Novozymes North America, Inc.

NOVOZYMES RESPONSE: REQUEST FOR INFORMATION: BUILDING A 21ST CENTURY BIOECONOMY

Creating the Building Blocks for a Bio-Based Society

Novozymes applauds President Obama for his initiative to develop a bioeconomy blueprint and improve America's health, food, energy and environment through science and innovation. We believe the future of America is contained in these pages.

Like the President, we imagine a world where everyday products are made with organic materials instead of oil:

- Transportation fuels made from agricultural and forestry waste and non-food energy crops, that burn up to 90 percent cleaner than gasoline
- Detergents that clean thoroughly in cold water, reducing energy consumption, consumer spending and water pollution
- Plastics and polymers based on renewable biomass – not petroleum
- Renewable chemicals that are less harsh to the environment
- Food crops that require less fertilizer and water, yet produce higher per-acre yields
- Animal feed that promotes greater nutrient absorption, and reduce harmful by-products in animal waste

These are the building blocks for America's bio-based society: a sustainable, low-carbon approach to energy and production processes in which renewable materials can meet the growing food and product needs of an expanding population at a time of scarce resources.

Biology as an Economic Engine

The United States is poised to be the leader in the development of the bioeconomy, combining biotechnology innovation, agriculture productivity and manufacturing expertise. Biotechnology will create 21st century innovations, jobs and sustainable economic growth. We believe many of those innovations and jobs will be rooted in renewable energy.

Americans are looking for less expensive, domestically-produced and cleaner ways to fuel their cars and trucks. In a new University of Texas poll focused on energy issues, Americans said their top concerns were U.S. consumption of foreign oil and the country's progress in developing renewable energy. Biofuels are meeting those needs.

Today the American biofuels industry provides more transportation fuel to the U.S. market than we import from Saudi Arabia. In 2010:

- ethanol production contributed $53.6 billion to the nation's Gross Domestic Product and generated $8.6 billion in federal tax revenues; and
- taxpayers were saved $39 billion that would have otherwise been sent to foreign countries by replacing 445 million barrels of oil with biofuels.

Converting biomass into fuels, energy and chemicals has the potential to generate upwards of $230 billion to the global economy by 2020, according to the World Economic Forum. Two challenges remain in realizing the potential of a bioeconomy in the United States:

1) Commercialization of the industrial biotechnology sector, including advanced biofuels and other biobased products; and
2) Increased public awareness on the potential and the benefits of bioenergy and the bioeconomy.

Providing a stalwart signal of support to the private investment and consumer market is where the federal government can have significant impact.

Recommendations

Legislative

- Insist on protection of the Renewable Fuel Standard as enacted in the Energy Independence and Security Act of 2007
- Call for reauthorization and mandatory funding of the Farm Bill Energy Title programs, in particular the Biomass Crop Assistance Program (BCAP) at USDA
- Support authorization and strong funding for Department of Energy biomass programs
- Continue to support the strengthening of the Department of Defense and US Military by calling for a strategic biorefinery initiative between the Navy, DOE and USDA
- Establish a federal matching grant program to fund projects to repurpose or retrofit existing idle or underutilized manufacturing facilities for the production of advanced biofuels and/or renewable chemical
- Establish a Synthetic Biology Research and Development (R&D) Grants Program
- Establish an Industrial Bioprocess Research & Development (R&D) program
- Strengthen and expand the USDA's BioPreferred ™ Program
- Because, the most fungible currency for a bioeconomy is sugar, reduce the cost of producing sugars from a diverse array of starch and biomass sources and to develop pathways from these sugars into fuels and renewable chemicals
- Support deployment of pioneering biorefineries that are demonstrating the commercial viability of using biomass based sugars

Regulatory

- Ensure that solicitations are coordinated across agencies such that all links in the value chain for new technologies receive funding in proportion to the technical challenges associated with each link
- Encourage multi-disciplinary, multi-institutional research programs
- Government labs should continue to play an important validation/verification role
- Government labs should position themselves as a link between basic research and commercial deployment
- The government should create a stable regulatory and financial environment for the deployment of advanced biofuels, and should mitigate infrastructure obstacles
- Obvious differences between biogenic and fossil fuel sources of GHG emissions should be recognized in regulatory programs
- Indirect emission impacts, such as indirect land use change should not be included in life-cycle analysis absent internationally recognized methodologies
- Regulations should ensure a level playing field between bioproducts and their incumbents
- Market and regulatory barriers to adoption of biofuels and other biobased products should be removed

About Novozymes

Novozymes is a technology and science company focused on bioinnovation; we respect and encourage both. We have more than 5,000 patents and 700 products at work in 130 countries: enzymes that remove trans-fats in food, lower the temperature needed to wash a consumer's clothes, and convert renewable biomass, from switch grass or corn stover, into biofuels. Our technology saves consumers money, creates domestic jobs, increases national security, and protects the environment for our children by making wise use of our natural resources.

