse gas emissions, are fairly well-understood, while others are not.** Oregonians' consumption-related greenhouse gas emissions in 2005 were three times larger (21.5 metric tons of carbon dioxide equivalent, $CO_2e$, per person) than the unsustainable global average of 7.1 metric tons of $CO_2e$ per person. Other environmental impacts, such as toxics, of Oregon's consumption are not as well-quantified.

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**It is widely understood that overconsumption threatens families, children, financial security, and the environment.**

A majority of Oregonians (70 to 82percent) agree that "our country would be better off if we all consumed less." More than 60 percent of Oregonians agree that "consuming less" would make people more self-reliant, provide more time to spend with family and friends, be better for the environment, and be "painful in the short term but better for us long term." Some consumers indicate that they want information on how to consume more sustainably but lack access to such information, particularly households with lower incomes and education. In the private sector, larger businesses are increasingly discussing "sustainable consumption."

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# End-of-Life Management in 2050

**Materials have a useful life after discard.** The large majority of products, materials, food scraps, and yard trimmings are captured for reuse, recycling, or reprocessing. High-quality recovered materials are available to be made into useful products. Few materials are landfilled or incinerated.

**Stable infrastructure and markets support highest and best use of discarded materials.** Well-developed markets for recovered materials contribute to Oregon's economic success. Systems for recovering materials and managing discards are available and cost-effective throughout the state, and access to these systems is clear, available, and convenient to consumers. Effective sorting systems add value to recovered materials, and new technologies use materials and energy that had previously been discarded. A strong, networked industry for reuse and repair exists. Many reuse, repurpose, and recovery jobs add to a prosperous economy, and these businesses are stable.

**Oregonians are engaged in making better materials choices for end-of-life management of materials.** Residents understand that materials have value after discard. Oregon's social norm is to conserve, reuse, repair, and recover.

**Health and environmental risks from disposed wastes are minimized.** Legacy waste and landfills, including stockpiled wastes, are managed safely.

**Public policies support sustainable materials management at end-of-life**. All prices including recovery and disposal prices reflect full costs and support directing recovered material to its highest and best use. Producers share responsibility with governments and the public for managing materials after discard. Government plays an appropriate role in setting and enforcing standards and in evaluating results of key recovery and discard management programs. Local governments have a role in designing programs to best serve their populations.

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**Materials have the most useful life possible after discard.**

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# End-of-Life Management Today

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**The economic recession beginning in 2008 resulted in decreased waste, recycling, and consumption.** The mixture of discarded content is changing over time, such as recent drops in newsprint and magazines.

**Of discarded materials, 46 percent are recovered for other uses.** Recovery rates vary broadly across materials. Paper, metal, and glass all have recycling rates above 65 percent. About 15 percent of plastics are recycled, and food, carpet, and textiles have recovery rates below 10 percent.

**Infrastructure and markets for discard management and recovery of materials vary by material and location.** Local governments have established infrastructure to collect discards and recyclables. Recycling is often available at home but not readily available outside the home. Curbside recycling is mainly available in urban areas and cities with more than 4,000 residents. Multifamily and commercial recycling collection is optional in certain cities. Options are limited for food scraps collection, composting, and distribution of leftover edible food. Long-term landfill capacity is ample statewide.

**Export markets play a significant role, particularly for plastics, metals, and mixed paper.** Paper has strong but threatened local markets. Metals, glass, and compost have moderate local markets, while plastics and carpet have limited local markets. Recycling services in urban areas have better access to markets than rural areas. Concerns about contamination of recyclables and finished compost are growing.

**Disposal and recovery prices do not reflect indirect and opportunity costs.** Funding for DEQ and some local government programs comes from disposal fees, which change with quantities disposed.

**Discard management systems continue to develop.** Solid waste collection operates under an established franchise system in most of the state. Some reuse businesses and nonprofit organizations exist.

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**Oregonians have a strong recycling ethic, but confusion exists** regarding waste prevention, recycling, biodegradability, and composting. State and local governments and collectors help inform and engage residents. Oregonians have growing interests in energy recovery technology.

**Existing policies and regulations set clear priorities**, provide residents with recycling opportunities, and set a precedent for product stewardship of difficult-to-manage or harmful materials. A statutory solid waste hierarchy sets clear priorities. Local governments are required to provide residents the opportunity to recycle. Landfill bans are in place for selected materials. Oregon's bottle bill, electronics, and paint laws set a precedent for product stewardship. Mandatory business recycling in the Portland Metro area is required but poorly enforced. Recycling is not mandatory outside the Metro area, except that certain materials are banned from landfills. Generally, the regulatory structure is focused on managing wastes at end-of-life. DEQ measures tons recovered and disposed, and state waste generation and recovery goals are based on waste tonnages.

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**Materials management:**

**Identifies impacts throughout the life cycle**

**Focuses on high-impact actions across the life**

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# Framework for Action

Taking action upstream—in design and production—offers the best opportunities to realize the *2050 Vision*. While producers shift to more sustainable actions, consumers also have important roles to play in the types of products they demand, how they use them, and how items are managed once they are no longer wanted. Effective management at end-of-life then redirects resources back into productive use, while helping to reduce the negative impacts of disposal.

