**United States Submission on Synthetic Biology**

The United States is pleased to provide the following information in response to CBD Notification Ref.: SCBD/BS/CG/MPM/DA/84279 of 6 February 2015. [1]

Information that is relevant to the work of the AHTEG, including views on

**(i) How to address the relationship between synthetic biology and biological diversity;**

Biological diversity provides the building blocks for many fields of research. Advances in biotechnology and biological engineering often draw upon, and contribute to understanding of, biological diversity. The results of such research are generating scientific, technical and institutional capacities that provide the basic understanding on which to plan and implement measures to conserve and sustainably use biological diversity to meet the food, health and other needs of a growing world population. Decision XII/24 noted that the Conference of the Parties (COP) was not able to agree to whether synthetic biology is a new and emerging issue related to conservation and sustainable use of biological diversity, and that we are still awaiting the completion of a robust analysis using the criteria in paragraph 12 of decision IX/29.[2]

**(ii) The similarities and differences between living modified organisms (as defined in the Cartagena Protocol) and organisms, components and products of synthetic biology techniques;**

The Cartagena Protocol on Biosafety defines living modified organisms (LMOs) as any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology. Living modified organisms are therefore a specific subset of products obtained through the use of biological engineering and may fall within the definition of the Protocol. The Protocol applies to certain activities related to LMOs that may have adverse effects on the conservation and sustainable use of biological diversity, taking into account risks to human health. It is important to note that the Protocol does not apply to pharmaceutical applications for humans that are addressed by other relevant international agreements or organizations, and that LMOs in transit or destined for contained use are exempted from the Protocol's advanced informed consent procedures.

We are concerned that the current language in Decision XII/24 is overly broad when describing the topic of "synthetic biology." It is unclear, for example, what is meant by "components" of synthetic biology and why they should be included in the discussion. Biological engineering uses commercially available products such as plasmids, reagents, and oligonucleotides, and we are opposed to pulling such commonly-used research and development tools into a discussion on biological engineering and the conservation and sustainable use of biological diversity. The United States focuses on the products of biological engineering when evaluating safety, not the tools or process by which the product is produced. Many such products are produced and used in

[1] http://www.cbd.int/doc/notifications/2015/ntf-2015-013-synthetic-biology-en.pdf

contained facilities and have no interaction with biological diversity, and we are concerned that conversations in the Convention on biological engineering may capture many standard research (e.g., plant breeding) and manufacturing processes and tools that have no connection to the objectives of the Convention and its Protocols.

**(iii) Adequacy of existing national, regional and/or international instruments to regulate the organisms, components or products derived from synthetic biology techniques**

The United States believes that regulation and oversight of emerging technologies should avoid unjustifiably inhibiting innovation, stigmatizing new technologies, or creating trade barriers. Regulation and oversight should be based on the best available scientific evidence, and with an awareness of the potential benefits and the potential costs of such regulation and oversight. Any measures taken should have sufficient flexibility to accommodate new evidence and learning and to take into account the evolving nature of information related to emerging technologies and their applications.

The United States has a coordinated, risk-based system to ensure that biotechnology products, whether through their use, research or production, and including those obtained using biological engineering, are safe for the environment and human and animal health. This system describes an approach to the oversight of planned introductions of biotechnology products into the environment that focuses on the characteristics of the biotechnology product and the environment into which it is being introduced, not the process by which the product is created. Established as a formal policy in 1986, under the auspices of the Office of Science and Technology Policy (OSTP) in the Executive Office of the President, the Coordinated Framework for Regulation of Biotechnology describes the Federal system for evaluating the safety of products developed using modern biotechnology. For example, in the case of genetically engineered plants, the U.S. agencies responsible for oversight of the products of agricultural biological engineering include the Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS), the Environmental Protection Agency (EPA), and the Department of Health and Human Services' Food and Drug Administration (FDA). To consider another example, FDA’s regulations for pharmaceutical approvals apply in the case of using genetically engineered microorganisms to produce recombinant human insulin – a product of biotechnology that was first licensed in 1980.

The EPA uses the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) to regulate the distribution, sale, use and testing of pesticidal substances including microorganisms and those produced in plants. The EPA uses the Toxic Substances Control Act (TSCA) to oversee the production, importation and use of microorganisms that are products of biological engineering, prior to commercialization of such organisms, including approval of research projects that intend to release engineered microorganisms into the environment. New chemical substances that result from biological engineering are also subject to review under related provisions of TSCA.