Today, we are nearing completion of a new state-of-the-art bioinnovation plant in the Midwest, a $250 million investment in America's future. Our Blair, Nebraska enzyme facility has already created 140 construction jobs and will bring 100 permanent jobs when it opens in 2012. In fact, 45 full-time employees are already at work. These are good-paying, sustainable jobs for families creating sustainable energy for our country. President Obama has been invited to the groundbreaking of this facility in May 2012.

As this investment demonstrates, we believe private industry plays a critical role in the success of America's economy. However, we also believe a strong partnership is vital to the success of any emerging industry, where the private sector provides the innovation and lion's share of capital to develop it – and the public sector provides consistent policy support to grow it.

At Novozymes, we believe fundamental, long-term change in the energy, industrial, and agriculture sectors is required for sustainable global growth. The world needs more than just short-term solutions that simply reduce the negative effects of current technologies, actions, and policies. With our breakthrough enzymes that drive greener, more efficient industrial processes, Novozymes is advancing the technologies and industries that will drive future economic growth and job creation.

On behalf of Novozymes and its 829 employees across America – from California, Wisconsin and Nebraska to North Carolina, Virginia and Maryland – we thank you for the opportunity to submit responses to the following "grand challenges" identified by President Obama:

(1) Identify one or more grand challenges for the bioeconomy in areas such as health, energy, the environment, and agriculture, and suggest concrete steps that would need to be taken by the Federal government, companies, non-profit organizations, foundations, and other stakeholders to achieve this goal.

The grand challenge for the advanced biofuels industry at this point is commercialization, moving from our proven science and technology and demonstrated impact on consumers to large-scale production within the United States. The advanced biofuel industry has done an extraordinary job, in a short period of time, overcoming technical and scientific challenges. Now we need to see steady public support for the industry in order to compete with Big Oil and attract the innovative first movers in the private investment space.

The federal government can help US companies and technologies win the race for the next energy gold rush and keep jobs and technology in this country by implementing the following policy priorities:

Maintain the Renewable Fuel Standard enacted in the Energy Independence and Security Act of 2007. This important policy is seen not only as a market driver for renewable fuels but also as a signal to the private investment community that the public sector values and supports this industry. In order to grow beyond the current industry and commercialize cellulosic and other advanced biofuels in an expedited way, the integrity of the RFS, and government support, cannot waiver.

Reauthorize and fund the Biomass Crop Assistance Program (BCAP) at USDA. BCAP is the key program encouraging and facilitating farmers and landowners to produce new purpose grown energy crops (PGECs) for advanced biofuels and biobased products. Developing the feedstock portion of the value chain is extremely important for bioproducts such as the increasing cellulosic biofuel volumes required in future years for the RFS.

Continue to authorize and fund government biomass programs. Such as the Biomass and Biorefinery Systems R&D Program, ARPA-E, Office of Science, Biological and Environmental Research and Basic Energy Science Office at the Department of Energy to continue the development of new technologies.

Strengthen the Department of Defense and US Military by continuing to pursue a strategic biorefinery initiative. This effort would aid in developing and commercializing alternative, domestically produced fuels qualified for military and aviation use which means our military would be less vulnerable to changes in both energy supply and price. DOD should pursue a strategic biorefinery initiative by establishing a DoD Strategic Biorefinery Deployment Program to finance construction of the first 5 commercial military advanced biofuel biorefineries to meet their alternative fuel goals and be given the authority for long term off take agreements.

Increase public awareness on the potential and the benefits of bioenergy and the bioeconomy. In the United States, there is ample market availability for many forms of alternative energy and other renewable products, the technology readiness and future of the biotechnology industry does not receive adequate attention, particularly when compared to other alternative technologies such as electric vehicles, solar and wind. Most biofuels focus is around the existing biofuels industry. There is more awareness of advanced biofuels than we have seen in the past, but still a limited knowledge base. This should be expanded to increase public support.