To help achieve the *2050 Vision* in Oregon, DEQ must take several different types of actions. The *Framework for Action* includes pathways to lead Oregon to the desired outcomes for 2050. These pathways include:


Within the pathways, this document lists potential actions for DEQ and others to pursue and leaves room to develop new actions over time. The framework is intended to serve as a flexible platform for action to guide progress toward the *2050 Vision*; it is not designed as an implementation plan for specific actions. The framework is structured to allow adaptability in implementation and detailed action planning as it steers overall efforts in the direction of the vision and desired outcomes for 2050.

DEQ will prioritize the following actions in fall 2012 and will begin work on the highest priorities within the first five years as resources allow. Prioritization will consider factors such as the staging and

relative timing of actions that build sequentially on each other, internal resource availability, opportunities to partner with other organizations and efforts, and other factors such as initiatives by key stakeholders that might facilitate certain actions.

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# Foundations (F)

The foundations pathway will create or strengthen infrastructure necessary to achieve the *2050 Vision*. Foundational work includes setting goals and measuring outcomes for the broader effort as well as specific projects, supporting and performing research to inform work in all four pathways, building the work into DEQ operations, and securing stable funding.

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## F1. Establish goals and measure outcomes

**a.** Establish new **goals for sustainable materials management**, and update existing goals.

**b.** Establish and track appropriate **sustainability measures** in coordination with the Oregon Sustainability Board and the Secretary of State's Oregon benchmarks.

## F2. Support and perform foundational research

**a.** Identify **high-impact materials and processes**, and disseminate information on easy-to-use life cycle **metrics** for high-impact product categories.

**b.** Perform research to **identify highest and best use at end-of-life** for discards with high environmental impacts (e.g., food, metals, paper, plastics, carpet, and wood), and conduct analysis to determine barriers, program and policy options, and steps needed to increase recovery.

**c.** Conduct a study of **regional standards** and opportunities for **carbon and environmental footprinting**.

**d.** Research and evaluate **definitions and criteria for addressing sustainable consumption** for Oregon.

**e.** Study **relationships between materials management and social and economic systems**, such as determining the economic value of reuse, borrowing and renting, jobs, and community, and understanding the values, preferences, and motivations that support and promote community-scale sustainable consumption.

**f.** Research **material subsidies** to identify opportunities to reduce environmental impacts.

**g.** Identify and evaluate barriers to designing **infrastructure and products for repair, reuse, and lifespan extension** in Oregon. Identify and evaluate options to **determine when product reuse is appropriate** based on environmental impacts.

**h.** Perform research on **product and disposal prices** to determine environmental and other potential costs not reflected in prices; develop tools, methods, and standards for **determining full costs**; study feasibility of incorporating environmental costs into prices (e.g., carbon tax), as a tool to encourage product design changes or discourage products with higher impacts.

**i.** Conduct periodic updates to **consumption-based greenhouse gas emissions inventory** and evaluate inclusion of additional (non-climate) **environmental impacts.**

**j.** Evaluate **value of local production**, and identify products for which local production benefits the environment.

### F3. Build *2050 Vision and Framework for Action* into DEQ's operations

**a.** **Organize DEQ's programs to effectively implement this *Framework for Action*.** Evaluate current solid waste program work, including permitting, and realign staff priorities to be consistent with the *2050 Vision*. Align resources with risks for permitting, inspections, and oversight.

**b.** **Review and update *2050 Vision and Framework for Action*** regularly.

**c.** Adopt a DEQ policy to **include environmental costs** in internal department decisions.

**d.** **Support implementation of DEQ's *Toxics Reduction Strategy***, which includes a focus list of priority toxic chemicals and actions to reduce and assess toxics in Oregon.

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## F4. Identify and secure sustainable funding for materials management programs

**a.** Identify and **evaluate potential funding models** and convene stakeholders to collaborate and **develop funding strategy**.

**b.** **Secure funding** for DEQ and other programs, such as state entities charged with fulfilling the materials-related sustainability goals under the Oregon Sustainability Act.

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# Policies and Regulations (P)

DEQ will evaluate and develop policies and regulations that move Oregon forward on the path toward achieving the *2050 Vision*.

## P1. Evaluate and adopt incentives to help Oregonians produce and consume more sustainably

**a.** Support policies that offer incentives for **developing sustainable manufacturing techniques and goods**, including green chemistry and nanoproducts, in Oregon.

**b.** Evaluate potential changes to tax policy to **shift consumption and support natural capital**.

## P2. Reduce life cycle impacts through product stewardship

**a.** Identify opportunities and establish **voluntary programs for producers and retailers** to support sustainable production and minimize life cycle impacts of products, such as greenhouse gas reductions and phase-out of persistent, bioaccumulative toxics.

**b.** Improve **information dissemination** across the life cycle of products such as credible **eco-labels** to foster reduction of environmental impacts of products; standardized **environmental footprint** information for products; comprehensive **hazard information** for chemicals; and **end-of-life instructions** for certain categories of products.

**c.** Evaluate and select products for suitable **environmental standards** ("choice editing") and implement **product standards for high-impact products** including phase-outs or bans. Coordinate with other states and provinces to **harmonize product stewardship efforts**.

**d.** **Prioritize products and materials for product stewardship** programs based on DEQ's product stewardship principles and support legislation consistent with these principles.

