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### Program on Development of Biotechnology in Russia through 2020

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**Report Highlights:**

On April 24, 2012 the Russian government adopted “The Comprehensive Program for Development of Biotechnology in the Russian Federation through 2020”. This document acknowledges that Russia is lagging behind both developed and developing countries in the development and use of biotechnology (including agricultural biotechnology) and sets targets to create a biotech-oriented economy by 2020. The Program envisages 1.2 trillion rubles (\$39 billion) financing from 2012 through 2020, including 200 billion rubles (\$6.7 billion) for development of agricultural biotechnology. This program seems to demonstrate that the Government is serious about the development and use of agricultural biotechnology in Russia and the realization of the potential benefits of the use of this technology for Russian agriculture.

## General Information:

On April 24, 2012, Vladimir Putin in his position as the Prime Minister<sup>[1]</sup> approved “The Comprehensive Program for Development of Biotechnology in the Russian Federation through 2020” (hereafter referred to as the Program). The Program was posted on the web-site of the Russian Ministry of Economic Development, the drafter of the program:

[http://www.economy.gov.ru/minec/activity/sections/innovations/development/doc20120427\\_06](http://www.economy.gov.ru/minec/activity/sections/innovations/development/doc20120427_06)

More than a year ago (April 1, 2011) the Russian government outlined pillars for modernizing Russia’s economy, and these focused on Russia’s development of advanced technologies and innovations in 3 spheres: information technology, nanotechnology and biotechnology. Since then the Russian Ministry of Economic Development in cooperation with other ministries and scientific centers has worked on the biotechnology program, which was finally approved on April 24, 2012.

The Program states that in the field of biotechnology (except biopharmaceuticals) Russia is lagging far behind both developed and many developing countries of the world. Russia’s share in the world market of biotechnology products is less than 0.1 percent, and in the segments of biodegradable materials and biofuels is close to zero.

The Program’s concept of biotechnology is very general. Thus, **biotechnology** is described as “the technology of living systems – 1) a discipline that studies the possibility of using living organisms, their systems or their metabolic products to solve technological problems, as well as the possibility of creating living organisms with the necessary properties by genetic engineering, and 2) use of biological structures for production of food and industrial products and for targeted transformations. Biological structures in this case are the microorganisms, plant and animal cells, cell components, such as membrane cells, ribosomes, mitochondria, chloroplasts, as well as biological macromolecules (DNA, RNA, proteins - mostly enzymes.)” (Appendix #1, Key Terms Used in the Program).

As for agricultural forestry and food biotechnologies, the Program describes them as branches of biotechnology, and gives the following term definitions:

- **Agricultural biotechnology** is a “section of biotechnology dealing with issues of theory, methodology and implementation of its achievements in plant and livestock production.” Agricultural biotechnology” incorporates so called “Green” biotechnology, which is described as “the development and introduction of genetically modified plants in agriculture;”
- **Forest biotechnology** is a section of biotechnology dealing with conservation and rapid reproduction of forest biological resources;
- **Food biotechnology (Food bio-industry)** is a section of biotechnology engaged in the development of theory and practice of production of common food, preventive health food and specialized food.

The priorities of the Program in the field of agricultural biotechnology are explained in section IV of the

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<sup>[1]</sup> Note: As of May 7<sup>th</sup>, Vladimir Putin became the President of Russia again and Dmitry Medvedev is currently the new Prime Minister.

Program, and include, among other priorities, the creation of genetically modified plants and animals (currently no genetically modified crops are approved for use in Russia and there is a de facto ban on cultivation as no government approval process exists<sup>[2]</sup>). For example, in explaining priority areas the Program lists the following in agriculture:

“5.2 “Plant breeds created by means of biotechnology methods”

At present time the Russian Federation does not create varieties and hybrids of new generations which are resistant to drought, diseases, herbicides, insect pests and difficult environment, using post genome technologies (breeding methods based on use of molecular markers) and genetic engineering which are wider and wider used in the world. Agricultural production of Russia will remain high-cost and will not be able to compete with foreign countries without the use of biotechnological innovations. Such situation shall have a detrimental effect on the domestic food production sector. The set of measures shall contribute to the development of advanced post genome and biotechnological methods in plant production and organization of robust markets of transgenic seeds and plants demanded by agricultural producers.

5.3 “The technologies of animals and poultry molecular breeding”

The development of technologies of molecular breeding is based on the development of modern genome analysis methods enabling to detect and arrange screening of a big number of mutations (polymorphisms) related to the level of development of economically important selection traits of farm animals. The set of measures stipulates establishment of competitive national technologies of molecular breeding in animal and poultry industry focused on increase of economically beneficial traits, on animal products quality improvement and, as a result, improvement of the effectiveness of animal products production.

5.4 “Transgenic and cloned animals”

The basic market factor for the segment growth is the fact that transgenic animals are many times more productive than the existing methods for obtainment of recombinant proteins and/or antibodies. The set of measures shall establish the conditions for Russian producers entering the market segments with high added value and for organization of technological advance contributing to the long-term competitiveness of the sector.” (Program, Section IV Biotechnology Development Priorities)

This Program (in total) will require 1.18 trillion rubles (\$39 billion) financing from 2011 through 2020, of which financing the development of agricultural biotechnology will require 17 percent of total funds, or 200 billion rubles (\$6.7 billion). The Program will be implemented in two phases, 2012-2015 and 2016-2020. It envisages that the biggest portion of financing will fall within the last 5 years (2016-2020), and for agricultural biotechnology 71 percent or 142 billion rubles (\$4.7 billion) of the funds are planned for the last 5 years. However, the financing figures seem to be optimistic, and likely will largely depend on the size of the federal budget (which in itself will largely be driven by prices of key natural resources) as well as financing from other non-governmental sources.

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<sup>[2]</sup> For more information on the status of agricultural biotechnology in Russia and legislation in the field of agricultural biotechnology see GAIN RS1132 \_ Agricultural Biotechnology Annual 2011 \_ Moscow \_ Russian Federation \_ 7/18/2011

The Program seems to demonstrate shifting views by the Government of Russia on the development and use of agricultural biotechnology and the realization of the potential benefits of this technology for Russian agriculture. This is the first Government program which calls for the long-term development and use of biotech crops, and acknowledges that Russia is falling behind many other countries of the world in this technology.

The non-official translation of select parts of the Program which refer to agricultural, food, forestry and marine biotechnology is in the Annex.

**ANNEX.****COMPREHENSIVE PROGRAM OF DEVELOPMENT OF BIOTECHNOLOGY IN RUSSIA  
THROUGH 2020  
with ATTACHMENTS I-5***Non-official translation***Table of contents**

Below is the complete table of contents of this Program. Titles highlighted in blue are those which relate to agricultural, food, forestry and marine biotechnology and for which a non-official translation is provided in this document.

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## I. Justification of the Need for the Program

A Comprehensive Program for the Development of Biotechnologies in the Russian Federation for the Period through 2020 (hereinafter – the Program) is developed in accordance with the decision of the Government Commission for Advanced Technology and Innovation as of April 1, 2011 (record No.2, section I, paragraph 1).

There are three key areas of technologies development for innovative development of modern economy: information technologies, nanotechnologies and biotechnologies. Implementation of modern information technologies in Russia is carried out during last 20 years. For such relatively short period modern communication systems have been established, advanced information technologies have been introduced into the sector of industry, the Internet and mobile communication have become easily accessible. During the last 5 years nanotech industry is being in the stage of its active forming. Being rather perspective and having huge market potential, the sphere of biotechnologies has not yet obtained the enough impulse for its development in Russia (save for biopharmaceuticals).

By estimate the world market of biotechnologies shall reach the level of 2 billion US dollars in 2025, expansion rates in terms of certain market segments are fluctuating from 5-7 up to 30% annually. Russian share in the biotechnologies market at present is less than 0.1 %, and in some segments (biodegradable materials, biofuels) is almost close to zero.

Highly developed economies like USA, Canada, Japan and European Union are the principal users of biotechnology products. However, during present decade the developing countries have also been engaged into the technological race: China, India, and Brazil are implementing large-scale development programs in all spheres of biotechnologies. World trend lines in the development of biotechnologies are presented in Appendix No. 2.

It is hard to overestimate the importance of biotechnologies for the development of Russian economy. Modernization of the technological basis for modern industrial production is impossible without mass introduction of biotechnologies and biotechnological products. Moreover, for a wide range of industries (agricultural and food sector, forest sector, a range of sub-branches of chemical and petrochemical industry, pharmaceutical industry and biomedical sector of public health service) modernization shall mean a transfer to biotechnological methods and products.

Due to economic and ecological advantages the share of chemical products being manufactured on the basis of renewable raw materials shall consequently increase and reach by 2025 15-20 % in the chemical sphere, and it shall reach 5-7% of the world overall production in the sphere of engine fuels. Biotechnology methods enable to fully process the agricultural industry's waste; and in a series of countries the very notion "waste" no longer exists for this sector. A substantial potential for the development of bioenergy may be implemented at the account of using the waste of forestry industry.

The tendency for replacement of chemical products with biological ones was formed 30-40 years ago. At that time USSR widely participated in the process: large manufacturing outfits were established, a system of field and academic scientific centers was forming, and new biological products were being actively introduced in agriculture, in food and chemical industry.