Establish a federal matching grant program to fund projects to repurpose or retrofit existing idle or underutilized manufacturing facilities for the production of advanced biofuels and/or renewable chemicals.

Establish a Synthetic Biology Research and Development (R&D) Grants Program. This type of program would fund research and development in industrial biotechnology for the enhanced sustainability of biofuels and renewable chemicals produced through synthetic biology technology.

Establish an Industrial Bioprocess Research & Development (R&D) program. An R&D program such as this would fund projects in industrial biotechnology for renewable chemicals, biobased products, and renewable specialty chemicals.

Strengthen and expand the USDA‘s BioPreferred ™ Program. Building a policy purchase mandate based on federal agencies and contractors purchasing renewable chemicals and biobased products would be very impactful. Expanding the list of products

and uses, particularly for upstream renewable chemicals production rather than just downstream products, would result in a significant increase of use.

Research and development: R&D investments, particularly in platform technologies, can support advances in health, energy, the environment, and agriculture, and accelerate the pace of discovery in fundamental life sciences research.

(2) Constrained Federal budgets require a focus on high-impact research and innovation opportunities. With this in mind, what should be the Federal funding priorities in research, technologies, and infrastructure to provide the foundation for the bioeconomy?

With constrained budgets, the Federal government should concentrate the majority of its funding on a select group of thrust areas of critical importance to the nation, one of which should be transitioning to the production of biobased products as a means to reduce dependence on petroleum imports. The government should take a more active role in steering funding programs which enable platform technologies that will impact the bioeconomy in a way that ensures that systematic progress is made, through the following means:

Ensure that solicitations are coordinated across agencies such that all links in the value chain for new technologies receive funding in proportion to the technical challenges associated with each link. In the case of advanced biofuels, for example, this would mean execution by the government of systematic, collaborative programs that are designed to optimize all unit processes in the production of these biofuels. For the conversion of biomass to sugars through a biochemical pathway, this would include an integrated optimization effort around biomass pretreatment, enzymatic hydrolysis and synthesis of fuels from biomass sugars, ensuring that an overall optimal solution is achieved.

Encourage multi-disciplinary, multi-institutional research programs. The Federal government -- and in particular the Department of Energy -- has done a good job of encouraging multi-disciplinary, multi-entity projects including representation from academia, government laboratories and private industry. These diverse perspectives and skills are critical in addressing the complex problems associated with new technologies.

The most fungible currency for a bioeconomy is sugar. Therefore, a major thrust for Federal funding efforts should be to reduce the cost of producing sugars from a diverse array of starch and biomass sources and to develop pathways from these sugars into fuels and renewable chemicals. The Department of Energy has provided substantial funding for research on converting biomass sugars into fuels and chemicals.

The primary product of any biorefinery concept supported by the Department of Energy must be a biofuel. Given DOE's mission, this constraint is understandable, but may distort the rollout of the biorefinery industry. Market forces could dictate a more varied or product neutral bioeconomy in which the first biorefineries are producing higher value products, such as renewable chemicals. This is perhaps where the Department of Agricultural could play a larger role. While DOE has funded large, industry-led consortia to develop biofuels, the USDA has not provided comparable funding for renewable chemicals and other bioproducts, although it seems a natural role for the USDA. **We therefore recommend that the USDA take a leadership role in providing funding for large, industry-led consortia to develop renewable chemicals and other bioproducts.** The USDA must also lead the development of feedstocks for the bioeconomy.

(3) What are the critical technical challenges that prevent high throughput approaches from accelerating bioeconomy-related research? What specific research priorities could address those challenges? Are there particular goals that the research community and industry could rally behind (e.g., NIH $1,000 genome initiative)?

Discovery of biocatalysts and creation of synthetic organisms are critical technical areas which underlie our ability to develop a sustainable bioeconomy. Tools which are utilized in these technologies are ones which may accelerate progress across multiple industries.

One current technical challenge is in high-throughput protein expression and characterization. Investment in technologies that allow researchers to express and assay proteins in a truly high-throughput fashion is a way to ensure that the vast genomic sequence data currently being generated can be explored rapidly. In particular technologies are needed to allow for proper require post-translational modifications, such as folding, proteolytic processing, and glycosylation. An example of a high-throughput functional characterization technology would include the substrate-on-a-chip approach with easy product read-out. Substantial improvements in the area of in vitro transcription/translation systems, coupled an automated fashion with micro-high throughput assay systems could make an impact in this area.

