Inspired Innovation

Expanding Oregon's Advantage in Sustainable Chemistry and Materials

December 2014

Fostering entrepreneurship. Supporting new businesses. Meeting global demand. Protecting human health. Cutting-edge research. Commercialization of new technology. Supporting key industries. Developing a skilled workforce. Incentivizing innovation. Creating healthier buildings. Forging strategic partnerships. Inventing next generation materials.

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Executive Summary

Materials are at the heart of the global economy. The availability and performance of materials has a direct impact on the competitiveness of key industries in Oregon. Strategic investments by Oregon's public and private sectors in the next five years will foster innovation and generate significant value for new and existing businesses in Oregon. In the context of global competition, commitment and timing will prove critical to success.

To help realize the economic, environmental, and public health benefits of developing the next generation of high performance chemicals and materials, **Oregon should prioritize the following actions over the next five years:**

1. Increase funding for strategic initiatives

Education and jobs are good investments. A modest public investment – $2 million in new funding – in three interdependent areas, including: 1) research, development, and commercialization, 2) entrepreneurship and new business creation, and 3) education and workforce training will help support growth across key industries in Oregon.

2. Raise awareness among decision-makers

Information gaps about green chemistry are significant among both policy makers and business leaders. The legislature can begin to close these knowledge gaps by establishing a green chemistry option as part of the annual Governor's Sustainability Awards and launching a sustainable chemistry and materials conference.

3. Forge strategic partnerships

Science-based economic growth requires strong collaboration between the research and business communities. We recommend establishing a dedicated position at Business Oregon (in partnership with Oregon research centers, universities, and other interested parties) responsible for identifying strategic needs and opportunities with Washington and California.

4. Reform relevant revenue streams

Oregon's current materials management fee system is outdated. The legislature can update the fee assessment mechanism and structure for relevant existing materials management fees, including the Hazardous Substances Possession Fee, to generate dedicated funding for the Toxics Use and Hazardous Materials Reduction Program and new green chemistry initiatives.

5. Strengthen demand

Consumer demand drives innovation. Department administrators should build on the success of the Oregon's initial efforts by accelerating adoption of the Department of Administrative Services' Green Chemistry Procurement Guidelines. Oregon should also take the lead in integrating the guidelines into multistate price agreements in collaboration with other states and national procurement organizations.

6. Enact comprehensive chemicals management policies

Businesses desire regulatory certainty. Oregon should enact clearer, stronger policies governing the management of hazardous chemicals to spur invention of safer alternatives and drive innovation, helping entrepreneurs overcome barriers to entry in the marketplace.

Introduction

Research indicates that the global market for chemicals and materials designed and manufactured using sustainable chemistry, also known as green chemistry, will continue to grow. It's estimated that the market will expand from about $3 billion in 2011, to almost $100 billion by 2020.[A] Oregon is poised to become a national leader in the development and commercialization of the next generation of affordable, high performance chemicals and materials.

Toxicity, energy and water intensity, and biodegradability are increasingly important factors in the performance of chemicals and materials. Materials that are safer for people, our ecosystems, and our global climate are in demand by new and existing businesses in Oregon's key industries like forest products, high tech, and outdoor gear and apparel, as well as other industries around the world.

In sustainable chemistry and materials, Oregon has substantial research, development, and commercialization capacity. It has an increasingly well-educated and well-trained workforce as well. Our universities and research centers are doing pioneering work in the fields of sustainable/green chemistry, engineering, and material science for decades, leveraging small-scale public investments to attract millions in private and federal funding in a highly competitive environment.

Oregon legislators, investors, and innovation leaders now must build upon Oregon's capacity and success in these cutting-edge fields to expand economic and health benefits throughout the state. Oregon should not miss the opportunity to support new businesses and new technologies that will be in demand around the world.

Based on input from experts in business, government, and academia, a general consensus has emerged that Oregon should focus on three main elements as we work to advance sustainable chemistry and materials development and manufacturing. These elements include **fostering innovation, facilitating effective collaboration, and implementing sound policies**.