For the last 20 years the world developed fundamentally new biotechnologies and products and manufacturing of previously known ones has been substantially improved. Russia has almost no part in this process. As a result, more than 80 % of biotechnological products being consumed in Russia are imported and consumption of biotechnological products in Russia remains incomparably lower than in both developed and developing countries.

An output of biotechnological products is arranged in small lots; laboratory equipment which is actually not intended for these purposes is used for that.

Institutes and universities continue their researches but their results are not commercialized as small enterprises do not invest funds into marketing of new products and they are unable to compete with leading world companies on the terms of "equal opportunities". Besides, the system for "scaling" of scientific biotechnological development for the purposes of industrial production and other elements of bioeconomy necessary for transformation of scientific knowledge into commercial products is totally absent in Russia. Thus, the results of scientific researches remain unclaimed or turn into the products which production output is limited by the capacity of the scientific laboratory.

International companies dominate in the segments where the consumption of industrial biotechnology products is relatively more developed: 100% of feed amino acids are being imported for agriculture (lysine), up to 80% of feed enzyme preparations, 100 % of enzyme for household chemistry, more than 50% of feed and veterinary antibiotics, 100% of lactic acid, from 50 to 100% of biological nutritive ingredients. For already 20 years the products of leading biotechnological companies of the world have been introduced at the Russian market but neither of these companies has organized its manufacturing in

Russia.

A number of tools for the support of biotechnologies development have been involved in Russia in recent years. A number of important decisions has been made recently aimed at elaboration of a long-term state strategy in the sphere of biotechnologies: the Strategy for the development of pharmaceutical industry of the Russian Federation for the period through 2020 (hereinafter – “PHARMA-2020”), and the Strategy for the development of forest complex of the Russian Federation through 2020 have been approved; and federal special-purpose Program (hereinafter - FSP) “The Development of Pharmaceutical and Medical Industry of the Russian Federation for the Period up to 2020 and Further Perspective” has been adopted. The Strategy for the development of medical industry of the Russian Federation for the period through 2020 is being worked out. Therefore, the perspectives for improvement of the situation in the forestry industry, in pharmaceutical branch and in medical industry have appeared.

Certain aspects of fundamental and industrial biotechnology are developed under the number of Programs: FSP “Research and Development in terms of Priority Areas for the Development of Scientific and Technological Complex of Russia for 2007 – 2013”, FSP “Scientific and Academic and Teaching Staff of Innovative Russia” for 2009 - 2013, FSP “The Development of Nanotech Industry Infrastructure in the Russian Federation for 2008 – 2011”, other Programs including Russian Federation state Programs under development (among them “Public Health Service Development” – Ministry of Health Care and Social Development of the Russian Federation; “State Program for Agriculture Development and Control of Agricultural Products, Raw Materials and Food’ Markets” – Ministry of Agriculture of the Russian Federation; “Natural Resources Restoration and Use” – Ministry of Natural Resources of the Russian Federation; “Fisheries Industry Development” – Russian Federal Fisheries Agency and others.)

Biotechnological topics are widely supported by the Russian Foundation for Basic Research and Scientific Programs of state academies like RAS, RAMS, Russian Agricultural Academy. Applied and implementable projects are financed by the Fund for the Promotion of the Development of Small Businesses in the Sphere of Science and Technology, JSC “RUSNANO”, JSC “RVC”. Regional Programs for the development of biotechnology are implemented (the Chuvash Republic, the Republic of Tatarstan.)

Three technological platforms of biotechnological orientation have been organized and included into the List of Technological Platforms by the decision of the Government Commission for Advanced Technology and Innovations, these platforms are “Future Medicine”, “Bioindustry and Bioresources - BioTech2030” and “Bioenergy”.

Bioenergy has been growing rather rapidly in the recent years (obtainment of electrical and heat energy from biomass, first of all from waste of forestry industry.)

At the same time, it is obvious that these implemented measures are not enough. Modern state of bioindustry in the world shows that many technologies and products are experimental by nature, using



of biopreparations is more complicated than using of traditional chemical products and their cost is higher. These facts are taken as disadvantage and reason for refusal from rapid development of biotechnologies in Russia. It needs to be acknowledged that “intermediary” status of many technological decisions and biotechnological products is a chance for Russia to enter the international system of production of new knowledge and technologies.

Bioindustry is developing at a fast pace in the world and the decisions and products applicable for mass and global introduction shall be found in 10-15 years. If by that time Russia establishes conditions for bioeconomic development, then the country shall appear among beneficiaries and co-owners of new technologies. And if the skepticism existing nowadays remains unchanged then Russia shall appear to be only the consumer at the world technological market and shall have to spend huge resources for import of new branches. The scales of this technological import may be comparable with the import of industrial technologies in 1930s.

Lagging behind in development and implementation of biotechnologies in a number of branches and markets Russian industry risks to appear behind the line of modern technological practice which is being formed in the world during the last 15-20 years. In the medium term it may lead to the systematic degradation of a number of industrial branches as both the development at the world markets and the competitive reproduction of production capacities shall not be possible without using the biotechnologies.

It is important to point out that the scale and pace of required changes is defined not by the preparedness of Russian economy but by the speed with which these changes take place in the world. Therefore, it is necessary to make decisions in a wide range of issues in very short terms.

The development of bioeconomy in Russia is impossible without active involvement of large industrial corporations: both Russian and international. Meanwhile Russian companies almost do not invest into establishment of assets in the sphere of biotechnologies, do not implement biotechnologies at existing industrial enterprises as such implementation requires, as a rule, engagement of workers with the respective qualification and transfer into new management technologies. International companies which products are presented in Russia are interested in sales increase but they do not show interest in organization of production and transfer of some researches and development to Russia.

Taking into account the carried out analysis of the state of biotechnology in Russia and in the world, it is possible to conclude that the development of biotechnological industry, moving of scientific researches and industrial production in this sphere onto the global level of competitiveness are impossible without implementation of targeted state policy. The question is not only in financial support but also in removal of existing regulatory barriers including in the field of customs and technical regulation, formation of stimuli for organization of the industry, establishment of necessary technological infrastructure, creation of demand for products, coordination of efforts of the state, scientific organizations and market participants.

The Program serves to:

- lay the systematic basis for the development of bioeconomy in Russia;
- provide establishment of new sub-branches of industry focused on issuance of innovative biotechnological products for chemical and petrochemical industry, processing of forestry products;
- stimulate the development of production and consumption at the existing markets in Russia, first of all, in agricultural and food sector;
- to establish a basis for industrial development of bioenergy;
- to add to the existing system of measures for medicine and pharmaceuticals support.

A long-term goal for Program implementation is to reach in 2020 the volume of bioeconomy in Russia amounting to around 1% of GDP and in 2030 amounting to at least 3% of GDP.

## **II. Program Goal and Objectives**

Russia's entrance to the leading positions in the sphere of biotechnologies, including in certain areas of biomedicine, agrobiotechnology, industrial biotechnology and bioenergy and establishment of globally competitive sector of bioeconomy, which along with nanoindustry and information technologies should be a basis for modernization and development of postindustrial economy is the strategic goal of the Program.

Program goal achievement is characterized by the following main aspects:

- 8.3 times increase in the consumption of biotechnological products;
- 33 times increase in the production of biotechnological products;
- reduction of share of imports in the consumption of biotechnological products up to 50%;
- increase of share of exports in the production of biotechnological products by more than 25 times;
- reaching the level of biotechnical products manufacturing in the Russian Federation amounting to around 1 % of GDP by 2020 and provision of conditions for achievement of at least 3% of GDP by 2030.

Program implementation shall lead to substantial social effects. The efficiency of medical treatment shall increase in the sphere of medical service due to new widely distributed methods of diagnostics and practice of individualized medicine. In the sphere of ecology effective methods for pollution elimination and prevention of harmful environmental impact shall be established. In agricultural sphere introduction of biotechnologies shall contribute to the improving of the country food supply security. The development of bioenergy sphere shall contribute to appearance of new accessible energy sources.

Program primary objectives are:

- establishment of infrastructure for biotechnology development;
- organization and implementation of priority innovative and investment projects in biotechnology;
- large-scale development of bioindustry in Russian regions in all sectors of biotechnology;
- support of the development of science about life and physicochemical biology;

- establishment of modern educational programs and system of staff training in the sphere of biotechnology;
- maintenance and development of bioresources potential as a basis for bioindustry;
- solving of essential social and economic, energy, ecological and other issues of the country by methods and means of biotechnology;
- integration of national biotechnology into the world bioeconomy; improvement of legal, economic, informational and organizational basis for biotechnology development.

The implementation of Program strategic goal includes 2 stages:  
 Stage I - 2011 - 2015 years, Stage II - 2016 - 2020 years.

The goal for implementation of the I stage is to develop domestic demand and export of biotechnological products that shall result in substantial growth of bioeconomy in short terms in such sectors as biomedicine and agricultural and food biotechnology and shall increase substantially the production of electric energy and heat out of biomass; establishment of production and technological basis for organization of new industry sub-branches able in the long-term to replace a substantial part of products which are produced by chemical synthesis method with biological synthesis products; establishment of technological and experimental-industrial basis for organization of biofuel industry.