USDA-APHIS addresses the protection of plant and animal health under several laws, and these laws enable protection regardless of which biological engineering techniques are used. Directly applicable laws under which APHIS protects plant and animal health are the Plant Protection Act, the Animal Health Protection Act, and the Virus Serum Toxin Act.

The FDA is responsible for ensuring the safety and proper labeling of human and animal foods, with the exception of edible meat and poultry, and processed egg products for human consumption, which fall under the authority of USDA. All foods, whether imported or domestic and whether derived from biological engineering techniques, must meet the same rigorous safety standards. Under the Federal Food, Drug, and Cosmetic Act, it is the responsibility of human and animal food manufacturers to ensure that the products they market are safe and properly labeled. In addition, any substance meeting the legal definition of a food additive in the United States must receive FDA approval before marketing. The FDA regulates genetically engineered animals under the new animal drug provisions of the Federal Food, Drug, and Cosmetic Act.

Using the current laws and regulations, the United States can address a range of biological engineering products. The United States re-evaluates its regulations and approaches as new information and techniques become available.

Internationally, biological engineering products fall under a range of already existing oversight mechanisms; additional oversight activities under the Convention are unnecessary. Safety with respect to the health of plants, animals, and humans is already addressed under the Codex Alimentarius, the International Plant Protection Convention, as well as cooperative efforts under the World Health Organization, and the Organization for Economic Cooperation and Development. These international fora rightly do not base their oversight on biological engineering techniques, but instead on the nature of the product and its intended use.

**(iv) An operational definition of synthetic biology, comprising inclusion and exclusion criteria;**

The United States understands synthetic biology as it is discussed in the research and development community to encapsulate a continuum of biological engineering tools and techniques leading to progressively advanced biotechnology products. The United States supports independent scientific research and development in many fields relevant to biotechnology and biological engineering. Rapid advances in computer science, biochemistry, and genomics, among many fields, are driving biological engineering, making it difficult and presumptuous to attempt to develop a formal definition of synthetic biology, let alone inclusion and exclusion criteria. Scientific advances would quickly render any definition obsolete. Application of strict definitions could unduly restrict or stifle cutting-edge research and development. Regulation and oversight must remain flexible enough to respond to changing techniques and increased knowledge and information. Establishing inclusion and exclusion criteria could lead to situations where products are excluded from regulation or oversight in situations where it is legitimately needed.

**(v) Potential benefits and risks of organisms, components and products arising from synthetic biology techniques to the conservation and sustainable use of biodiversity and related human health and socioeconomic impacts relevant to the mandate of the Convention and its Protocols;**

The United States supports research and development for innovative applications of biotechnology and biological engineering, both at home and with partners around the world.

Over forty years of research, education, and product development using recombinant DNA techniques have led to clear benefits relevant to the Convention's objectives, and these benefits will continue to emerge with continued application of biological engineering tools and techniques. For example, recombinant human insulin was first licensed in 1980 and is now used worldwide to fight diabetes in humans. Medical research with transgenic mice and other organisms has enabled the elucidation of diseases and therapies for humans and animals. Modified plants have improved crop production methods with a number of benefits, including reduced soil erosion, decreased use of chemical pesticides, new disease-resistant varieties, and improved farm productivity and farmer income. We note that a great deal of the biological engineering research and development in the United States is aimed at reducing dependence on petroleum products, which often serve as the primary substrates for production of many important chemicals and fuels.

The Cartagena Protocol recognizes the need to consider potential adverse effects LMOs may have on the conservation and sustainable use of biological diversity, taking also into account risks to human health. Nevertheless, great care should be exercised when drawing linkages between the products of biological engineering and potential risks and benefits to biodiversity and human health. Peer-reviewed, independent studies should provide the basis for statements on risks and benefits to biodiversity and human health. However, the absence of information should not stop innovative research and development from proceeding, in accordance with applicable regulations and international obligations. The United States supports the internationally accepted approach of taking the least restrictive measures possible to achieve reasonable safety objectives, in the absence of evidence of likely harm.

Under the Cartagena Protocol, Parties may also take into account, consistent with their international obligations, socio-economic considerations arising from the impact of LMOs on the conservation and sustainable use of biological diversity. Few peer-reviewed, independent studies exist on the potential socio-economic impacts arising from the impact of biological engineering on biological diversity.

