OBAMA-BIDEN TRANSITION PROJECT

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Policies to Promote Green Chemistry and Engineering and Sustainable Materials for a Stronger and Safer Economy

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In rebuilding and strengthening the United States economy we need new chemical polices that prioritize green chemistry and engineering and sustainable materials. The future will put new pressure on the chemical and manufacturing sectors to invent and develop safer and more sustainable chemicals and materials. The global and domestic markets are becoming increasingly sensitive to energy and health risks and competitiveness of U.S. firms will depend on their capacity to internalize environmental factors. Not only is the public increasingly sensitive to the risks of conventional chemicals, national and international governments are increasing scrutiny and tightening regulations on many of the chemicals of highest concern. Greater attention to chemicals that pose significant health and environmental risks and the prospect of further government regulations provide incentives for chemists and private chemical research labs to direct research towards safer chemical substitutes and more sustainable materials and products.

Today, hundreds of chemists around the world are working to develop chemicals that are safer and more compatible with ecological processes. The most common name for these efforts is “green chemistry” which is defined to mean "the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products". [i] Green chemistry involves rebuilding the “molecular infrastructure” of our industrial systems in the same way that we can rebuild our transportation industry by manufacturing electric cars and public transit and building safer and smarter highways and rail lines

Green chemistry has emerged over the past two decades from tentative explorations by a few leading chemists and firms to a worldwide movement with professional associations, journals, training programs and supporting institutions. There are now green chemistry initiatives in over thirty countries. For the leading figures and companies in this movement these initiatives mark a significant break with conventional approaches to the field of chemistry and a commitment to a thorough overhaul of the chemicals industries. For many others, green chemistry offers new opportunities to redirect current research, redesign and market new products, and find new markets and sources of funding.

The substitution of new chemical sources for petroleum in the petrochemical industries provides an innovation pathway to green chemistry. The rapidly fluctuating price of petroleum has reactivated research into the development of chemicals made from agricultural feedstocks, prairie grasses and other low impact feedstocks. Over 15 percent of the dyes and 16 percent of the inks on the market today are made from plant matter, as are several pigments, detergents, surfactants and adhesives. There is a rapidly growing

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market for biopolymers-plastics made from corn, potatoes, sugar beets, sugar cane or cellulosic feedstocks. Demand for biodegradable plastic in the U.S. is forecast to expand nearly 16 percent per year to 720 million pounds in 2012, valued at $845 million. [ii]These resins are now commercially available for use in various applications such as fibers, films and extruded and thermoformed containers for packaging. Recent initiatives in Maine are exploring the use of the state's potato crop and cellulosic waste as a source material for biobased polymers. Numerous other plants are on line or in development to create hundreds of millions of pounds of additional biobased resins. However, biopolymers are not the only new area for green chemistry product development. Biorefineries, initially being built to produce ethanol as a fuel are further considered as a source for chemicals such as glycerol carbonate, and succinic acid and can offer a transition to other, even more sustainable chemicals. [iii]

Green chemistry and sustainable biobased economic initiatives can play a crucial role in bolstering agriculture, assuring more competitive businesses, and creating new jobs in the United States by helping us move beyond petrochemicals towards an energy independent and low carbon economy. More and more businesses are recognizing the importance of creating healthier products. The demand is huge as evidenced by Lifestyles of Health and Sustainability (LOHAS) estimates of 41 million adults in the United States with estimated purchases in those sectors of $420 billion by 2010. A sustainable biomaterials economy could provide the food, fuel, fiber and materials we need, protect and enhance the environment, benefit family farms and create economic opportunity across the rural and urban parts of the country.

To support this growth in a bioeconomy we must strengthen our agricultural productive capacity. To do that – in the face of increasing demand from food, feed, energy and materials markets, the increasingly apparent impacts of climate change and rising costs of agricultural inputs such as fertilizer – we need to emphasize and support resilient farming systems that can better handle weather-base disruptions, improve environmental quality, and provide diverse and abundant food and biomass production. – To this end, prioritization for agricultural feedstock production will need to be on crops and crop residues which minimize fossil fuel inputs, enhance environmental quality, reduce greenhouse gas emissions, and improve, and not detract, from food security in the US and globally.

At the same time, we must strengthen policies to promote waste prevention and increased reuse and recycling. Cycling materials back into the economy not only reduces pollution and greenhouse gases, but also creates jobs and new businesses. To do this we must change the rules governing the marketplace that now favor a one-way flow of materials from the mine or forest, to the producer, to the consumer, to the landfill or incinerator.

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As the United States considers new directions in environmental policy it should focus as much on developing new and safer chemicals and sustainable materials as on phasing out higher hazardous chemicals. The problem here is not only the absence of enough research in this area; there are not enough researchers. The number of chemists graduating from conventional higher education chemistry programs has been declining for years. The number of green chemistry or green engineering programs in colleges and universities remains limited.

The United States has a long history of providing incentives for innovation in the chemical industry. During the 1940s the federal government invested heavily in the Rubber Reserve Program to develop a synthetic rubber; today, the government invests over a billion dollars a year for research into nanoscale materials. Over the years, the government has employed different initiatives such as tariffs, patent protection, tax incentives, preferred purchasing, and direct subsidies for research and education. These same government instruments could be used today to promote environmentally sensitive chemicals innovations.