To achieve the goals of the Stage I of the Program it is necessary to solve the following primary objectives:

1. To establish the system for assisting promotion of bioindustry products to the domestic and foreign markets for a profound increase output of already produced and demanded biotechnologies products, and saturation of existing markets with specified products.
2. To establish efficient stimuli for localization of production for part of biological products of international companies in Russia. To improve the effectiveness of mechanisms for commercialization of research and development results in the sphere of biotechnologies, among other things on the basis of private-public partnership.
3. To establish adequate bioeconomy structure in Russia including pilot, experimental-industrial, industrial enterprises, engineering companies and centers of fine-tuning technologies for biotechnological products implementation.
4. To provide substantial growth of electric energy and heat production output at the account of mass introduction of modern biopower plants.
5. To arrange a motivated range of industrial companies in chemical, petrochemical industry, agroindustrial sector and forestry industry, which are able to become a driving force for new technologies introduction.
6. To establish organizational and legal basis for the organization of new biotechnological products markets, first of all in industrial biotechnology and biofuel production.
7. To establish a system of voluntary ecological certification taking into account international experience for implementation of “green” standards.
8. To arrange conditions for stable functioning and development of a system for staff training, retraining and employee retention to provide effectiveness of research and development in the sphere of biotechnologies.

9. To organize regional biotechnological programs and bioclusters in a number of constituent entities of the Russian Federation.
10. To take an inventory of biological collections of the Russian Federation and to organize basic bioresources centers of federal significance

The goal of Stage II of bioeconomy development in the Russian Federation is to organize institutional conditions for a profound modernization of technological basis for existing industry branches at the account of mass introduction of biotechnological methods and products into the production. An integration of scientific and process engineering sector of Russia into international system of knowledge production is necessary with moving to the priority development of scientific potential focused on establishment of knowledge and technologies able to provide industrial sector modernization along with nanotechnologies and information technologies.

To achieve the goal of Stage II of the Program a set of objectives should be solved, including:

1. Organization of production and technological basis in terms of all basic kinds of products of industrial biotechnology.
2. Establishment of industrial basis for bioenergy development including electric power and heat production out of biomass, biofuel production.
3. Establishment of complex interdisciplinary system of research and development which is deeply integrated into international technological environment.
4. Improvement of support mechanisms for small innovative business focused on engagement of scientific organizations' potential into the creation and production of new biotechnological products.

At the Stage I of Program implementation a basic growth of consumption and production output shall be seen in biomedicine, agricultural and food sector (including waste recycling of the Agro-Industrial Complex) and bioenergy (including waste recycling of forestry industry).

At the Stage II of Program implementation a technological and production basis for new markets shall be established (in the first place, in industrial biotechnology, forestry industry and in biofuel production), the consumption of biotechnological products shall increase by 2.5 times, product exports shall increase by 5 times.

Performance targets for development of Russian biotechnologies resulting from Program implementation are shown in Appendix No.3.

Program financial provision shall be carried out at the account of federal budget funds, budgets of constituent entities of the Russian Federation, local budgets and non-budgetary financing.

Program financing at the account of federal budget funds shall be carried out in terms of financing of federal executive bodies and their subordinate organizations' activities acting or newly established federal special-purpose Programs, long-term state Programs, state Programs of the Russian Federation stipulated by the instruction of the Government of the Russian Federation as of 11 November 2010 No.

1950-r “Concerning the Approval of the List of State Programs of the Russian Federation” and other mechanisms defined by the Government of the Russian Federation.

At the Stage I of Program implementation basic investments shall be focused on:

- bioeconomy infrastructure establishment;
- organization of scientific and process capacity in the sphere of biotechnologies (financing of research programs with respect to bioeconomy key areas through the programs of fundamental studies, scientific funds grants, projects with respect to R&D development institutes and private business).

At the Stage II basic investments shall be focused on new production establishment and development of production capacities at organized markets and also on financing of programs for products and technologies mass introduction in a wide range of industry branches.

The supposed amount of financing with respect to Program areas is given in Appendix No. 4. During federal budget organization and administration the amount of financing may be specified.

Federal budget funds, budgets of constituent entities of the Russian Federation, state institutes for development, state corporations and companies with state participation, large and middle business shall be the basic source of financing of the I stage of Program implementation. The substantial part of investments may be drawn from international corporations interested in localization of production capacity in Russia; funds drawn at Russian and international capital market shall compose some part of financing.

The funds of Russian and international corporations, funds of enterprises of middle and small business, funds of state institutes for development and investments drawn at the stock market shall be the basic source of financing of Program’s Stage II.

### **III. Basic Tools for Biotechnologies Development Support**

#### 1. Stimulating demand for biotech products

Biological products demand stimulation in terms of the Program implementation shall be carried out according to several basic areas:

1. Setting of specific guidelines for increase of biological products consumption in program documents of the Government of the Russian Federation focused on the development of certain economy sectors.
2. Development of the system of measures for statutory and technical regulation of certain kinds of products stimulating recycling of products and waste products.
3. Development of the program for consistent and predictable increase of payments and stiffening of technological specifications for emissions and disposals of substances and microorganisms for stationary, mobile and other sources on the basis of using the best existing technologies.

4. Forming of necessary tools and mechanisms for the support of state procurement of biotechnological products in terms of establishment of federal contractual system and in terms of state defense order.
5. Inclusion of biotechnology products in the state support of agricultural producers;
6. Establishment of mechanisms that provide equal status of chemical and biological products (including fertilizer, means of plant protection) during the state support of agricultural producers;
7. Improvement of regulatory support of biomedical products and services circulation.
8. Stimulating the use of biotechnologies in public sector of economy including companies with state participation and public corporations, among other things by means of inclusion of business improvement issues (productivity, ecological compatibility, industrial safety and others) at the account of biotechnologies using into business-strategies and Programs of companies' innovative development.
9. Development of set of measures for stimulation of biotechnological projects implementation by private sector, among other things for establishment of corporate research and development centers in Russia by transnational companies.

## 2. Promoting the competitiveness of biotech enterprises

Implementation of set of measures for stimulation of business innovative activity shall contribute to accelerated development of biotechnologies. The set is provided by the Strategy for innovative development of the Russian Federation for the period through 2020 approved by the Decree of the Government of the Russian Federation as of December 8, 2011 No. 2227-r; among other things the set includes necessary tax package, measures for infrastructure establishment, for support of small innovative business.

At the same time, with respect to biotechnologies common institutes and tools for stimulation of innovative activity and companies' competitive growth shall have some specific character. In terms of this Program the contribution to competitive growth shall be carried out according to the following areas:

1. Provision of financing on a grant basis including in the line of RFTD or on the conditions of interest-free loan for implementation of Research and Advanced Development Programs for middle and large enterprises of bioeconomy and Programs of strategic researches in terms of technological platforms.
2. Extension of priority for biotechnologies development in the activity of development finance institutions directed to intensive growth of financial support at early stages of innovative activity – “pre-seed” and “seed”, and in terms of the support Program for small and medium businesses, the activity of the Fund for the Promotion of the Development of Small Businesses in the Sphere of Science and Technology (hereinafter – the Fund for the Promotion), and the activity of seed investments funds being established at the federal and regional levels, the activity of JSC “RVC”, of JSC “RUSNANO”, of the Bank for Foreign Economic Activities.
3. Improvement of the system for export support in the part of promotion of biotechnological products onto foreign markets.
4. Defining of the mechanisms for import support of certain advanced foreign technologies (and

respective technological equipment) which are characterized by high potential for distribution in the economy and contribute to the transfer to new technological practice.

5. Development and establishment of resources support mechanisms for establishment and activities of new biotechnological companies at the account of development of innovative infrastructure network including prototyping centers, pilot, experimental-industrial companies, centers for fine-tuning technologies for use of biotechnological products, technologies transfer centers, centers for public access to equipment and others.
6. Using of financial mechanisms of United Nations Framework Convention on Climate Change for stimulation of biotechnologies.
7. Establishment of the system of voluntary ecological certification which takes into account international experience for implementation of “green” standards for the provision of minimization of negative impact of industrial facilities on the environment, rational use of natural resources, introduction of advanced energy-efficient and energy-saving solutions, rendering help to consumers during selection of products which do not make a negative impact on the environment, assistance to the development of “green” technologies in Russia.
8. Acceleration of the process for adoption of new standards and harmonization of regulatory and legal framework of the Russian Federation, EAEC, European Union and other countries in the sphere of production control and biotechnological products circulation including introduction of mechanisms of mutual recognition of certification results by laboratories and certification centers.

### 3. Development of education in the sphere of biotechnology

The primary tasks for staff training in the sphere of biotechnologies are: forming of a path for obtainment of necessary competence, knowledge and skills on pre-higher, higher, post graduate stages of education on the basis of renovated educational standards and programs, forming-up of the system for continuous professional development, substantial raising of biotechnological business influence on forming of educational programs, especially on late (undergraduate courses, master course, postgraduate education and professional development) stages.

In terms of the Program the advancement of education shall be carried out according to the following areas:

1. Development of efficient interaction of the most competitive educational institutions in the sphere of biotechnologies with establishing leadership centers with respect to various biotechnological areas in the part of education, arrangement of joint studies, development of new technologies and products. The financial support of such interaction is carried out by means of existing support tools for higher institutions innovative activities.
2. Development of new and modification of existing educational standards for various categories of specialists in various branches of bioeconomy.
3. Establishment of new educational programs in accordance with staffing needs of biotechnological business.
4. Using of modern educational methods with compulsory engagement of high-level specialists from abroad who present leading companies and university biotechnological centers.