**e.** Develop and enforce **management standards for extended producer responsibility (take-back) programs**.

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**Product stewardship refers to a broad umbrella of actions to minimize harmful impacts across the entire life of their product.**

**Extended producer responsibility (EPR) is a specific application of product stewardship that shifts responsibility for end-of-life management of products and materials to the producer.**

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## P3. Achieve the highest and best use at end-of-life

**a.** Develop a strategy to **limit food, yard waste, and metals from entering the disposal stream** of wastes destined for landfill, where appropriate. Mandate food scraps collection in areas with composting or anaerobic digester capacity at a reasonable price. Ban food scraps, yard waste, and metals from entering the disposal stream (destined for landfill or incineration) by 2025, with exceptions as appropriate.

**b.** Evaluate **potential bans** to prevent other recyclable materials from entering the disposal stream destined for landfill or incineration.

**c.** Evaluate legislation or other authority to **limit feedstock sent to conversion technology facilities** to only non-recyclable material, as appropriate.

**d.** **Increase recycling collection opportunities** in Oregon through review and update of the Opportunity to Recycle Act including considering mandating multi-family and commercial recycling service as well as expanded education and promotion programs; reviewing the definition of "recyclable material" to consider other costs not reflected in recycling and disposal prices; and updating recyclable materials lists through rule adoption.

**e.** Set ambitious yet achievable **recovery goals** for materials and products, such as rigid plastic containers.

**f.** Mandate **post-collection sorting** for dry waste loads in large-volume markets.

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# Collaboration and Partnerships (C)

DEQ aims to collaborate with other state agencies, businesses, nongovernmental organizations, local governments, individuals, and other states to foster innovative solutions. DEQ will identify, convene, and participate in cooperative partnerships; share information among partners; seek opportunities for collaboration on research; and play a leadership role and endorse other efforts, where appropriate.

## C1. Foster business and industry collaboration and innovation

**a.** Evaluate needs and opportunities for **business-to-business information dissemination** on impacts of products and processes. Support improvements in supply-chain reporting and information management including development of standardized methodologies for data collection and evaluation of product impacts, life cycle assessment standards, product category rules, and rating systems for manufacturing.

**b.** Support **Oregon Green Chemistry Innovation Initiative** to build awareness in the business community about the economic, environmental, and public health benefits of green chemistry.

**c.** Evaluate and engage in potential partnerships with industry to adopt incentives, grants, tax changes, and other state and local policy alternatives to **support repair and reuse**, including product repair and building material reuse.

**d.** Evaluate and engage in potential partnerships with industry to adopt incentives, grants, tax changes, and other state and local policy alternatives to **support collaborative and sustainable consumption**.

**e.** Investigate methods and technologies to better **sort and preserve value of recovered materials**.

**f.** Support efforts to set **standards for finished compost quality**.

**g.** Support **voluntary business accounting efforts** to monetize environmental impacts.

**h.** Support higher standards for new buildings (e.g., "net zero" plus offset of materials) and improvements to materials-related elements of **green building** certification systems.

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## C2. Work with government agencies to advance sustainable materials management

**a.** Work with Oregon's Department of Administrative Services, the Oregon Sustainability Board, and others to develop **sustainable procurement policy and programs** for state and local government and institutional purchasers.

**b.** Coordinate with Business Oregon, the Oregon Business Development Department, to identify and **support innovation in manufacturing**.

**c.** Support improvements to Oregon Reach Code and baseline **building codes**, such as material selection, preferences, restrictions, and incentives for space-efficient homes.

**d.** Support **expanding the State Energy Efficient Design requirements** for construction and renovation of state buildings to include energy impacts of materials.

## C3. Support sustainable consumption "early adopters"

**a.** Evaluate and pursue opportunities to support **space-efficient housing**.

**b.** Engage with other partners to research feasibility and efficacy of reducing consumption by facilitating voluntary adoption of **shorter work weeks**.

**c.** Evaluate existing **food waste prevention programs** (such as "Love Food Hate Waste" and others) for application in Oregon. Partner with others to implement efforts in Oregon including efficient food redistribution systems.

**d.** Support opportunities for consumers to effectively **opt out of receiving unwanted mail**, if desired.

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# Education and Information (E)

Much of DEQ's work related to education and information will involve others. For example, DEQ will share information it develops with partners for distribution to appropriate audiences.

## E1. Engage communities in sustainable consumption

**a.** Identify and support opportunities to **limit greenwashing**.

**b.** Develop information that can be used to **help consumers understand relative impacts of actions and choices**, and partner with others to disseminate the information.

**c.** Embed sustainable consumption concepts into existing **public education programs**, such as outreach under the Opportunity to Recycle Act. Revise "Rethinking Recycling" curriculum and supporting materials; expand the curriculum to include grades 6 to 12 and a broader materials management perspective.

## E2. Develop a communication plan focused on sustainable end-of-life management

**a.** Support efforts to set **revised ASTM standards** for product compostability and to **clarify product labeling** for compostability and biodegradability.

**b.** Develop **consistent statewide messaging** on the benefits of reuse, repair, composting, recycling, and disposal, taking into account differences in programs throughout the state.

**c.** **Work with partners** such as grocery and retail stores and libraries **to deliver messages** related to sustainable end-of-life materials management.