These elements are highlighted in ***Advancing Green Chemistry in Oregon*** (2010), ***A Roadmap for Advancing Green Chemistry in Washington State*** (2013), and in a recent report to Governor Kitzhaber on implementation of his Executive Order 12-05: ***Fostering Environmentally-Friendly Purchasing and Product Design*** (2012).

Oregon's Innovation Environment

There is an emerging market for safer chemicals and more sustainable materials, with growing regional and international demand across multiple sectors. Entrepreneurs and existing businesses looking to meet that demand must have access to strong research and development partners, access to a skilled workforce, and capital.

According to the Oregon University System, Oregon now faces steep competition from other states and nations building similar but larger strategic initiatives linking economic development with research and innovation. Washington, Arizona, Ohio, and others have out-invested Oregon in the past decade, helping to protect their economies from recession and increasing the rate at which they receive federal grants.[B]

Oregon Innovation Council

Oregon has already demonstrated a level of success in this area worthy of expanded support. Oregon Innovation Council (Oregon InC) has helped incubate more than 90 companies in less than 8 years. It's also lead to more than $490 million in federal grants to Oregon and raised more than $130 million in private capital. That represents a **$6 return on every $1 invested**, spurring wealth and job creation. Oregon InC initiatives have provided start-ups access more than $130 million in private capital, and provided more than 300 organizations access to business-friendly R&D facilities and researchers through its network of 11 shared university labs.[C]

Strategic Needs and Opportunities

Oregon BEST is a Signature Research Center funded by Oregon Innovation Council. To help identify collaborative research opportunities between university researchers and businesses, Oregon BEST periodically hosts agenda development forums, where they identify needs and opportunities in sustainable technology. Oregon BEST recently identified a number of places where green chemistry innovations could be applied to existing processes, products, and industries.

These needs and opportunities are two sides of the same coin: Needs exist where there is a clear and unmet market demand; Opportunities for innovation exist in fields where Oregon researchers and universities display expertise. Oregon BEST developed a Green Chemistry Research Agenda that identified the following needs and opportunities:[D]

- Conversion and Utilization of Biomass - Development of technologies to convert biomass cultivated and captured from agricultural and forest product waste streams into feedstock for green chemistry products

- Depolymerization and Deconstruction - Cost-effective materials designed with "cradle-to-cradle" deconstruction, removal, and degradation in mind

- Coatings - Having the necessary viscosity to preclude the need for solvents during application, and antimicrobial coatings for healthcare applications

- Apparel - Safer, more sustainable alternatives for durable water repellants, flame retardants, antimicrobials, and plasticizers used in textiles and polymers

- Electronics - Earth abundant metals for thin film applications in the manufacture of high and cleantech products

Additionally, Oregon BEST assembled a Living Building Challenge Materials research agenda, identifying specific materials and product categories in which safer alternatives to hazardous chemicals are needed by building designers and contractors. These materials and product categories include: Insulation, composite wood products, waterproofing membranes, electrical wiring, plumbing, small electronics, countertops/work surfaces, plastics, and concrete and Portland cement.[E]

Oregon's universities and research centers including the University of Oregon, Oregon State University, Oregon BEST, and ONAMI have built the sustainable chemistry research and development capacities to address these needs, particularly in the fields of adhesives, polymers, composite materials, thin films, and nanomaterials. For example, Beet Inc., a company created with original research from the Center for Sustainable Materials Chemistry recently received a national innovation award for its work developing a high efficiency solar cell.

Center for Sustainable Materials Chemistry

The Center for Sustainable Materials Chemistry'a (CSMC) technical and R&D capabilities, coupled with its emphasis on translating research into business opportunities, make it an excellent source of chemistry and materials innovation. The Center is encouraging entrepreneurship among researchers. Graduate students and potential entrepreneurs have access to a variety of resources to help launch businesses based on their research into new technologies. These resources include the opportunities to work with a team of business consultants and being matched with start-up businesses for internships where they can experience a start-up environment firsthand.

Recommendation for Action - Innovation

Increase funding for strategic initiatives

The Oregon legislature should increase funding for the Oregon Innovation Council, specifically for sustainable chemistry and materials research, development, and commercialization.