5. Organization of flexible modular structure for educational programs.
6. Establishment of continuous system for professional development and retraining of biotechnological staff with the remaining possibility to change specialization without losing skills in terms of peculiar branch of bioeconomy.
7. Organization of advanced scientific and technological basis in the most competitive educational institutions in the sphere of biotechnologies.

#### 4. Development of science in the sphere of biotechnology

Progress in the sphere of fundamental fields of biosciences, in the first place in physiochemical biology, development of new methodological approaches and research platforms are the basis for the development of modern biotechnologies. Merely for the last several years such scientific fields as systems and synthetic biology have appeared, high-performance methods for research of genome, transcriptome, proteome and others (so called “omics”) are booming.

The implementation of set of measures for the support and development of scientific studies is necessary to provide scientific basis for biotechnologies development:

1. General increase of share of the expenditures for science in the structure of budget of the Russian Federation during outrunning growth of expenditures for studies in the sphere of biosciences. According to the information of the Ministry of Education and Science of the Russian Federation, 27.3 billion rubles have been assigned for research projects in the sphere of biosciences in 2007 - 2011. For the same period China which rapidly develops biotechnologies has invested into R&D approximately 1.7 billion US dollars of public funds and drawn approximately 2 billion US dollars of private investments. In Russia there is almost no drawing of private funds into R&D in the sphere of biotechnologies.
2. Development of strategic research Programs with respect to subject-matter biotechnology branches – medicine, industrial, agricultural, forest biotechnologies, bioenergy with the participation of specialized technological platforms.
3. Coordination of study designs of state academies of sciences, companies with state participation and state corporations, grant topics of scientific funds with strategic study Programs of specialized technological platforms.
4. Improvement of competitive selection mechanisms for research and technological projects being financed in terms of federal and regional Programs of all levels.
5. Simplification of tendering procedures and forms of reporting, provision of disclosure and transparency during tendering process. Registration of topics and fields of studies entered in strategic study Programs as priority ones during announcement of topics of respective tenders and Programs.
6. Establishment of leadership centers with respect to subject fields of biotechnology – biomedicine, bioenergy, industrial, agricultural, forest biotechnologies on the basis of scientific and academic educational institutions leading in this field.

#### 5. Development of experimental production base



The establishment of modern flexible experimental base focused on mass introduction of biotechnological products into industry, agriculture and at the consumer's market is a key element for Program implementation providing both drastic improvement of efficiency of budgetary expenditures for research work, efficient use of existing scientific capacity and organization and development of biotechnological products markets.

State support of Program measures in the sphere of development of experimental production capacities of bioeconomy shall be carried out with respect to the following areas:

1. Innovative infrastructure development in the part of biotechnologies at the account of establishment of pilot enterprises and prototyping centers aimed at small-capacity production, development of industrial regulations for the production of biotechnological products and for preliminary studies with small production lots for arrangement of production testing, clinical research and preliminary studies with production lots for testing sales.
2. Innovative infrastructure establishment for the production of selective seed products on the basis of agricultural and forest biotechnologies and for arrangement of long-term field testing of up-to-date biotechnological and selective forms of plants with set characteristics.
3. Stimulation of industrial and experimental industrial production for large-capacity output of biotechnological products created on the basis of experimental technologies with the purpose of further optimization of basic technological processes.
4. Overcoming of deficit of innovative projects acceptable for financing by venture capital funds in terms of the activity of the Fund for the Promotion and funds of seed investments at the account of establishment of biotechnological centers able to integrate the requests of user industries and capabilities provided by R&D centers.
5. Creation of organizational conditions for engagement of specialized international companies to the process of bioeconomy infrastructure development in Russia which are able to introduce the respective competencies and to provide integration of establishing infrastructure elements into international system of knowledge and technologies production.
6. Development of mechanisms of private-public partnership stipulated for stimulation of late-stage projects at the account of establishment of specialized centers for fine-tuning technologies for biotechnological products implementation.
7. Organization of sub-Programs and certain measures for the establishment of pilot and experimental industrial enterprises, prototyping centers, engineering centers, specialized centers for fine-tuning technologies for biotechnological products implementation in terms of respective state Programs of the Russian Federation and federal special-purpose Programs.

#### 6. Support and development of bio-collections

The Program stipulates establishment of special infrastructure for provision of centralization, standardization and availability of genetic resources of biotechnological importance; the infrastructure includes large national and specialized centers of bio-resources (or genetic resources) and research collections which differ according to their functions (including service ones).

Program support and implementation shall be carried out with respect to the following areas:

1. Taking of inventory of existing biological collections (microorganisms, fungi, plants, animals).
2. Defining a list of collections authorized to arrange deposit for the purposes of national patent procedure on behalf of the Russian Federation and approval of deposit guidance.
3. Development of set of measures for establishment of Russian Federation biological collections network with the prospect of their further integration into the European and Global (worldwide) information networks of BRC (Global Biological Resource Centre Network, GBRCN) in accordance with OECD recommendations.
4. Development of set of measures for reorganization of largest biological collections of the Russian Federation into national biological resource centers in accordance with OECD recommendations.
5. Development and implementation of state support measures for existing biological collections and biological resource centers under establishment including provision of long-term financing, tax remissions and improvement of customs regulation during transfer or exchange with collection biomaterials.
6. Harmonization of Russian and international statutory regulation for the activities on circulation of genetic resources and biological collections.

#### 7. Interaction between business, science and education

Along with involvement of already existing tools for improvement of interaction between business, science and education technological platforms including “Bioenergy”, “Bioindustry and Bioresources - BioTech2030”, “Future Medicine” are the main instrument providing interaction between business, science and education in terms of Program implementation.

The assistance to organization and implementation of technological platforms with respect to Program areas shall be carried out by means of using the following mechanisms:

1. Registration of proposals from technological platforms coordinating organizations during organization of tender topics and distribution of financing funds with respect to Program areas in terms of special-purpose Programs, state Programs, Programs of fundamental scientific studies of state academies of science, RFBR, RFTD tenders, the activities of state institutes for development.
2. Participation of representatives of organizations included into technological platforms in consultative bodies that carry out preparations of proposals in terms of topics of research, R&D works being financed out of budgetary sources, financing of measures for innovative infrastructure development and support of innovative activities with respect to Program areas.
3. Engagement of technological platforms coordinating organizations in the development and approval of draft regulatory documents affecting the issues of their activity including development of federal special-purpose programs and state Programs.

#### 8. Support of biotechnologies in regions

The support of Program implementation at the regional level shall be carried out with respect to the

following areas:

4. Coordination of expenditures for biotechnologies support at the federal, regional and municipal level.
5. Contribution to implementation of regional initiatives including regional Programs for the development of biotechnologies on the basis of private-public partnership.
6. Discovery of the most competitive clusters in the sphere of biotechnologies and development of measures for their support.
7. Support of regions of the Russian Federation as subjects of international cooperation in the sphere of biotechnologies.

### 9. International cooperation

The implementation of Program measures is focused both on the deep integration of research and production capacity of Russia into international bioindustry and on the substantial growth of presence of international corporations at the Russian market, first of all at the account of localization of production capacities and establishment of international research centers and world-class engineering companies in Russia.

The support of international cooperation development in terms of the Program shall be provided at the account of implementation of a set of measures:

1. Consideration of issues for activation of participation of Russian research organizations and companies in international research and technology Programs of multilateral cooperation in the sphere of biotechnologies including EC framework Programs with respect to researches, technological development and demonstrational activities and international technological platforms.
2. Membership provision for Russia and respective Russian organizations in international scientific organizations in the sphere of biotechnologies (European Molecular Biology Laboratory; Federation of European Biochemical Societies and others), networks and research projects, establishment of national divisions of international biotechnological associations, international and regional organizations for standardization in Russia.
3. Initiation of projects for scientific and technological development with respect to Program areas with broad international participation.
4. Engagement of international biotechnological corporations for participation in the development of joint scientific research projects and stimulation of establishment of international research and development centers and corporate centers for research and development at the territory of Russia.
5. Russia participation in the development of market mechanisms for ecological regulation in terms of UN and on bilateral and multilateral basis.

### 10. Establishment of biotechnologies informational and analytical infrastructure

The system of informational and analytical support of Program measures stipulates:

1. Establishment of biotechnological network uniting research and development centers, multi-access centers, institutions of RAS, Russian Agricultural Academy, and RAMS, higher institutions, biotechnological laboratories with respect to subject-matter topical bioindustry areas.
2. Establishment of a database and a knowledge base in the sphere of biotechnologies, among other things in the part of evaluation of bioresources integrated with systems for data storage with respect to subject topics established in the federal executive bodies and state institutes for development.
3. Development of the federal website “Modern biotechnologies and bioindustry development” including videoconference service support system for commercialization of progress in the sphere of biotechnologies and popularization of biotechnologies in the society.
4. Provision of access to the system of cloud computing established at the federal level – these are services for possibilities to use geographically distributed supercomputer resources and unique equipment for the purposes of biotechnologies development.
5. Organization of the system of statistical monitoring for the development of biotechnologies sphere in the Russian Federation including development of methodology and toolkit for the statistical monitoring of establishment, commercialization and use of biotechnologies and production of biotechnological products on the basis of international statistical standards OECD adopted in this sphere.