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[1] For example, the International Monetary Fund reports that global commodity prices for primary metals (an index of copper, aluminum, iron ore, tin, nickel, zinc, lead, and uranium) rose 47% between 2006 and 2011. Prices for food and beverage commodities rose 64%; agricultural raw materials (an index of timber, cotton, wool, rubber, and hides) rose 41%; and energy rose 62% during the same time period.

[2] In 1900, 41% of the materials used in the U.S. were renewable (agricultural, fishery, and forestry products); by 1995, only 6% of materials consumed were from renewable sources. The majority of materials consumed in the U.S. now are nonrenewable, including metals, minerals, and fossil-fuel derived products. Lorie A. Wagner, "Materials in the Economy—Material Flows, Scarcity, and the Environment," *U.S. Geological Survey Circular* 1221 (February 2002), **http://pubs.usgs.gov/circ/2002/c1221/c1221-508.pdf**.

[3] Oregon Department of Environmental Quality, *Supplemental Technical Report: Greenhouse Gas Emissions and Emissions Intensities for Consumption of Materials, Services, Fuels and Electricity* (2011), **http://www.deq.state.or.us/lq/consumptionbasedghg.htm**.

[4] Figure 2 was modified from Center for Sustainable Systems, University of Michigan, "U.S. Material Use Factsheet," Publication Number CSS05-18 (2011), **http://css.snre.umich.edu/css_doc/CSS05-18.pdf**. The University of Michigan graphic was based on a figure from G.R. Matos and L.A. Wagner, "Consumption of Materials in the United States 1900-1995," *Annual Review of Energy and the Environment* (1998), version 23, pages 107-122. Also based on Lorie A. Wagner, "Materials in the Economy—Material Flows, Scarcity, and the Environment," *U.S. Geological Survey Circular* 1221 (February 2002).

[5] Oregon's calculated recovery rate for solid waste (excluding statutory "2 percent credits") has grown from 27% in 1992 to 46% in 2010. At the same time, solid waste landfills and incinerators have implemented more rigorous pollution controls.

[6] For example, among domestic sources of greenhouse gas emissions in 2006, roughly 2.2% of emissions came from landfills and wastewater treatment, while "upstream" sources were roughly 20 times higher: 32.2% of domestic emissions are associated with resource extraction and production processes, and 7.1% are associated with the movement of freight. These figures do not account for the transnational emissions associated with foreign supply chains satisfying domestic consumption; doing so would further increase the "upstream" emissions (relative to disposal-related emissions). Similarly, a rough analysis of sources of air toxics in the Portland Air Toxics Inventory found that the vast majority of sources of air toxics are associated with production or consumption activities, rather than management of wastes at end-of-life.

[7] Waste recovery activities in Oregon in 2010 saved approximately 32 trillion British thermal units (Btus) of energy—the equivalent of 258 million gallons of gasoline, or 3.0% of total energy used by all sectors of the economy in Oregon. Similarly, waste recovery activities reduced greenhouse gas emissions by approximately 3 million metric tons of carbon dioxide equivalent, roughly the same as tailpipe emissions from 620,000 "average" passenger cars over a year. Oregon Department of Environmental Quality,

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*2010 Oregon Material Recovery and Waste Generation Rates Report* (2011). While DEQ has not quantified other environmental benefits, a meta-analysis of life cycle analyses conducted in the United Kingdom concluded that recycling activities typically also reduce a variety of other pollutants, such as those contributing to toxicity, acidification, and smog formation, relative to landfilling or incineration. WRAP, *Environmental Benefits of Recycling—2010 Update* (2010). Specific to jobs, a recent study found that landfilling supports roughly 1 job per 10,000 tons of waste landfilled annually, while composting and recycling support, on average, 5 and 20 jobs per 10,000 tons, respectively, with as many as 100 jobs per 10,000 tons of plastics recycled, and even higher job potential for reuse and remanufacturing. Tellus Institute and Sound Resource Management, *More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.* (2011).

[8] For an example of the increasingly global nature of our environmental footprint, one recent study showed that reductions in territorial greenhouse gas emissions in developed countries between 1990 and 2008 were more than offset by an increase in emissions in other countries associated with producing goods for consumption in the developed countries. Peters *et al.*, "Growth in Emission Transfers via International Trade from 1990 to 2008," *Proceedings of the National Academy of Sciences of the United States of America* (May 24, 2011).

[9] Nationally, achieving nearly 95% recovery (recycling and composting) of municipal solid waste and 70% recovery of construction and demolition materials would reduce the greenhouse gas emissions associated with the life cycle of materials (excluding use of energy-using products) by roughly one-seventh—a significant accomplishment, but still leaving most of the emissions associated with materials untouched. U.S. Environmental Protection Agency, *Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices* (2009). Similarly, estimations of the reduction in greenhouse gas emissions associated with different program and policy alternatives conducted by DEQ for the Oregon Global Warming Commission found that the potential reductions associated with "upstream" actions were many times larger than the reduction potential from actions addressing management of wastes. Oregon Global Warming Commission, *Interim Roadmap to 2020* (October 2010).