Research, Development, and Commercialization
Oregon's Signature Research Centers (SRCs) illustrate how smart, strategic investments in innovation pay off for our state economy. For example, Oregon BEST is helping to transform cleantech research, including green chemistry research, into economic prosperity. Since 2008, it has helped 23 Oregon start-ups and 200+ Oregon BEST Member Faculty attract over $102 million in research funding for clean technologies.[F] Oregon BEST has awarded more than $460,000 in proposal matching grants for projects related to green chemistry, which in turn attracted over $8.7 million in research funds and equipment to the state. These green chemistry grants compose 45% of the leveraged dollars attracted across all Center research areas, by spending only 24% of proposal matching funds.

Oregon Innovation Council's first Signature Research Center, Oregon Nanoscience and Microtechnologies Institute (ONAMI), is helping to lead the way nationally in the application of green chemistry principles in nanoscale science through the Safer Nanomaterials and Nanomanufacturing Initiative.

Entrepreneurship and New Business Creation
Oregon should strengthen and expand efforts that foster entrepreneurship and the creation of new businesses based on green chemistry and sustainable materials technologies. Specifically, it should provide financial support to help access funding from the National Science Foundation (NSF) Small Business Innovation Research (SBIR) program. Business Oregon should also establish a SBIR matching funds program for supplemental awards made by NSF.

Matching Fund Programs

Several states, including Kentucky have established matching funds programs to enhance SBIR awards. The Kentucky SBIR/STTR Matching Funds Program provides Matching Funds up to $150,000 for Phase I and up to $500,000 for Phase II (not to exceed two years). The funds are used for new and additional work tasks that complement existing Federal SBIR/STTR awards. For example, the Kentucky program has returned $26 for every $1 invested in helping researchers secure funding, and a return of $7 for every $4 invested in matching funds.[G]

Education and Workforce Training

Oregon needs a world-class workforce to compete in the global economy. Oregon ranks 45th among states when it comes to state assistance for higher education, while tuition and fees paid by Oregon University System students more than doubled from 1992-93 to 2012-13, adjusted for inflation.[H] Oregon should establish a stable funding source for providing financial assistance to students, including those in science, technology, engineering, and math fields (STEM), who will play important roles in advancing sustainable materials chemistry.

The Greener Education Materials for Chemists (GEMs) project at the University of Oregon features an interactive collection of chemistry education materials focused on sustainable chemistry. According to the University of Oregon, sustainable chemistry strategies and tools are essential for students who will be key players in discovering and developing new chemical processes. Equally important is the opportunity to introduce these strategies and methods to larger group of students who may not become chemists, but rather educators, policy makers, and active citizens in our global technological society.

Dedicated Higher Education and STEM Funding

Funding for education and workforce training in science, technology, engineering, and math (STEM) fields, including sustainable/green chemistry, materials science, engineering, and product design, among others, should be a priority. A dedicated, permanent state fund that uses investment revenue to increase assistance for students at community colleges and universities is a smart and sustainable solution.

Recommendations for Action - Innovation

Raise awareness among decision makers

In the mid -to long-term, green chemistry education and workforce training, coupled with increased consumer demand for safer alternatives for consumer goods and materials, will raise awareness of chemical and materials issues among decision-makers. There are also some simple and cost-effective steps Oregon can take to further accelerate awareness of our chemical and material environment, and innovations in the near term.

Establish a sustainable chemistry and materials award
To help build awareness about the economic and social benefits of developing safer, more sustainable materials and products, we recommend establishing a sustainable chemistry and materials option as part of the annual Governor's Sustainability Awards, managed by the Oregon Sustainability Board. An outreach effort should accompany this new option to ensure sufficient number of applications from academia and businesses, as well as multisectoral collaborative efforts.

Establish a sustainable chemistry and materials conference
A group of Oregon universities, businesses, trade associations, and nonprofits should also establish a sustainable chemistry and materials conference. An annual conference has become an integral element of Michigan's green chemistry business outreach efforts, attracting hundreds of attendees from the Great Lakes region. Oregon's conference could focus on technologies relevant to key industries in the Pacific Northwest like outdoor gear and apparel, forest products, and high technology.