#### **IV. BIOTECHNOLOGY DEVELOPMENT PRIORITIES**

In addition to basic tools for Program implementation representing “horizontal” measures for biotechnologies sector development the Program distinguishes measures with respect to basic areas of biotechnologies development representing “vertical” measures for the sector development; they are united by general subject of the respective biotechnology results application.

Taking into account existing scientific capacities and tendencies, current state and potential of markets development and social and economic effect the following priorities are distinguished:

- biopharmaceutics and biomedicine;
- industrial biotechnology and bioenergy;
- agricultural and food biotechnology;
- forest biotechnology;
- environmental (ecological) biotechnology;
- marine biotechnology.

In terms of specified priorities the sets of measures interrelated and coordinated by time, resources and performers are organized, including R&D, logistical, staffing, informational, regulatory and economic support. Below these sets of measures are set out with respect to the areas. Furthermore, extension No. 5 represents a list of priority actions with respect to Program implementation.

Every basic priority for biotechnologies implementation or every distinguished part of priorities is

allocated to the federal executive bodies responsible for state policy exercise in this sphere. These include:

1. Biopharmaceutics

2. Biomedicine

3. Industrial biotechnology

4. Bio-energy

5. Agricultural biotechnology

6. Food biotechnology

7. Forest biotechnology

8. Environments (ecological) biotechnology

9. Marine biotechnology

#### 5. Agricultural biotechnology

In agriculture biological preparations for diseases treatment, prevention and diagnosis are represented by a wide range of products both imported and Russian. The expansion of physical volume of production in agricultural sector has severe restrictions at the world markets: at some time further expansion of volume shall be impossible without change of technological approach (cultivation, storage and transportation conditions in plant science, management, feeding and processing conditions in animal industry).

Using of biotechnology in agriculture is focused on stable development of agricultural production, solving of issue of food security, obtainment of high-quality, ecologically clean food products, recycling of agricultural production waste, soil fertility recovery. In this area the most prioritized are:

- development of new cultivars of agricultural plants and farm animals using new modern postgenomic and biotechnological methods;
- development and implementation of genomic certification to increase the efficiency of selective stock breeding, breeding animals cloning technologies;
- production of biopreparations for plant science;
- production of supplementary feeds for farm animals;
- production of veterinary biopreparations.

For implementation of this area the sets of measures specified below shall be included into the state Program of the Russian Federation “State Program for Agricultural Development and Regulation of Agricultural Products, Raw Materials and Food Supplies Markets”, Ministry of Agriculture of the Russian Federation is the executive in charge.

### 5.1 “Biological plant protection”

During the last 10 years new generations of biological plant protection products have been created by means of biotechnology methods which may easily compete with chemical protection products in terms of cost performance. As a result, almost in all large agricultural areas of the world there is a large-scale growth of use of biological products.

The measures for biological plant protection provide means for crop yield increase, reduce losses in plant production industry, and implement integrated plant protection systems. They lead to reduction of active ingredients residue in the end products and this is crucially important during control in countries importing Russian agricultural products (grain at present stage). At present time there is a directive in the European Union which approved REACH Program defining a sharp increase of requirements towards chemicals use (besides, not only in agriculture). The development of biological plant protection leads to substantial reduction of chemical burden in plant industry and contributes to a long-term competitiveness of the sector.

### 5.2 “Plant breeds created by means of biotechnology methods”

At present time Russian Federation almost does not create varieties and hybrids of new generation which are resistant to drought, diseases, herbicides, insect pests and difficult environment, using post genome technologies (breeding methods based on use of molecular markers) and genetic engineering which are wider and wider used in the world. Agricultural production of Russia will remain high-cost and will not be able to compete with foreign countries without use of biotechnological innovations. Such situation shall have a detrimental effect on domestic food production sector. The set of measures shall contribute to the development of advanced post genome and biotechnological methods in plant production and organization of robust markets of transgenic seeds and plants demanded by agricultural producers.

### 5.3 “The technologies of animals and poultry molecular breeding”

The development of technologies of molecular breeding is based on the development of modern genome analysis methods enabling to detect and arrange screening of a big number of mutations (polymorphisms) related to the level of development of economically important selection traits of farm animals. The set of measures stipulates establishment of competitive national technologies of molecular breeding in animal and poultry industry focused on increase of economically beneficial traits, on animal products quality improvement and, as a result, improvement of the effectiveness of animal products production.

#### 5.4 “Transgenic and cloned animals”

The basic market factor for the segment growth is the fact that transgenic animals are many times more productive than the existing methods for obtainment of recombinant proteins and/or antibodies. The set of measures shall establish the conditions for Russian producers entering the market segments with high added value and for organization of technological advance contributing to the long-term competitiveness of the sector.

#### 5.5 “Biotechnology of soils and biofertilizers”

In the framework of the set of measures the conditions for development of biotechnological means of soil improvement and development of biofertilizers production shall be created. Soils biotechnology may improve substantially the quality and productivity of soils at the account of use of plants containing necessary bacteria without use of chemical fertilizers or with the substantial reduction of amounts of their use. During organic waste recycling the use of bacteria may substantially reduce the price and advance the processes for organic fertilizers creation and that shall contribute to the development of organic farming in Russia and shall contribute to the reduction of ecological damage arising from agricultural activities.

#### 5.6 “Biopreparations for animal industry”

Biological preparations for animal diseases treatment, prevention and diagnosis are represented by a wide range of products both imported and Russian. As a rule, international companies occupy segments of expensive high-efficiency preparations, including the ones obtained by means of using methods of genetic engineering. The use of local microbial strains isolated in Russia or in the neighboring countries for production of domestic immunobiological drugs for veterinary application is their most important competitive advantage. As a rule, it provides highest specific efficacy of specified drugs during their use at the territory of the Russian Federation and at the Eurasian Continent. The implementation of set of measures shall lead to entering of domestic producers into higher-value-added segments keeping the existing competitive advantages.

#### 5.7 “Feed protein”

Feed microbial protein (feeding yeast) is a dry concentrated biomass of yeast cells specially cultivated as a feedstuff for farm animals, poultry, fur-bearing animals, and fish. Supplement of feed protein into the feedstuff improves their quality greatly and contributes to productivity improvement in animal industry. The set of measures shall provide the development of feed protein production in Russia and establishment of new technological advances improving technologies of its production and kinds of use.

#### 5.8 “Agricultural waste recycling”

The technology of microbiological conversion is increasingly applied recently in the recycling of agricultural waste and food industry organic waste. The technology of microbiological conversion is

really “omnivorous” and uses most diverse organic waste. Waste remaining during harvest of agricultural crop, brewery waste, waste from grain, milk, fruits and vegetables processing, meat processing waste, etc. may be used as initial raw material.

Microbiological conversion enables recycling wine and sugar industry waste, waste appearing in the result of various products conservation, during the production of vegetable oil and vegetable fats in general. The technology perfectly disposes tea, wine and perfume industry waste.

Thank to such technology even infested, partially decomposed waste contaminated with microbial flora may be recycled. Bioconversion may restore and improve feeding quality of poor-quality waste. The set of measures shall provide improvement of agricultural waste recycling by means of biotechnological methods.

### 5.9 “Biotechnological components of foodstuff and premixes”

Current state of farm animals feeding technologies is based on extensive use of biological components (enzymes, amino acids, PVC, probiotics and other). In the result of animal industry development in Russia which is mainly based on import of technologies and breed animals a broad market of these biotechnological products has been formed. However, market development so far did not lead to the development of industrial and technological basis, appearance of new products created on the basis of scientific achievements of Russian scientists.

In 2010, 45 million tons of grain was used in animal industry as foodstuff, it shows extremely low efficiency of feed production in the country. The content of grain in compound feedstuff amounts to 70% (40-45% in European Union countries); moreover, more than a half of the total amount of feedstuff grain was used unprocessed.

It is important to mark that production of compound feedstuff and premixes is carried out to a great degree without the use of biopreparations (enzymes, veterinary and feed antibiotics, probiotics, etc). Feedstuff conversion into animal products is lagging far behind from the world indicators and that hurts the ability of Russian animal industry to compete. The set of measures shall provide conditions for the development of industrial and technological basis of biotechnological components in feedstuff and premixes.

Implementation of specified sets of measures shall enable to develop high-performance agriculture and provide population with adequately balanced food.

The Ministry of Agriculture of the Russian Federation is responsible for the development and implementation of set of measures with respect to the area.

## 6. Food biotechnology

Modern food biotechnology represents industry of food ingredients – nonspecific additives added into food products during their production for their useful properties improvement.



At present time an overwhelming majority of food ingredients is being imported, in this regard the organization of their production in Russia is a topical, socially demanded task.

#### 6.1 “Food protein”

People traditionally obtain proteins, fat and carbohydrates (main food components) from animal and plant sources. Nowadays these sources already do not supply constantly increasing human needs. Modern biotechnology methods combined with application of ultra- and nanofiltration systems make extraction of food protein from wide range of raw products and food industry waste economically feasible. In such a manner, the set of measures is focused on distribution of technologies turning waste of low value into protein products and components with high-added-value cost.