Looking just at one product category, DEQ's life cycle analysis of drinking water delivery systems compares the benefits of increasing recycling of single-use bottles with other actions that producers and consumers might engage in. For example, increasing the recovery rate for conventional PET water bottles from 37% to 62% recovery (roughly equivalent to the change in recovery rate when water bottles were added to Oregon's bottle bill) decreases life cycle impacts of these bottles by 5% for global warming potential, 7% for energy use, 5% for respiratory effects potential, and 1% for ecotoxicity potential. (This is based on an allocation method that assigns only half of the benefits of recycling to the generator of recycled waste and the other half to the user of recycled material; an alternative approach that allocates all of the benefits to the waste generator would produce benefits roughly twice those listed above.) In contrast, increasing the recycling rate to 62% while simultaneously lightweighting the plastic bottle (an "upstream" or producer-related action not directly related to end-of-life management) leads to much larger reductions: 21% for global warming potential, 23% for energy use, 22% for respiratory effects potential, and 20% for ecotoxicity potential. Going further, decisions by the consumer to eschew bottled water and drink water from the tap instead could reduce these impacts by 26% to 99%. Franklin Associates, prepared for Oregon Department of Environmental Quality, *Life Cycle Assessment of Drinking Water Delivery Systems: Bottle Water, Tap Water, and Home/Office Delivery Water* (2009).

[10] Several of the best examples of suboptimal decisions resulting from focusing on end-of-life considerations rather than the full life cycle involve the very common practice of using end-of-life objectives (e.g., recycling, composting) to inform purchasing decisions (e.g., recyclable, compostable). As recycling and composting are generally viewed as good for the environment, a natural inclination is for people to assume that recyclable and compostable products must similarly be good for the environment. Two examples

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from projects in Oregon illustrate the hazards of this approach. First, a life cycle analysis of green building practices shows that, when choosing among competing wall framing practices, design for "waste prevention" and design for "recycling" can both lead to suboptimal outcomes. Over the life cycle of the home, several wall designs with lower overall environmental impacts tend to use more material (and thus generate more solid waste) and more types of materials that are currently difficult to recover. Quantis, Earth Advantage Institute, and Oregon Home Builders Association, prepared for Oregon Department of Environmental Quality, *A Life Cycle Approach to Prioritizing Methods of Preventing Waste from the Residential Construction Sector in the State of Oregon—Phase 2 Report* (2010).

Similarly, when considering options for shipping non-breakable goods in an electronic commerce order fulfillment environment, DEQ's e-commerce packaging life cycle analysis clearly shows that criteria such as "recyclable" and "recycled content" do not consistently correlate well with reductions in environmental impacts. In contrast, several packaging options that are both difficult to recycle and contain limited recycled content (such as plastic shipping bags) have environmental burdens that are considerably lower than options that are easy to recycle and contain higher levels of recycled content (such as corrugated boxes with paper void fills). Franklin Associates, prepared for Oregon Department of Environmental Quality and U.S. Environmental Protection Agency, *Life Cycle Inventory of Packaging Options for Shipment of Mail-Order Goods* (2004).

[11] Specifically, in *Oregon Revised Statutes 459.015(1)*, the Legislative Assembly makes several findings and declarations, including that "(e) There are limits to Oregon's natural resources and the capacity of the state's environment to absorb the impacts of increasing consumption of resources…" and "(f) It is in the best interest of the people of Oregon to conserve resources and energy by developing an economy that encourages waste prevention and recycling."

[12] While recycling bridges the worlds of materials production and end-of-life management, the production element has been historically underemphasized. Further, some of the current challenges involving recycling (such as contamination of recyclables and loss of end-markets) may in part be a consequence of managing recycling as a solid waste activity as opposed to a materials management activity. Thus, the shift from solid waste management to materials management provides opportunities to improve outcomes from discard management programs, while also providing more effective opportunities to realize the broader policy objectives of conserving resources and reducing pollution.

[13] World Business Council for Sustainable Development, *Sustainable Consumption Facts and Trends from a Business Perspective* (2008).

[14] TerraChoice, a subsidiary of Underwriters Laboratories, has published a series of reports on "greenwashing." Its most recent involved a review of 5,296 consumer products sold in the U.S. and Canada. These products made more than 12,600 "green" claims. Only 4.4% of products making green claims avoided all of TerraChoice's "seven sins of greenwashing." Put differently, the vast majority of products making environmental claims are engaging in some form of greenwashing, as defined by TerraChoice. The most common "sins" include the "sin of no proof" (making claims that are not substantiated), vague claims, hidden trade-offs (implying greenness by calling out environmental attributes that may be positive but largely irrelevant, while not mentioning other negative environmental impacts), and the use of false or bogus certifications. TerraChoice, *The Sins of Greenwashing* (2010).

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# Appendix A
# Glossary

**Backcasting:** A technique used in The Natural Step and elsewhere that starts from an envisioned future outcome and works backwards to determine steps that can lead from current conditions to that future outcome.

**Choice editing:** Instances where less sustainable products or services are removed and replaced with more sustainable items. Governments may introduce outright bans or introduce timelines for the elimination of a product or service. Businesses may phase out production of less sustainable items or remove items from sale, whether voluntarily or in response to government initiatives.