**(vi) Best practices on risk assessment and monitoring regimes currently used by Parties to the Convention and other Governments, including transboundary movement, to inform those who do not have national risk assessment or monitoring regimes, or are in the process of reviewing their current risk assessment or monitoring regimes;**

The United States believes that transparency in decision making, and sharing publicly the decisions and methodologies of developing the decisions, is essential to the global development and any review of national risk assessment and monitoring of regimes. The United States has a robust, practical, science-based approach to enable the safe use of organisms for a variety of uses from education to research, to medical uses, as well as uses in food production, crop production and animal husbandry. The U.S. approaches embrace the spectrum of tools common to regulatory frameworks, ranging from guidance for best practices, to laws that set standards for product attributes, to regulations for specific activities and uses. The United States has in place programs to detect and monitor the health and safety of humans, plants and animals, and we encourage sharing of such best practices.

In the realm of biomedical research, the National Institutes of Health (NIH) published its first Guidelines for the creation and containment of recombinant DNA organisms in 1976. Updated guidelines, *the NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules (NIH Guidelines),* were issued in 2013 to cover research involving recombinant or synthetic nucleic acid molecules, and detail safety practices and containment procedures for basic and clinical research involving recombinant or synthetic nucleic acid molecules, including the creation and use of organisms and viruses containing recombinant or synthetic nucleic acid molecules. An entity receiving NIH funding for recombinant or synthetic nucleic acid molecule research is obligated to follow the NIH Guidelines for all research involving recombinant or synthetic nucleic acid molecules, regardless of a specific project's funding source. Many companies not receiving NIH funding, but that are working with recombinant or synthetic nucleic acids, also voluntarily follow the NIH Guidelines as best practice.

Moreover, there are a number of international forums and arrangements that currently exist where nations can share, communicate and develop, as needed, international guidelines for regulatory frameworks and risk management recommendations that they may then implement as appropriate and consistent with their individual national statutory and governance authorities. Some, such as the Organisation for Economic Co-operation and Development's (OECD) Environmental Risk Assessment Toolkit, offer guidance on risk assessment and provide consensus information useful in a risk assessment. The OECD has a Working Group on Harmonization of Regulatory Oversight in Biotechnology, which produces consensus documents on the biology of organisms as well as guidance documents relevant to risk assessment practices.

**(vii) The degree to which the existing arrangements constitute a comprehensive framework in order to address impacts of organisms, components and products resulting from synthetic biology relevant to the objectives of the Convention on Biological Diversity and its Protocols, in particular threats of significant reduction or loss of biological diversity;**

There are many international arrangements for addressing the safety of different products, whether they are chemicals, living organisms, pharmaceuticals, or other substances and products produced from biological engineering or otherwise. Some of the most relevant organizations where countries and relevant stakeholders develop, share, and implement safety guidelines and practices include the World Organisation for Animal Health, the International Plant Protection Convention, the World Health Organization, the International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use, and the Organisation for Economic Co-operation and Development. New frameworks to address biological engineering or resulting products are not needed.

**In addition to the points above, we would like to submit information on research and capacity building related to biological engineering and biodiversity.**

A number of U.S. agencies fund research in the area of biological engineering, including the National Science Foundation; Department of Agriculture's National Institute of Food and Agriculture; Department of Energy; National Aeronautics and Space Administration; Defense Advanced Research Projects Agency; and other defense agencies. The term synthetic biology is often used by researchers and funders in the United States to capture a wide range of disciplines

and techniques that form a continuum of advances in biotechnology tools and techniques. The research focuses on fundamental understandings of biological systems as well as technology development that would speed the application of biological engineering and enable commercialization of research. There are specific programs in areas associated with stability and evolution of genetically modified organisms, mechanisms of containment and biosafety to reduce the risks of release and probability of survival in the environment, along with specific programs to examine the relationship between environmental pressures, ecology and evolution.

The National Science Foundation (NSF), in partnership with the Woodrow Wilson International Center for Scholars and the Center for Nanotechnology and Society at University of Arizona, engaged in several workshops and developed a roadmap for progress in evaluating potential environmental risks associated with synthetic biology and assessing public perception and risks and benefits to society of biological engineering and synthetic biology. Ongoing efforts at the NSF-funded center in Synthetic Biology at University of California Berkeley (SynBERC) address environmental risk and societal concerns. An NSF-wide working group on synthetic biology that includes representatives from the biological sciences, physical sciences, engineering, and the social and behavioral sciences provides a mechanism for coordinating the agency's efforts in the area of synthetic biology and biological engineering. Finally, the NSF's collaborations reach beyond the United States. The NSF has partnerships with a number of international entities including the United Kingdom's Biotechnology and Biological Sciences Research Council and the European Commission to jointly fund research in the area of biological engineering and synthetic biology. In many of these research programs consideration of the responsible conduct of research is a review criteria (including ecological and societal impact). There are discussions about increasing these international activities, which would increase research capacity and training in partner nations.