#### 6.2 “Enzyme preparations”

Enzymes used in food productions are products with high-added-value cost; they are barely produced in Russia. The development of this area shall enable to establish compact in scale but high performance sector being on the one hand a basis for the development of all areas in food branch focused on deep raw material processing and, on the other hand, the production of food enzymes has high export potential.

#### 6.3 “Prebiotics, probiotics, synbiotics”

The development of production and food engineering of products of this group is a necessary element for the development of healthy nutrition market in Russia. The task of this set of measures is establishment of probiotic products, development of studies and practice introduction of new products and integrated solutions into enterprises assortment.

#### 6.4 “Functional food products including medical, preventive and infant ones”

Food products of systematic consumption, maintaining and improving health and reduction of pathogenic mechanisms risks by virtue of functional ingredients present in their structure are referred to functional food products. They are not drug preparations but they prevent contractions of certain diseases, contribute to children growth and development, and slow down organism ageing. In accordance with world practice the product is considered to be functional if regulated content of micronutrients in it is enough to satisfy (during usual level of consumption) 25-50% of daily average demand in these components. The development of the area is an important social objective reducing the load over the medicine sector and social and economic damage from diseases.

#### 6.5 “Food ingredients including vitamins and functional mixtures”

Food ingredients are used to raise the nutritive value, to extend storage period, to the body and to intensify products flavor. As a rule, food ingredients used by producers have vegetable or bacterial origin. Many amino acid additives, flavor intensifiers and vitamins added into food products are

produces with the help of bacterial fermentation. In the result of set of measures implementation the biotechnology should provide food products producers with a possibility of synthesis of a number of food additives which are too expensive or difficult to access these days due to limitation of natural sources for these compounds.

## 6.6 “Advanced processing of food raw materials”

Biotechnology represents many possibilities for improvement of methods for raw materials processing into end products: natural flavoring matters and coloring agents; new technological additives including enzymes and emulsifiers; starter cultures; new means for waste disposal; ecologically clean production processes; new means for product safety provision during production.

Modern technologies of food raw materials deep processing are built on the principles of waste-free production: the derivatives either return to the production cycle or are used in other industries (in the first place in production of beauty products, pharmaceuticals, agricultural production). Introduction of such technological schemes is largely caused by modern biotechnology progress which made extraction of a wide range of new products from food raw materials accessible and economically feasible. The conditions for the distribution of technologies of food raw materials advanced processing and drastic reduction of food industry waste shall be created in terms of this set of measures. In the result of Program implementation the production of a wide range of food ingredients including vitamins and functional mixtures shall be arranged in Russia, high figures for food raw materials processing shall be reached, import substitution with respect to the majority of ingredients for food products production being imported at present shall be arranged.

The Ministry of Agriculture of the Russian Federation is responsible for the development and implementation of set of measures with respect to the area.

## 7. Forest biotechnology

Program implementation in the part of priority area “Forest biotechnology” shall lead to the establishment of a modern system for forest planting management in the country with engagement of DNA marking methods, establishment of new biotechnological forms of trees with set characteristics, development of artificial forest planting, establishment of conditions for timber low-waste processing, saw milling waste disposal and to creation of demand for modern ecologically safe means of forest protection.

### 7.1 “Use of biotechnologies for forest planting management”

Molecular (DNA) marking is one of the priority areas for forest biotechnology development; it is focused on the solution of the following objectives of forestry and timber industry:

- improvement of principles and approaches of forest seed regionalization;
- genetic certification and seed certification;
- monitoring of phytosanitary state of nurseries and forest stands;

- timber origin legality checking.

Consequently, the set of measures is focused on the development and speed-up of advance technologies distribution, as well as extensive application of biotechnologies with the purpose of forest planting management efficiency improvement.

### 7.2 “Use of biotechnologies for conservancy and regeneration of forest genetic resources”

Modern methods of forest biotechnology shall enable to carry out effective monitoring of resources condition, to conserve and to regenerate forest genetic resources. Such biotechnologies are as follow:

- establishment of banks in vitro of rare and vanishing species of forest plants;
- cloned micro-propagation of rare and vanishing species of forest woody and herbage plants for establishment of reserves;
- monitoring of forest genetic resources condition by applying DNA analysis methods;
- evaluation of genetic diversity of forest rage by using DNA analysis methods.

### 7.3 “Creation of biotechnological forms of trees with set characteristics”

Economic efficiency of forest stands (in particular, forest plantations) in the first place depend on the productivity and resistance of used forest trees to biotic and abiotic environmental factors. These characteristics in turn depend on genetic value and quality of planting stock. It is necessary to develop biotechnologies focused on the establishment of new forms of forest trees with set characteristics. The following biotechnologies are referred to such ones: selection of basic forest forming species on the basis of DNA marking for breeding of new hybrid and varietal forms; creation of biotechnological forms of trees with set characteristics, for instance, with reduced content of lignin, resistance to herbicides; cloned micro-propagation of genetically valued forms of trees with the purpose of quick introduction of newest selection achievements to the market and improvement of seed material quality.

Biotechnological forms of trees are the source of raw materials for present day timber-processing industry. The substantial part of expenditures during timber processing is accounted for by separation of wood pulp from lignin which is a substance joining wood grain. Herewith caustic lye solutions, high temperatures and pressure are used. Use of wood containing less lignin and more pulp substantially increases marketability of timber-processing industry.

Fast-growing trees are also one of the effective ways of climate change control as carbon dioxide absorbers. The use of fast-growing forest as a raw material for biofuel is another area.

### 7.4 “Biological means of forest protection”

Use of chemicals destructively influences the biodiversity of forest communities and lack of work for establishment and production of new biological protective means (including microbiological and entomophage) prevent from control of distribution of new hazardous invaders and phytopathogenes in forests and it impinges fire safety in forests and leads to substantial social and material damage due to fires.

The set of measures is focused on survey of biotechnological protective means promising for use in forest protection and development of technologies on their basis for obtainment and implementation of ecologically safe means of forest protection from hazardous organisms.

Implementation of specified set of measures shall enable to compensate the lack of biological means for forest protection in the country and shall contribute to establishment of low-tonnage productions in Russia. Increase of a number of biological means for forest protection and extension of their sphere of application shall enable to reduce both social and economic losses due to hazardous organisms' epidemics and pesticide burden over forests contributing to biological diversity maintenance.

In the result of Program implementation a new up-to-date basis of industrial production shall be established in Russia characterized by improved forest resource potential and substantially reduced level of timber industry nonrecoverable waste.

State Forest Enterprise of Russia is responsible for the development and implementation of set of measures with respect to the area.

## 8. Environmental (ecological) biotechnology

The production of industrial biotechnology products is more eco-friendly than chemical production. The ability of bioproducts to decompose into non-hazardous matters makes their recycling safe for environment and materially reduces aggregate expenditures for waste storage and disposal. A selective effect which is made by a biopreparation (for instance, by biological pesticide) to the target objects substantially reduces risks of its use and the following harm for human organism. Finally, industrial biotechnology products themselves getting into human or animal organism do not do the harm which may be done by a chemical preparation. This area is based on use of biotechnology for environment protection and includes the following sets of measures:

### 8.1 “Bioremediation”

Bioremediation is a set of methods for reclamation of waters, soils and atmosphere using metabolic potential of biological facilities – microorganisms, plants, fungi, insects, worms and other organisms. The set of measures in this sphere organizes conditions for active use of biotechnological methods during rectification of adverse effect onto the environment.

### 8.2 “Ecologically clean dwelling”

The set of measures is focused on creation of a wide range of biotechnological products applied during construction materials production, introduction of ecologically clean building technologies, and use of biomaterials in engineering systems and in the process of servicing of buildings, constructions and building area. During the development of house (low-height in the first place) construction this segment of biotechnological products market may be substantially developed.

### 8.3 “Biological collections and bioresource centers”

Around 100 collections of cultures the content of which comprises almost all known groups of microorganisms are registered in the Russian Federation. The set of measures for the development of biocollections is focused on provision of effective system of registration, storage, and use of registered microorganisms, provision of centralization, standardization and accessibility of genetic resources of biotechnological importance.

The Ministry of Natural Resources of the Russian Federation is responsible for the development and implementation of set of measures with respect to the area “Bioremediation”.

The Ministry for Regional Development of the Russian Federation is responsible for the development and implementation of set of measures with respect to the area “Ecologically clean dwelling”.

The Ministry of Education and Science of the Russian Federation is responsible for the development and implementation of set of measures with respect to the area “Biological collections and bioresource centers”.

## 9. Marine biotechnology

The importance of marine biotechnologies is defined by the genetic diversity and unique chemical composition of aquatic organisms, calorific and nutrition value, strong sustainability, absence of virus diseases and allergens hazardous for humans, chemical and radiation safety, high functional properties, resource sufficiency. In terms of the area the following sets of measures are provided:

### 9.1 “Establishment of aquabiocenters networks”

Aquabiocenters are specialized units established for elaboration of various technologies (fish farming, keeping conditions, feeding technologies, drill of feedstuff recipes). Aquabiocenters are an important element of infrastructure which provides introduction of up-to-date products and technologies into the branch. From the point of view of Program objectives aquabiocenters act as centers for elaboration of technologies for biotechnological products use (in the first place of specialized feedstuff).