**Consumption:** The using up of a resource, product, or material. In the *2050 Vision*, "consumption" typically refers to the stage in the life cycle of a product where it is acquired and used, following production but prior to end-of-life management. However, "consumption" in the context of the **consumption-based greenhouse gas emissions inventory** has a slightly different meaning, referring to the purchase of goods and services by households and governments, as well as business purchases that are classified as capital or inventory formation (economic final demand).

**Consumption-based greenhouse gas emissions inventory:** An estimation of the quantity of gases contributing to climate change that are associated with consumption (economic final demand). A consumption-based inventory is sometimes contrasted with a territorial inventory. A territorial inventory estimates the emissions that physically originate within a community (e.g., Oregon). In contrast, many of Oregon's consumption-based emissions occur in other states and countries, in the course of producing goods and services for consumption in Oregon.

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**Conversion technology:** The use of primarily chemical or thermal processes to convert solid waste to fuels or other useful products. Examples include pyrolysis, gasification, transesterification (biodiesel production), hydrolysis, and distillation. Anaerobic digestion and fermentation (for ethanol production), which are both biological processes, are often considered to be forms of conversion technology.

**Discard management:** The collection, transport, processing or disposal, managing, and monitoring of waste materials at end-of-life.

**Downstream:** Those actions and impacts that occur after that point in the life cycle, at any point on a product's life cycle. For example, as viewed by a consumer, downstream actions are those associated with disposal or recycling of the product.

**End-of-life:** The point at which a product or material is no longer useful to the person possessing it and is either discarded or abandoned.

**Energy recovery:** The use of solid waste to produce a fuel, or the direct combustion of solid waste as a fuel for heat recovery or to produce electricity.

**Environmental footprint:** A measure of the environmental impacts associated with the life cycle of a good or service, including resource extraction, production, transport, sale, use, and end-of-life management. For example, the "Ecological Footprint" is one specific methodology of evaluating environmental impacts in terms of the amount of land required to produce goods and services that an individual or organization consumes. The methodology was originally developed by Mathis Wackernagel and William Rees.

**Extended producer responsibility (EPR):** A mandatory type of product stewardship that includes, at a minimum, the requirement that the producer's responsibility for its product extends to post-consumer management of that product and its packaging.

**Green building:** Constructing and maintaining structures in a way that optimizes resource use and minimizes environmental and human health impacts throughout the life cycle, through design, material selection, operation, and adaptable reuse or deconstruction considerations.

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**Green chemistry:** The invention, design, and application of chemical products and processes to reduce or to eliminate the use and generation of hazardous substances.

**Life cycle assessment (or analysis), LCA:** A standardized process used to estimate the impact that a product or process has over the whole of its lifespan, including extraction of raw materials, production, transport, use, and disposal.

**Materials management:** An approach to reduce environmental impacts by managing materials through all stages of their life. Materials management identifies impacts and actions across the full cycle of materials and products as they move through the economy—from raw material extraction to product design and manufacture, transport, consumption, use, reuse, recycling, and disposal.

**Natural capital:** The stock of natural ecosystems that yields a flow of valuable goods or services into the future. It is an extension of the economic definition of capital, which traditionally refers to only the stock of human-made goods and machinery.

**The Natural Step:** A process derived from the work of Dr. Karl-Henrik Robèrt that businesses and organizations use to advance sustainability goals based on four "system conditions." The four conditions are that the natural environment is *not* subject to systematically increasing concentrations of substances extracted from the earth's crust, concentrations of substances produced by society, or degradation by physical means; and people are not subject to conditions that systematically undermine their capacity to meet their needs.

**Product stewardship:** The act of minimizing health, safety, environmental, and social impacts and maximizing economic benefits of a product and its packaging throughout all life cycle stages. The producer has the greatest ability to minimize adverse impacts, but other stakeholders, such as suppliers, retailers, and consumers, also play a role. Stewardship can be either voluntary or required by law.

**Sustainability:** Using, developing, and protecting resources in a manner that enables people to meet current needs and provides that future generations can also meet future needs, from the joint perspective of environmental, economic, and community objectives.

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**Upstream:** Those actions and impacts that occur before that point in the life cycle, at any point on a product's life cycle. For example, as viewed by a consumer, upstream impacts are those associated with extraction of raw materials, production, distribution, and sale of the product.

**Waste management:** A subset of materials management specifically addressing the management of discards; often used to include, recycling, material recovery, composting, energy recovery, and landfilling.

**Waste management hierarchy:** Priority in methods of managing solid waste, established by Oregon law as follows: reduce the amount of solid waste generated; reuse material for the purpose for which it was originally intended; recycle material that cannot be reused; compost material that cannot be reused or recycled; recover energy from solid waste that cannot be reused, recycled, or composted, so long as the energy recovery facility preserves the quality of air, water, and land resources; and dispose of solid waste that cannot be reused, recycled, composted, or from which energy cannot be recovered by landfilling or other method approved by the Department of Environmental Quality.


**Waste prevention:** To reduce the amount of solid waste generated or resources used, without increasing toxicity, in the design, manufacture, purchase, or use of products or packaging. "Pure" waste prevention does not include recycling or composting.

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# Appendix B
# Background Documents

DEQ collected and developed background documents for this project to inform Workgroup members, capture institutional knowledge, and explore relevant topics more deeply. Background documents are available at **www.deq.state.or.us/lq/sw/materialsmgmtplanbkgrddocs.htm**

## Upstream, Production, and Consumption

### Waste Prevention

This paper examines the topic of **waste prevention**, the "reduce, reuse" part of the solid waste management hierarchy. It provides a summary of research findings on prevention, an overview of DEQ's *Waste Prevention Strategy*, and a short discussion of key challenges moving forward.