Another area of investment should be in decreasing costs of DNA synthesis, particularly for synthesis of large molecules >10 kb. Current prices are around 70-80 cents per base for synthetic DNA fragments in the 1-2 kb size range. In order for ultra high throughput synthetic biology to become a reality, the cost needs to be much lower, on the order of a penny per base or lower. The capability to assemble 50-100 kb size molecules needs to be improved. Some companies are already pushing the envelope in synthetic biology approaches to enhance expression of pharmaceutical proteins (by combinatorial shuffling promoter/enhancer elements, signal peptides, various domains, etc). One can certainly imagine that extremely cheap DNA synthesis will greatly accelerate these applications,

and in addition will enable microbial genome design for biosynthesis of biofuels, chemicals, and even enzymes.

(4) The speed of DNA sequencing has outstripped advances in the ability to extract information from genomes given the large number of genes of unknown function in genomes; as many as 70% of genes in a genome have poorly or unknown functions. All areas of scientific inquiry that utilize genome information could benefit from advances in this area. What new multidisciplinary funding efforts could revolutionize predictions of protein function for genes?

Moving life sciences breakthroughs from lab to market: It is a challenge to commercialize advances in the life sciences because of the risk, expense, and need for many years of sustained investment. The Administration is interested in steps that it can take directly, but is also interested in encouraging experimentation with new private-sector-led models for funding commercialization of life sciences research.

As described in our response to the previous question, this issue clearly relates to technologies for high-throughput expression and characterization. Advances in this arena would potentially add greatly to the ability to predict function. Having a much larger database of characterized proteins would give much greater power to the purely bioinformatic approaches of predicting function such as clustering, tree building, motif scanning, and structure prediction. High-throughput structure determination would additionally add to the predictive power, and this is already occurring to some extent. Better tools for gene model prediction would also be helpful since many of the gene models currently being generated are incorrect and can lead to incorrect functional predictions.

(5) What are the barriers preventing biological research discoveries from moving from the lab to commercial markets? What specific steps can Federal agencies take to address these shortcomings? Please specify whether these changes apply to academic labs, government labs, or both.

Support deployment of pioneering biorefineries that are demonstrating the commercial viability of using biomass based sugars. Novozymes believes that it is critical for DOE to follow through on supporting the deployment of near-term proven technologies (*eg.*. cellulosic biofuels) and not be overly distracted by promising but highly uncertain (from both a technical and economic standpoint) technologies that are many years from commercial realization. We encourage Federal agencies to allocate the necessary funds to ensure that novel technologies can cross the "Valley of Death" and be commercialized within the U.S. Otherwise, the benefits accruing from technologies developed in the U.S. could be harvested elsewhere.

Government labs should continue to play an important validation/verification role -- Government labs are in a unique position to objectively compare novel energy technologies. Industry and often academia have a vested interest in particular technologies and cannot provide independent assessments of nascent technologies.

Government labs should position themselves as a link between basic research and commercial deployment -- Government labs should not try to duplicate basic research performed by academic labs, but should instead conduct research to help bridge the gap between basic research and commercial deployment. Government labs should be encouraged to work closely with industry to transition technology into the marketplace.

The government should create a stable regulatory and financial environment for the deployment of advanced biofuels, and should mitigate infrastructure obstacles – the government should, through legislation and regulation, provide a stable environment so that proven energy technologies can be deployed/commercialized and allowed to mature with concomitant reductions in cost.

(6) What specific changes to Federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs would help accelerate commercialization of federally-funded bioeconomy-related research?

Although it does not benefit our company directly, we believe the SBIR/STTR program provides a greatly needed source of funding for startup companies and has led to the development of many groundbreaking technologies. It is one of the only sources of funding that these companies have available to them that does not include giving over a substantial portion of the equity in the company.

(7) What high-value data might the government release in the spirit of its open government agenda that could spur the development of new products and services in the bioeconomy?