Sustainable Chemicals and Materials in Key Industries

A number of businesses in Oregon key industries are recognized leaders in the design, manufacture, and use of more sustainbale chemicals and materials. Columbia Forest Products uses a safer, less hazardous bio-based adhesive developed in partnership with Oregon State University. Nike developed a rubber formula for shoes that is less toxic to aquatic life. Several tech companies are using novel thin film processes to create next generation display screens.

Oregon's Collaborative Environment

Oregon should develop stronger strategic partnerships with organizations in the region and beyond.

The Center for Sustinable Materials Chemistry's success in attracting federal research funding – including a five year, $20 million grant from the National Science Foundation in 2012 - illustrates the value of collaboration between Oregon universities and other out-of-state research institutions. Under this grant, collaborative research in materials chemistry is carried out across six academic institutions – Oregon State University (Center headquarters), University of Oregon, Washington University at St Louis, Rutgers University, University of California Davis and University of California Berkeley.

Partners for Oregon: Northwest Green Chemistry

Another regional center for collaboration is Northwest Green Chemistry (NGC), a nonprofit organization located in Washington. NGC's mission is to enhance human and environmental health by fostering innovation and economic opportunities through sustainable and green chemistry and engineering. The center facilitates research, development, commercialization, technical assistance, and education in green chemistry and engineering. Oregon should work with NGC to leverage the expertise and capacity at our universities and research centers to address regional needs and opportunities for businesses, while fostering entrepreneurship and the commercialization of new technology.

Recommendation for Action - Collaboration

Forge strategic partnerships

To identify and act on strategic needs and opportunities for advancing green chemistry and sustainable materials in collaboration with Washington and California, we recommend that Business Oregon establish a dedicated position to work in partnership with Oregon research centers, universities, and other interested parties. The position should also be responsible for aligning state and regional efforts with national, and international partners ,including the Green Chemistry & Commerce Council, the American Chemistry Institute, the National Institute of Standards and Technology, and the International Trade Administration, among others

Partners for Oregon: Green Chemistry & Commerce Council and NIST

The Green Chemistry & Commerce Council is a cross sectoral, business-to-business collaborative network that seeks to advance green chemistry across sectors and supply chains. The National Institute of Standards and Technology (NIST) is a non-regulatory federal agency within the U.S. Department of Commerce that seeks to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology. Oregon, in partnership with Washington, could work with NIST to establish an Institute for Manufacturing Innovation focused on safer high performance chemicals and materials.

Updating Policy for an Innovative Future

While fostering innovation and facilitating partnerships are important to advancing sustainable chemistry and materials, updating relevant policies is essential to a comprehensive approach. Action is needed to reform revenue streams, strengthen demand for safer, innovative products, and enact comprehensive chemicals management.

Implementing sound policy also requires the ability to measure progress towards achieving goals and making strategic modifications over time based on those measurements. Oregon has an opportunity to be the first state in the country to develop metrics for measuring progress in advancing green chemistry. Partnerships with the Green Chemistry & Commerce Council could allow these metrics to be adopted and refined by other states across the country.

Small Business Owners Support Comprehensive Approach

A survey of more than 500 small business owners shows that a majority believe toxic chemicals threaten public health. Those surveyed agreed that manufacturers should be held accountable for chemical safety and that stricter regulation of chemicals is needed.[i] As is true throughout the nation, small businesses, which employ half of Oregon's workforce, represent a critical source of jobs and economic activity.

Recommendations for Action - Policy

Reform relevant revenue streams

Investing in the networks and infrastructure that drives innovation, entrepreneurship and new business creation requires new sources of revenue. Oregon's existing materials management-related fees, including the Hazardous Substances Possession Fee, have not been revised since 1994. As a result, the fees do not provide sufficient revenue for investments in high performance, bio-based materials and chemicals. Fee assessments should also be updated to generate dedicated funding for the toxics use reduction program, with special emphasis placed on creating and supporting green chemistry initiatives. Like the successful user fee on dry cleaning chemicals in Oregon, toxicity-based fees on hazardous substances can spur development and use of safer chemicals.

Strengthen demand

As part of implementing Governor Kitzhaber's Executive Order 12-05, Oregon Department of Administrative Services (DAS) created Green Chemistry Procurement Guidelines to protect human health and increase demand for safer, less-hazardous products designed using green chemistry. The agency piloted these guidelines in a joint price agreement for janitorial supplies and paper goods in partnership with Washington.