### 9.2 “Advance processing of fishery aquatic organisms and aquaculture products”

On the basis of biotechnologies a considerable assortment of goods is produced from marine hydrobionts obtained by means of fishing: fish meal, hydrolyzed protein for food purposes and microbiological production, technical, veterinary and medical fish oil, biopolymers and other biological stock, semi-finished products, consumption products. In terms of this area both as in case of advance processing of food raw materials the objective is to introduce up-to-date biotechnological methods into the practice of fish-processing enterprises which may provide economically feasible obtainment of wide range of food ingredients and valuable food products with high-added-value from aquatic organisms.

### 9.3 “Specialized feedstuff for aquacultures”

Aquaculture development is based on high use of combined feedstuff the quality of which is stipulated by special requirements. As opposed to the similar products for farm animals the fish combined feedstuff should contain higher level of protein, lipids, metabolic energy and vitamins and also be resistant to aggressive aqueous environment.

In the result of this set of measures implementation the production of a wide range of feeds and premixes shall be developed in Russia providing the development of aquaculture with feeding basis.

This section of Program shall be carried out in close cooperation with FSP “Improvement of the Effectiveness of Use and Development for Fisheries Industry Resource Potential in 2009 - 2012” being implemented by Russian Federal Fisheries Agency. The sets of measures shall be taken into account during organization of State Program of the Russian Federation “Fisheries Industry Development”.

Russian Federal Fisheries Agency is responsible for the development and implementation of set of measures with respect to the area.

## **V. MANAGEMENT OF IMPLEMENTATION OF THE PROGRAM**

*This part of the program names the Ministry of Economic Development as a coordinator of the Program, describes the role and functions of the coordinator. Determines the federal bodies of executive power that will work together with the coordinator in implementation of the Program. The coordinator of the program forms the interagency council, which will include the leading scientists, representatives of business, government, public organizations, who will develop the Program strategy.*

## **APPENDIX #. 1 KEY TERMS USED IN THE PROGRAM**

*Extract :*

“**Biotechnology** (the technology of living systems) - 1) a discipline that study the possibility of using living organisms, their systems or their metabolic products to solve technological problems, as well as the possibility of creating living organisms with the necessary properties by genetic engineering, and 2) use of biological structures for production of food and industrial products and for targeted transformations. Biological structures in this case are the microorganisms, plant and animal cells, cell components, such as membrane cells, ribosomes, mitochondria, chloroplasts, as well as biological macromolecules (DNA, RNA, proteins - mostly enzymes);

“**White**” **biotechnology** is production of bio-fuels, enzymes and biomaterials for various industries;

**Veterinary Biotechnology** - part of the agricultural biotechnology, which refers to use of biotechnology for treatment of animals;

**“Green” biotechnology** - the development and introduction of genetically modified plants in agriculture;

**“Red” biotechnology** - production of biopharmaceutical preparations (proteins, enzymes, antibodies) for human beings, as well as for correction of the genetic code;

**Forest Biotechnology** - Biotechnology section dealing with conservation and rapid reproduction of forest biological resources;

**Medical Biotechnology** - Biotechnology section dealing with production of biopharmaceuticals, medical devices purposes and dietetic products (see also "Red" Biotechnology);

**Marine Biotechnology** - Biotechnology section that study aquatic organisms, seafood processing, commercial breeding of marine fauna and flora in aquaculture;

**Food Biotechnology (Food bio-industry)** – section of biotechnology engaged in the development of the theory and practice of production of common food, preventive health food and specialized food;

**Applied Biotechnology** – branch of biotechnology that is responsible for practical application of achievements of this science;

**Environmental Biotechnology (Ecological Biotechnology)** – branch of biotechnology dealing with environmental issues by biotechnological methods;

**Industrial Biotechnology** - branch of biotechnology that carries out large-scale production of biological products for all biotechnology sectors (health, food, agricultural, energy, environmental, etc.) (Also see “White” Biotechnology;)

**Agricultural Biotechnology** – branch of biotechnology dealing with issues of theory, methodology and implementation of its achievements in plant and livestock production (see also "Green" Biotechnology.)

## **APPENDIX #2. GLOBAL TRENDS IN THE DEVELOPMENT OF BIOTECHNOLOGY AND POSITION OF THE RUSSIAN FEDERATION**

1. Biopharmaceuticals
2. Biomedicine
3. Industrial Biotechnologies
4. Bioenergy
5. Agricultural Biotechnologies

6. Forest biotechnologies
7. Marine biotechnologies
8. Biological collections

## 5. Agricultural biotechnologies

The use of biotechnology in agriculture is focused on stable development of agricultural production, solving of food security and safety issues, obtainment of high-quality and ecologically clean food products, agricultural production waste recycling, soil fertility recovery. In this area the production of biopreparations for plant industry, supplement feeds for farm animals, veterinary biopreparations and creation of new species of useful plants and animals using up-to-date genetic and biotechnological methods is of top priority.

Enzymes for feed production, biological means of plant protection and plant stimulant fertilizers, silo starters and veterinary preparations for animal industry are the basic types of biopreparations for agriculture. As with food ingredients, imported biological preparations are basic for Russian market.

As of 2010 biopesticides market in Russia was worth 5 times less than EU market (around 60 million. US dollars) and 10 times less than US market (around 120 million. US dollars). By 2015 Russian market may increase 2.7 times, annual average growth rate shall make 22 %.

Creation of new high-productivity species of agricultural plants resistant to diseases, invaders and difficult environment is a key area of agricultural biotechnology in the sphere of plant industry.

Last year's progress in the sphere of genomics, molecular biology and plant genetic engineering has become a basis for new methods of selective work based on the use of molecular markers and on directive genetically engineered plant modification. First area supposes use of plants natural genetic resources defining their agronomic character, herewith multiple acceleration of selective work is achieved at the account of use of molecular markers of respective characteristics. Deciphering of genomes for basic agricultural plants including potato has opened new possibilities for use of these postgenomic technologies.

Another approach is based on introduction of a new characteristic into the plant by means of genetically engineered modification (creation of transgenic plant). Economic effect from use of biotechnological (genetically modified) plants in USA during the period from 1996 to 2009 amounted to around 65 billion. US dollars, 44% of them at the account of reduction production costs and 56% by virtue of substantial yield improvement (229 million. t).

In 2010 the global market value of biological cultures seeds is worth 11.2 billion. US dollars (as compared to 10.6 billion. US dollars in 2009), it makes 22% of the world market of plant protective means in 2010 and 33% of seed market. The use of biotechnological plants is not forbidden in Russia;



however the gaps in regulation system in this sphere prevent the market from development and, consequently, there is no drive for the development of applied researches in this sphere.

Current volume of veterinary biotechnology preparations in the world market is worth 4.8 billion. US dollars. At present time the adverse factors influencing the market are neutralized almost in full and by 2015 the market volume is expected to increase up to 5.6 billion. US dollars.

The percentage of the Russian Federation amounts to approximately 5% of the world market. Imported biological preparations form a basis of the market in Russia and in the structure of domestic preparations consumption low yield products prevail (for instance, vaccines); however, they have certain export potential.

During the period of 2005 - 2010 the amount of antibacterial preparations consumption (including therapeutic antibiotics and antibacterial premixes) increased from 28 to 93 million. US dollars. A sector of therapeutic antibiotics providing volume increase is a key sector; more than 80% of volume in monetary terms falls to its share. At present time antibacterial preparations market (both therapeutic and antibacterial premixes) depends almost in full on import deliveries. The potential volume of consumption for all types of antibiotics in 2015 is worth 145 million. US dollars.

As on 2010 the volume of feed probiotics market in the Russian Federation was worth 20 million. US dollars. By 2015 a duplication of consumption volume is expected, the figure of annual average growth rate shall make 19%.

In 2010 the volume of production of microbiological feed protein in the Russian Federation amounted to around 31 million. US dollars, in 2015 the value of production volume may increase by 13% (up to 35 million. US dollars).

In 2010 the market of amino acids obtained by biotechnological means in the Russian Federation amounted 133 million. US dollars. The main share in the market structure is accounted for amino acids lysine and threonine. By 2015 the proposal at the amino acids market may increase 2 times (up to 265 million. US dollars) in case the existing growth figure remains the same.

At present time there is a growth of demand in animals cloning in the world, in the first place in cloning breeders obtained for selective stock breeding. Removal of previously put veto for use of descendents of cloned animals (cattle, pigs and goats) for consumption in USA (in 2008) and Europe (in 2011) became an drive for market development. Such decision is based on the results of large-scale studies of qualitative factors and factors of harmlessness and safety of products obtained from descendents of cloned animals. At present time around 4 000 animals of cloned cattle and around 500 cloned pigs are used commercially in USA. Viagen (Texas, USA) is a leader in cloned animals' obtainment in the world.

According to the information of U.S. Food and Drug Administration (FDA) the demand of European cloned animals market is worth 250 million. Euro per annum.

The development of molecular selection area is determined by the development of effective genome scanning methods enabling to arrange screening of big number of mutations and calculate animals' genome breeding value at the same time; in the result it helps to increase the effectiveness of selective breeding work and, subsequently, the effectiveness of production of animal industry products. Largest international manufacturers of breeding material of farm animals and poultry are the leaders of the development of this market area: ABS (USA), DanBred (Denmark), Topigs and Hypor (the Netherlands) and others.