### Residential Green Building

Residential green building is one element of DEQ's work in waste prevention. This report summarizes the results of DEQ's life cycle assessment of residential waste prevention building practices, outcomes of that research, next steps for DEQ, and emerging issues.

### Sustainable Consumption and Waste Prevention

This paper provides background on sustainable consumption and explores its relationship with waste prevention. It concludes that DEQ's traditional waste prevention work may be more effective if reframed clearly in the context of sustainable consumption.

### Literature Review: Key Challenges in Sustainable Consumption

This paper summarizes a literature review addressing the challenges specific to sustainable consumption.

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### Literature Review: Alternatives for Advancing Sustainable Production and Consumption through Government Programs and Policies

This document summarizes the results of a broad but limited literature review specific to program and policy alternatives that support sustainable production and consumption.

### Recommendations for Product Stewardship in Oregon

This report recommends that Oregon pursue product stewardship as one strategy to reduce the environmental and public health impacts of products. It also recommends eight key elements for product stewardship programs and policy in Oregon.

## End-of-Life Management and Recovery

### Oregon's Solid Waste Hierarchy—Intent and Uses

This document describes the policy intent behind Oregon's solid waste hierarchy (reduce, reuse, recycle, compost, energy recovery, and disposal) and DEQ's application of the guidance.

### Trends in Oregon Waste Generation, 1993-2010

This document describes wastes tracked by DEQ, overall disposal and recovery trends for Oregon, and trends in generation, disposal, and recovery for individual material groups.

### Best Management Practices for Discarded Food Scraps

This paper describes a food waste hierarchy that identifies activities and practices intended to minimize the amount of food waste generated and beneficially use food discards.

### What are "Conversion Technologies"?

This paper describes processes and technologies used to convert the energy stored in carbon-containing organic wastes to chemicals and products which can be used to create energy or make new products. The paper also briefly identifies potential benefits and concerns relevant to conversion technologies.

### Potential for Additional Material Recovery

This paper examines current recovery rates for materials in Oregon and evaluates several potential environmental impacts if recovery could be increased.

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### General

#### What Are "Sustainable Materials" and "Sustainable Materials Management"?

This paper briefly introduces six different responses to these questions and summarizes some of the advantages and limitations of each approach.

#### Materials Management and Greenhouse Gases

A summary of how materials contribute to greenhouse gas emissions and opportunities to reduce emissions through materials management.

#### Alternative Criteria for Measuring Environmental Impacts of Materials Management

This paper examines some of the more important criteria and examines how changes in materials management might affect those criteria.

#### DEQ Toxics Reduction Strategy

DEQ's draft *Toxics Reduction Strategy* includes a Focus List of priority toxic chemicals and 25 actions to reduce and assess toxics in Oregon.

#### Rare Earth Elements

Rare earth elements are used for manufacture of wind turbines and electric vehicle technologies, among other products. These elements will continue to be of considerable interest for the foreseeable future, and demand is projected to grow, presenting business and military concerns.

## Background Documents from Outside DEQ

#### Sustainable Materials Management: The Road Ahead

U.S. Environmental Protection Agency, 2009.

#### The Natural Step Story: Seeding a Quiet Revolution

Karl-Henrik Robèrt, 2008.

#### More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.

Tellus Institute and Sound Resource Management, 2011.

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# Appendix C
# Systems and Capabilities

This appendix describes systems and capabilities broadly needed to achieve the *2050 Vision for Materials Management in Oregon*. To attain the future described in this *2050 Vision*, DEQ and others will need various systems and capabilities in place. Some of these capacities already exist, while others are not yet developed. DEQ and others will build the following systems and capabilities to the support the *2050 Vision for Materials Management in Oregon*.

## Information

- Ability to distill and credibly use information about environmental, societal, and economic impacts.
- Knowledge and disclosure of environmental impacts for the full product life cycle.
- Ability to determine highest and best use of materials.
- Robust research and innovation initiatives toward sustainable materials management.
- Systems for sharing information and knowledge.
- Ongoing stakeholder involvement.

## Economic Systems

- Sustainable funding.
- A level playing field between Oregon businesses and global competitors.
- Financial signals that point consumers and manufacturers in the right direction.
- Full-cost accounting and cost internalization.

## Social Systems

- Effective communication among government, producers, designers, distributors, retailers, consumers, recovery, and discard management providers.
- Political and public support for achieving the *2050 Vision*.
- Social norms around sustainable production, consumption, and end-of-life management and recovery.
- Infrastructure for reuse, repair, and sharing.
- Equitable access to sustainable choices

## Leadership in Government

- Outcome-based management.
- Organizational structure and sufficient resources dedicated to materials management.