To build on the success of these initial efforts and further strengthen demand for products that are safer for people and ecosystems, Oregon DAS should work in partnership with the Oregon Sustainability Board and department administrators to expand the adoption of the guidelines to other product categories and services, including furniture, flooring, electronics, and consumer goods. Oregon should also take the lead in integrating the guidelines into multistate price agreements. These products represent a better overall value for Oregon because they can reduce risks to employee health and lower lifecycle costs.

Leadership Opportunity: Construction and Renovation Projects

Construction and renovation projects offer important opportunties to protect people, reduce risk, and strengthen demand for safer high performance products. Research shows that healthier, more sustainable building projects can be completed at little or no additional cost.[J] Oregon DAS should work with project managers and contractors to develop a credible, actionable approach that emphasizes the selection of healthier materials and products in new construction, capital improvement and major renovation projects.

Strengthening demand will require additional training for agencies, including the development of metrics for measuring progress. For multistate price agreements, Oregon should seek to partner with other states and through existing organizations like the Western States Contracting Association (WSCA) and the National Association of State Procurement Officers (NASPO).

While refining public sector procurement preferences and sourcing decisions is critical to strengthening demand for safer chemicals, materials, and products, Oregon should also identify and actively engage in opportunities to inform private sector procurement professionals.

Enact comprehensive chemicals management policies

Research shows that stricter rules for the management of hazardous chemicals helps spur the development of safer alternatives and drive innovation. They also help overcome barriers to entry for new businesses and entrepreneurs.[K] Better management of hazardous chemicals in the workplace and home will minimize exposures, reduce healthcare costs, and increase productivity, and enhance quality of life. Based on an evaluation of domestic and international laws and regulations, we find that a comprehensive chemicals management policy in Oregon should include the following elements:

- Prioritize chemicals of concern based on the inherent health hazards to protect vulnerable populations and communities.

- Increase access to consumer-friendly information about chemical ingredients and hazards, strengthening transparency in the marketplace and protecting the consumer's right to know.

- Use established, practical methods including chemicals alternatives assessments, to avoid regrettable substitutions in which one or more hazardous chemicals are replaced by other hazardous chemicals.

- Enable regulatory agencies to take reasonable and appropriate actions on chemicals of concern, including phasing them out from the market place when necessary to protect people and ecosystems.

- Include a testing and compliance program to ensure that a level playing field is maintained in the market place and the intellectual property of Oregon businesses is protected.

Conclusion

The Oregon Business Plan envisions a future where the "...growth and success of leading-edge, innovative companies based in Oregon selling their products and services across the globe. These companies provide high paying jobs, bring in new revenue that is invested in local suppliers and service providers, and grow Oregon's tax base."[L]

Implementing the recommendations outlined in this report will help achieve this vision. Companies across Oregon will benefit from the competitive advantages that sustainable, high performance chemicals and materials provide. The recommendations represent a comprehensive approach to helping foster entreprenuership that creates new jobs, while supporting the needs and opportunities of existing businesses in our state.

Next-generation high performance materials being developed using sustainable chemistry will also help protect the health of people and ecosystems not only in Oregon, but across the nation and globe. Chronic diseases are among the most common, costly, and preventable of all health problems in the United States. Strong scientific evidence links hazardous chemicals to such chronic diseases as cancer and asthma. Medical expenses and the associated losses in productivity caused by chronic diseases cost an estimated $13 billion in Oregon in 2010.[M]

We can design chemicals, materials, and products to be inherently safer by applying the principles of green chemistry.[N] These principles also help create more efficient and safer manufacturing processes. They also help reduce costs for businesses, while protecting employees, meeting increasingly stringent government regulations, investor criteria, and consumer demand. Investments that help accomplish so many complementary goals are a smart investment that promise to deliver extensive benefits to our economy and society.

Nurturing "inspired innovation" in the development and use of high performance materials and sustainable chemistry will help Oregon achieve a higher level of prosperity and well-being in the 21st century. It represents an opportunity we can't afford to miss.

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