The government should establish a **National Green Chemistry and Sustainable Materials Initiative** with the enthusiasm and resources with which it it launched the Apollo Project. Such an initiative could be modeled on the National Nanotech Initiative that today offers over a billion dollars in research support each year through ten cooperating federal agencies. This new initiative should:

- *Fund a federal extramural research program*. The U.S. House of Representatives has already passed a bill, *H.R. 1215, Green Chemistry Research and Development Act,* which would provide annual appropriations for research on environmentally benign chemical products and processes. This bill should be expanded in scale upwards towards a billon dollars per year and broadened to include funding for the development and redesign of educational curriculum as well as research support. Some of the funding from this bill could support programs that issue annual challenges for green chemistry and engineering research and education that focus on particular environmental and health problems of high concern.

- *Establish regional green chemistry and engineering centers.* Green chemistry research could be promoted at state or national labs. Sandia National Laboratory has a history of research programs on Environmentally-Conscious Manufacturing. The state pollution prevention initiatives demonstrated the importance of regional technical assistance centers that can work directly with individual facilities trying to adopt environmentally preferred practices and technologies. Funding for some ten or more green chemistry and engineering centers that could involve consortia of universities, community colleges, state agencies and professional organizations could offer critical facilitation services in helping smaller firms adopt inherently safer chemicals and technologies. Each of these centers could offer specific areas of focus such as agricultural feedstocks, waste reduction chemistries, renewable materials for energy, etc.

- *Promote and Fund a Chemical Hazard Database for Green Chemistry.* Identification of chemical hazard data is critical for evaluation and eventual greening of materials. Funding a searchable comprehensive hazard database

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would greatly speed this evaluation and allow for more consistency among the various green initiatives – regardless of whether the work is being performed in industry, academia, or a government level. Such a hazard database could also leverage multi-country collaboration (such as the European Union's REACH Regulation)

- *Support Preferred Product Purchasing Programs.* Government environmentally preferred procurement programs could be expanded and focused on sustainable materials promotion. There are several Presidential executive orders that already encourage environmental considerations in federal purchasing decisions. The new *Biobased Products Preferred Procurement Program* established under the 2002 Farm Bill requires that all federal agencies purchase biobased products when they are available, affordable and perform as indicated. Activating this program, which has been languishing since its creation in 2002, and making sure that its criteria include considerations of sustainability (beyond just "biobased"), would be important steps in moving forward the sustainable materials market in the United States. These procurement programs could also favor products that minimize materials use.

- *Aid Colleges and Universities in Establishing Green Chemistry and Engineering Educational Programs*. The National Institutes of Health offer financial support for various graduate training programs to increase the number of well trained health care specialists. These programs could serve as models for encouraging and supporting chemistry and engineering departments in creating new curriculum and supporting students engaged in undergraduate and graduate green chemistry and engineering programs. The annual Presidential Green Chemistry awards should be expanded to recognize new curriculum and leaders in green chemistry teaching.

- *Develop and Support Green Jobs Initiatives*. Green jobs initiatives can be expanded to provide incentives for economic development for green chemistry and biobased businesses, and recycling-based enterprises. Public investments are needed in renewable energy, energy and resource conservation and recycling-based economic development through grants, low-interest loans, and loan guarantee programs. This should include a just transition program for workers displaced from hazardous chemical industries and a national Green Jobs Corps for meeting the training and work skill development needs of younger workers.

- *Promote Biobased Materials Development in Agriculture Policy*. As many of the crops expected to be used, to make sustainable materials and chemicals are not traditional commodities, we need to make sure that farmers are provided the incentives and risk mitigation to produce new crops that the market requires. The Conservation Stewardship Program and the Biomass Crop Assistance Program (BCAP) are two key new US Department of Agriculture programs that could serve this need. Rules still need to be written for these programs and should allow use of BCAP for biobased chemical and materials production (currently it only is allowed for energy) and provide higher incentive payments for resource-conserving crop rotation under CSP.

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- *Promote Materials Recycling to Reduce Waste*. Waste prevention is a key green chemistry principle and an integral component of a sustainable economy. We recommend that we implement policies to expand source reduction recycling and composting to address resource consumption and wasting problems. We need to support the development of the reuse, recycling, and composting infrastructure and fund research and development to identify new technologies and innovative ways to turn used materials into useful new products. These programs must focus on upstream product redesign and management and the downstream material handling, separation, and recycled product development. Policies should be enacted to make companies responsible for the products that they produce and be a part of the solution to fund and support the localized private and public infrastructure needed to collect and recycle product waste. Further we should establish a national waste disposal surcharge on landfills and incinerators to finance investment in waste prevention, reuse, and recycling and a national recycling investment tax credit. We should end renewable energy credits for landfills and waste incinerators and support new policy mechanisms such as minimum recycled-content standards, and product take-back schemes.

New chemical policies prioritizing green chemistry and engineering and sustainable materials are needed in the United States. Strong support from the federal government will ensure that the growing awareness of safer chemicals becomes a national initiative with significant investment in education, research and development and new jobs in green chemistry and engineering. Greater attention to the issue of safer chemistry will provide incentives for creating safer substitutes for use in business and in homes actively looking for better alternatives. We can make a difference in the health of our children and the strength and sustainability of our economy, and the time to start is now.

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[i].Paul T. Anastas and John C. Warner, *Green Chemistry: Theory and Practice*, New York: Oxford University Press, 1998, p. 11 and p. 30.

[ii]http://green.tmcnet.com/news/2008/09/02/3629211.htm

[iii]James H. Clark, et. al., "Green Chemistry and the Biorefinery: A Partnership for a Sustainable Future", *Green Chemistry*, 8, 2006, pp. 853-860.

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