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# Appendix D
# Workgroup Members

## 2050 Vision for Materials Management Workgroup Members

| | |
|---|---|
| **Mark Brady*** | Business Oregon |
| **Eden Brukman** | International Living Future Institute |
| **Meghan Butler** | Recology |
| **Chris Chapman** | Washington State Department of Ecology |
| **Steve Clem*** | Skanska USA Building |
| **Julie Daniel** | BRING Recycling |
| **Shannon Davis** | U.S. Environmental Protection Agency |
| **Mike Dewey** | Legislative Advocates |
| **Anisha Ladha*** | Intel Corporation |
| **Kristan Mitchell** | Oregon Refuse and Recycling Association |
| **Jeff Murray*** | Recycling professional |
| **Babe O'Sullivan** | City of Eugene |
| **Garry Penning*** | Rogue Disposal and Recycling |
| **Megan Ponder*** | City of Portland |
| **Colin Price** | Oregon Environmental Council |
| **Jennifer Purcell** | Tillamook County |
| **Wayne Rifer*** | Green Electronics Council |
| **Meg Rowe** | Oregon Sustainability Board |
| **Jeanne Roy** | Center for Earth Leadership |
| **Heather Schmidt** | New Seasons Market |
| **Andy Sloop** | Metro |
| **Chris Thomas** | Association of Oregon Recyclers (Waste Connections) |
| **Wendy Wiles** | Oregon Department of Environmental Quality |
| **Adam Winston*** | Waste Management |

** Not pictured*

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## 2050 Vision and Framework for Action

www.deq.state.or.us/lq/sw/materialsmgmtplan.htm

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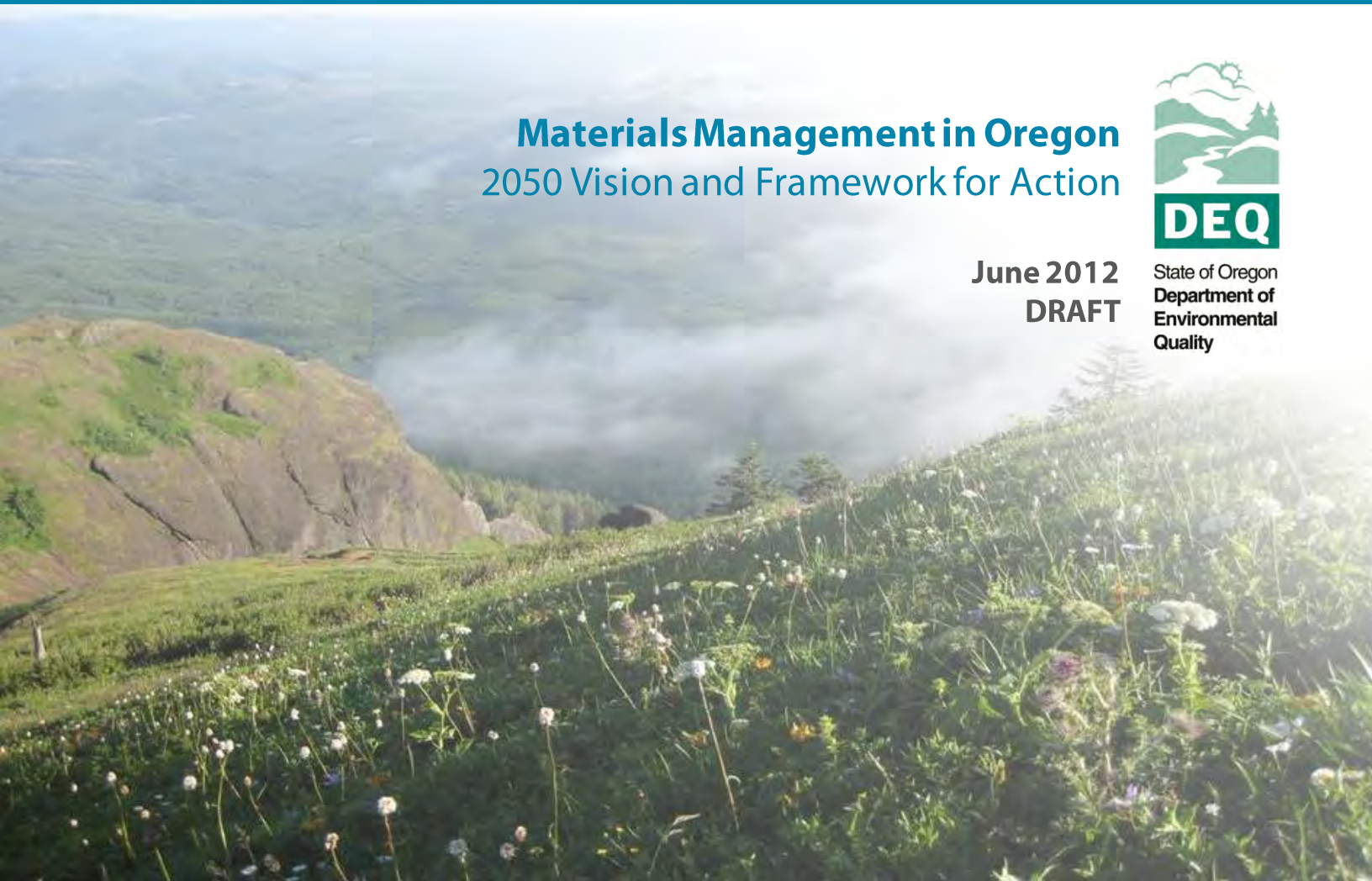
**June 2012**
**DRAFT**



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