In line with our recommendation that government labs serve a validation/verification role, we believe that independent, objective analysis and testing by government labs of new technologies is very useful to companies considering the further development of or investment in these technologies. As an example, NREL's report entitled "Process Design and Economics for Biochemical Conversion of Lignocellulosic Biomass to Ethanol" serves as the only publicly available benchmark for the conceptual design of an advanced biofuels production plant. It serves as a baseline for our own process models for advanced biofuels.

(8) What are the challenges associated with existing private-sector models (e.g. venture funding) for financing entrepreneurial bioeconomy firms and what specific steps can agencies take to address those challenges?

The challenges associated with existing private-sector models for financing bioeconomy firms is centered on building an extremely high level of trust with the institutional investors to help catapult their business model toward commercialization. Investors are seeking rates of returns that remain out of reach for many of the first-to-market players. For the advanced biofuel producer, the cost of capital remains high and attracting investors in this economy is proving to continue to be a challenge. As the dialogue continues, investors and producers are finding creative ways for securing financing given these challenges. The path for success comes down to trust in the industry, the business, the team guiding them forward and security in the market and public support.

Strategically, companies that invest heavily in an experienced and exceptionally strong executive management team, board of directors and advisors are moving quickly in securing needed capital from investors. These companies are finding it much easier to gain the assurance required to secure the funding needed to overcome the so-called "valley of death". On a tactical level, these solid teams know what investors need to develop that level of certainty. Some tactical examples surfacing that help secure the capital they required are centered on securing long terms feedstock agreements for their plants, proving their technology with economically viable results, providing strong business and economic models as well as executing on solid off-take agreements.

Federal agencies can address these challenges by taking on slightly increased risk, as they have historically done, and focusing specifically on the pieces of the value chain highlighted above – feedstock development and production, continued research and development for processing technologies and the ability for federal agencies to act as a secure customer of these technologies by providing long term purchasing agreements. All with the goal of reducing costs and increasing private sector confidence.

Workforce development: Investment in education and training is essential to creating a technically-skilled 21st century American bioeconomy workforce.
(9) The majority of doctorate recipients will accept jobs outside of academia. What modifications should be made to professional training programs to better prepare scientists and engineers for private-sector bioeconomy jobs?

Academia, the government, and private industry should work together to make internships and apprenticeships in private industry more readily available. North Carolina has a good example of a program that helps ready Ph.D.'s for industrial research careers. The North Carolina Biotechnology Center's Industrial Fellowship Program "provides the state's

Ph.D. scientists with an opportunity to gain industry experience and companies to benefit from new talent and expertise. The program is for recent doctoral graduates and postdoctoral fellows who would like to transition from academia to permanent employment in the state's life sciences industry."

(13) What specific regulations are unnecessarily slowing or preventing bioinnovation? Please cite evidence that the identified regulation(s) are a) slowing innovation, and b) could be reformed or streamlined while protecting public health, safety, and the environment.

Toxic Substances Control Act (TSCA) Inventory Nomenclature - USEPA

(a) On Nov. 15, 2004, the EPA announced that it is considering new procedures and regulations for naming enzymes and proteins when listing these substances under the Toxic Substances Control Act (TSCA) Inventory. The EPA is considering modifications to the procedures and regulations that govern the naming of enzymes and proteins as they are listed in the TSCA Inventory. Currently, the naming procedure focuses on the function of the enzyme. However, EPA is now proposing to expand the requirements of the naming procedure to include the source, process, and amino acid sequence of the enzyme or protein.

Enzymes and host organisms have been modified to enhance performance in industrial and food products since they were first commercialized. Moreover, modified enzymes that are used in EPA-regulated products, such as detergents, textiles, fuel ethanol, pulp, and paper have produced no known new risks beyond those already identified for enzymes in general.

(b) The justification for the proposed procedural changes remains unclear and possibly statutorily insufficient. EPA's authority to regulate chemical categories is evident in section 26(c) of TSCA, which specifically provides that any action the agency is required to take concerning a single chemical substance may be taken also with respect to a category of chemical substances. This proposed rule appears hold enzymes to a standard not applied to other materials listed on the TSCA Inventory for unclear reason(s), which could discourage innovation and commerce.

(14) What specific steps can Federal agencies take to improve the predictability and transparency of the regulatory system? (Please specify the relevant agency.)

The obvious differences between biogenic and fossil fuel sources of GHG emissions should be recognized. The U.S. Congress has worked diligently to develop definitions of renewable biomass for authorized bioenergy and bioproducts programs such as the Renewable Fuel Standard that preclude the use of biogenic carbon from unsustainable sources. Therefore, biogenic carbon accounting framework should not be overly

complicated or burdensome. In addition, methodologies applied to biofuels and other bioenergy sources should apply uniformly to all end uses.

Indirect emission impacts, such as indirect land use change should not be included in life-cycle analysis absent internationally recognized methodologies that enjoy widespread consensus in the scientific and economic communities. The government should promulgate regulations that depend on estimates of indirect land use effects only when these effects have been calculated using robust, scientifically defensible models that have been rigorously reviewed by expert scientific panels. Further analysis of complex and controversial ILUC models is needed.

Regulations should ensure a level playing field between bioproducts and their incumbants. A level playing field enables introduction of new products and process pathways in order to maximize opportunity for innovation and to remove barriers for market entry.

Environmental benefits of industrial biotechnology should be sufficiently and consistently rewarded in the regulation of precedent-setting climate programs (e.g. cap and trade, LCFS).

Market and regulatory barriers to adoption of biofuels should be removed. This could be transportation fuel infrastructure upgrades such as increased production of flex fuel vehicles, blender pumps, additional refinery and pipeline capacity.

(15) What specific improvements in the regulatory processes for drugs, diagnostics, medical devices, and agricultural biotechnology should federal agencies implement? What challenges do new or emerging technologies pose to the existing regulatory structure and what can agencies do to address those challenges?

US Food and Drug Administration (FDA)
Docket No. FDA–1997–N–0020; Formerly Docket No. 1997N–0103; Substances Generally Recognized as Safe (‘GRAS’)

Over the last thirteen years, the FDA’s Center for Food Safety and Applied Nutrition (CFSAN) has gained significant experience under the framework of the 1997 proposed rule (62 FR 18938) and reviewing hundreds of GRAS notifications for human food. In June 2010 the FDA’s Center for Veterinary Medicine (CVM) announced a pilot program and start to review GRAS notifications for animal feed; unfortunately, only three submissions were reviewed 9 months after this announcement (see link at: http://www.fda.gov/AnimalVeterinary/Products/AnimalFoodFeeds/GenerallyRecognizedasSafe GRASNotifications/ucm243845.htm).

The vast experience highlighted by CFSAN in its "experience document" provides valuable learning that can be of benefit to CVM and therefore the food and feed industries. Both CFSAN and CVM should strive for harmonization of their requirements and policies, so the process is not more stringent for one industry than the other.

The Pesticide Registration Improvement Renewal Act (PRIA) - USEPA

(a) The Pesticide Registration Improvement Renewal Act (PRIA) requires EPA to conduct the review process within a defined time period. Unfortunately, the EPA has difficulty meeting the mandated timelines. Some of the mandated decision times being proposed for PRIA 3 (effective Sept. 2012) are being extended by at least 50%, with an additional time requirement for final label approval. For example, B580.86 approval may increase from the current 18 months to as long as 27 months.

(b) The Federal Insecticide, Fungicide, and Rodenticide Act (or FIFRA), Section 33 (e) directs EPA to identify and evaluate reforms to the registration process with the goal of reducing review times for applications. Novozymes would like to see the agency focus more on identifying these reforms and refrain to unilateral extension of mandated decision timelines in PRIA 3. (Note: In 5+ pages of proposed changes to the Biopesticide section, none of the times are decreased. Nearly all reviews are increased by 2-12 months, plus the additional 1-3 months for final label review). Additionally, EPA has established a "fast track" regulatory review process for "safer pesticide alternatives" for new technologies that meet the criteria. Novozymes would like to see EPA's BPPD identify opportunities where reduced-risk products could be accelerated through the registration process, without sacrificing the scientific integrity of evaluation process. One can further accelerate the registration of a new active ingredient by being encouraged to submit for a joint USEPA/Canadian review, with the incentive being a (US) Federal review time as low as 12 months.

Pesticides; Policies Concerning Products Containing Nanoscale Materials - USEPA

(a) EPA seeks comment on several possible approaches for obtaining information about what nanoscale materials are present in registered pesticide products. One possible approach would involve using section 6(a)(2) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to obtain information regarding what nanoscale material is present in a registered pesticide product and potential effects on humans or the environment. Another approach would be to use Data Call-In notices (DCIs) under FIFRA section 3(c)(2)(B). Additionally, EPA is also proposing a new approach for how EPA will determine on a case-by-case basis whether a nanoscale active or inert ingredient is a "new" active or inert ingredient for purposes of FIFRA and the Pesticide Registration Improvement Act (PRIA), even when an identical, **non-nanoscale form of the nanoscale ingredient is already registered for legal use**.

In the Agency's own words, the current description is not intended "to cover biological materials (e.g. DNA, RNA, proteins) or materials in their natural state (e. g. clays)." (page 35387, third column of current proposed rule).
(b) Novozymes maintains that biological substances that naturally exist at small scales , such as microorganisms or proteins (e.g. enzymes) should not be included in the EPA's definition of nanoscale material. Novozymes would like to see the nanoparticle language by strengthened by adding enzymes and microorganisms to the list of exempted examples, with the resulting read: "biological materials (e.g. DNA, RNA, ***proteins, enzymes and microorganisms***)".

Public-private partnerships: The Administration is interested in serving as a catalyst for public-private partnerships that build the bioeconomy and address important unmet needs in areas such as health, energy, agriculture, and environment.
(16) What are the highest impact opportunities for public-private partnerships related to the bioeconomy? What shared goals would these partnerships pursue, which stakeholders might participate, and what mutually reinforcing commitments might they make to support the partnership?

Highest impact public-private partnerships related to the bioeconomy are currently in the areas of biofuels and renewable chemicals. The shared goals of these public-private partnerships could be:

- Development of feedstocks suitable for the desired end use
- Technologies to reduce the cost of producing sugars from biomass
- Development of conversion technologies which are able to utilize pentose and hexose sugars in biomass hydrolysates to produce fuels and platform chemicals

Key attributes of a successful public private partnership are:

- Government can create, through its own use or by statute, stable and significant demand for the product (biofuel or bioproduct)
- Government ensures that the regulatory framework can support introduction of the product
- All major steps in the value chain are represented among the industry partners
- Government ensures that private partners have the resources to meet project objectives
- Government establishes baseline performance and measures progress through monitoring and audits

We expect and hope that the MOU between the DOE, Navy, and USDA (related to providing diesel and jet fuel for Navy transportation needs) will develop into an effective public-private partnership. In this case, the Navy can provide a stable demand for the biofuels, the USDA can work with its constituents to provide feedstock, and the

DOE can fund optimization of conversion technology and provide loan guarantees for the biofuel production plant.

(17) What are the highest impact opportunities for pre-competitive collaboration in the life sciences, and what role should the government play in developing them? What can be learned from existing models for pre-competitive collaboration both inside and outside the life-sciences sector? What are the barriers to such collaborations and how might they be removed or overcome?

We see an opportunity for continued collaborations in the national centers which provide resources in genomics, such as JGI and NCBI. Using these as examples of government supporting life science research, we would comment that JGI unfortunately caters heavily to the academic community and a shift in their emphasis would be needed for them to have a more direct impact on development of biofuels and biochemicals.

The community effort to annotate the genomes is rather hit and miss and the quality of the annotations varies dramatically for organisms that are relevant for accelerating technology related to bioeconomy advancement. As an example, fungal genomes that are relevant for discovery of industrial enzymes lags far behind relative to quality of annotations for fungal genomes that are of interest to the relevant to the medical community. It appears to reflect the level of interest in a particular organism in the community at large dictates the quality of genome annotation. We recommend that an effort be made to establish dedicated groups of experts on specific protein classes which can act to pass judgment on the quality of the gene models and their annotations. For some protein classes, such as the glycoside hydrolases (GH), experts exist, and tools and analyses exist for quality curation of new genes that fall in these classes. New gene models corresponding to other protein families are not as carefully analyzed. While genome annotation can be partially automated, the process still requires a degree of human intervention, and further investments in automated annotation pipelines are necessary.

We also see an opportunity for technology breakthroughs from the three DOE-funded Bioenergy Centers (BESC, JBEI, and GLBRC). These Centers are already producing useful insights into the recalcitrance of lignocellulosic feedstocks for biofuel applications. If the goal is for these Bioenergy Centers to become true public-private partnerships, they will need to increase their efforts to solicit guidance from biofuels industry stakeholders.

Thank you for the opportunity to submit to this Request for Information regarding a national bioeconomy blueprint.