It shall be noted that there is a tendency for arrest of development in abovementioned biotechnologies areas in the Russian Federation as compared to the international level. Certain scientific researches carried out in RAS and Russian Agricultural Academy institutes enabled to develop technologies being competitive at the international level. However, further development of such technologies with the purpose of their commercialization is held in by lack of unified Program for the development of agricultural biotechnologies in the Russian Federation.

### 5.1 Biotechnologies for waste recycling

Biotechnology methods play an extremely important role in industrial waste recycling. In developed countries millions of tons of food industry waste (milk whey, grain stillage, animal industry waste and other) is recycled using industrial biotechnology methods. At present time not all technologies are commercially effective but the history (especially in the last 10 years) enables us to suppose that during the last 10-15 years the technologies for industrial waste recycling and disposal shall be introduced into the mass production.

Disposal (recycling) of industrial waste using biopreparations is yet a small but very prospective market. Agroindustrial complex is one of the largest waste producers. According to statistics in Russia in 2010 agricultural and timber industry sectors issued almost 68 million. tons of waste, 18.8 million tons (28% of the volume) of them are reused or neutralized.

Similar index of animal and plant origin waste (including waste during processing of agricultural products in food industry) in European Union for the year of 2008 amounted to 115.56 million tons, approximately 74.5 million tons (64% of the volume) of them have been recycled.

At present time approximately 30% of agricultural production waste is recycled or neutralized in Russia. The applicable standards for waste utilization, in particular, animal industry waste, are not observed.

As compared to agroindustrial sector the situation in food processing industry is characterized by a careful optimism. According to State Statistics Committee, 11.4 million. tons (45% of the total volume) have been recycled or neutralized from 25.1 million. tons in Russia in 2009.

Common annual volume of distillery waste amounts to 10 million. tons in actual weight. According to experts' estimates, approximately one fourth of this volume is being recycled. In USA almost 100% of

ethanol production waste is recycled and used as animals feed in two kinds: in humid form and dry granulated form.

Milk whey is one of the main by-products from production in dairy industry. According to State Statistics Committee 1.97 million tons of whey is obtained in 2009; before 2008 inclusive the volume of whey working-out exceeded 2 million tons. Approximately 40% of this volume goes for recycling to dairy industry. The biggest amount of whey is subject to disposal as production waste. In European Union the volume of available liquid whey amounts to more than 75 million tons, this is the highest regional index in the world. All the whey in European Union is subject to recycling, among other things at least one third is recycled and high-quality food ingredients and other products are obtained. Annually the whey volume increases by 1-2 %.

An issue of packaging materials disposal remains unsolved; annual level of polymeric waste accumulation in Russia amounts to 710 thousand tons.

## 5.2 Food industry

Modern world market of food ingredients is worth 24 billion US dollars; in 2015 its volume shall increase up to 28 billion US dollars. The market is divided into the following segments: flavoring matters (28%), flavor intensifiers (14%), acidity regulators (12%), sweeteners (9%), starch and gelatin (7%).

At present time Russian market of food ingredients is worth approximately 2 billion US dollars with expectable increase by 30% by 2015. Russian market of food ingredients is formed 90% at the account of import deliveries.

World nutritional care market is worth 18 billion US dollars. This segment is dynamically developing in the world and by 2015 the sales volume may amount to more than 27 billion US dollars. In Russia the sales volume of nutritional care and functional nutrition (including infant food) does not exceed 16,8 billion rubles (550 million. US dollars) and may increase by 2015 by 27% (up to 700 million. US dollars).

## 6. Forest biotechnology

Around 50% of the world aerial reserve of organic carbon is concentrated in the forests and forest biomass amounts to around 80% of aerial biomass. Annually 3.3 billion cubic meters of wood is extracted in the forests including 1.8 billion cubic meters of energy wood and charcoal. Active use of world forest resources along with insufficient volumes and efficiency of reforestation works show that forest squares annually reduce by 7-9 million hectares according to the different estimates.

Biotechnologies are used in the world forest sector in the practice of forest protection, establishment of new forms of wood plants with set characteristics, seed material production, seed material quality evaluation, phytosanitary state monitoring, nurseries and forest stands, and in advance timber

preprocessing, waste disposal, house-building.

Various groups of biotechnologies are applied in the practice of forest protection and forest stands arrangement in developed countries:

- establishment and production of biological means of forest protection from invaders and pathogens;
- cloned micro-propagation of plants (including somatic embryogenesis) for quick propagation of selective achievements and production of high-quality seed material;
- genetic transformation methods for creation of new forms of wood plants with set characteristics (USA and China take leading positions in commercial use of these technologies);
- molecular labeling methods for selective work effectiveness improvement, genetic certification of seeds and plants, quality evaluations of seed material, nurseries and forests in general, timber origin legality checking;
- forest genetic resources conservation by means of establishment of cryobanks and banks for plant material deposition in vitro.

In Russia due to general arrear from international level of innovation technologies these biological methods are at the stage of scientific studies and first precedents of introduction into the practice. For instance, they are used during selective work, update of information with respect to forest seed regionalization. Seed material of some especially valuable forms of wood plants, for instance, karelian birch, triploid forms of aspen is produced by method of cloned micro-propagation. Genetically modified forms of wood plants with new characteristics for plantation forestry, for instance, with complete resistance to herbicides are created.

The domestic sector of high technologies for forest resources processing (timber, in the first place) the situation is very similar. Thus, in 2010 pulp and paper making industry of the world produced around 400 million. tons of paper and paper board, while Russia having greatest reserves of wood and ranking 8 in the world with respect to pulp volumes and 14 with respect to the volumes of paper and paper board manufacture produced only 7.57 million tons. At present time pulp and paper industry does not participate in the development of innovative bioproducts production on the basis of complex advance reprocessing of all wood biomass called biorefining.

Wood and technological waste including chip and bark, waste liquor, slimes, sediments, fiber waste and others are mainly used as biomass for obtainment of steam and electric power. The experiments for production of bioethanol and biodiesel from pulp and paper industry waste and works for production of new bioproducts and their entering into the market are in the egg. Finland, Sweden and USA are the leaders in the development and use of new biotechnologies. According to leading world companies, an exchange of up to 30% of traditional products of pulp and paper industry into innovative is possible already in the second decade.

The technologies for production of liquid and solid biofuels, raw materials for pharma industry, carbon

fiber and carbon fiber reinforced plastic from lignin, composite materials, polymers shall be introduced.

Taking into account low level of innovative activity in Russia and insufficiency of existing scientific capacity knowledge generation and stimulation of innovative activity for introduction of developed technologies in the sphere of forest protection and forest plantations creation into practice and modernization of existing enterprises for bioproducts production using biotechnologies already utilized in the world is the priority.

### 7. Marine biotechnology

In 2010 the volume of the world marine biotechnology market amounted to 3.7 billion. US dollars, 4.1 billion. US dollars are expected by 2015. Russia has a substantial potential to compete at the world market of marine biotechnologies.

Fishery fund of internal freshwater bodies of Russia includes 22.5 million hectares of lakes, 4.3 million hectares of reservoir storages, 0.96 million hectares of agricultural multi-purpose reservoirs, 142.9 thousands ha of ponds and 523 thousands km of rivers.

As on 1 January 2006 the common fund of pond areas being on the books of fishery enterprises and organizations amounted to 142.9 thousands ha; however, no more than 110 thousands ha of ponds are used for fish cultivation.

The Russian Federation possesses extensive line of sea coast (around 60 thousands km); herewith the area of sea surface in Barents, White, Azov, Black, Caspian and Far East Seas (Bering Sea, Sea of Okhotsk and Sea of Japan) suitable for distribution of marine culture complexes amounts to around 0.38 million sq. km, while up-to-date area of aquatories used for marine hydrobionts cultivation does not exceed 25 thousands ha.

### 8. Biological collections

Around 100 collections of microorganisms cultures belonging to various offices and institutions are registered in the Russian Federation. Aggregate amount of collection funds of the Russian Federation comprises almost all known groups of microorganisms. The following collections are the largest: Russian Collection of Microorganisms (Institute of Biochemistry and Physiology of Microorganisms RAS, Pushchino city, Moscow region) and Russian Collection of Industrial Microorganisms (State R&D Institute of Genetics, Moscow). The collections of Russian R&D Institute of Agricultural Microbiology, Russian R&D Institute of Plant Protection and collection of basidium fungi of RAS Botanic Institute are widely known.

A seed collection of rare, unique and vanishing kinds of animals is organized and supported in Russian R&D Institute of Animal Industry of Russian Agricultural Academy, the world largest biocollection of fowl is established in Russian R&D and Technological Institute of Poultry Breeding (VNITIP), for more than 30 years biomaterial of outstanding stud-horses of various horse breeds is maintained in Russia

R&D Institute of Horse Raising (VNIHK). A number of other institutes of Russian Agricultural Academy maintain local biocollections.

Vavilov collection of plant genetic resources of Russia R&D Institute of Russian Agricultural Academy is unique in terms of its scientific and practical importance; it has universal importance and is located in Saint-Petersburg and Krasnodar cities. Specified collections may be considered as a possible basis for organization of biological resource centers in Russia.

### APPENDIX #3. PERFORMANCE TARGETS OF IMPLEMENTATION OF THE PROGRAM

*(extract on agricultural, veterinary, food industry, bio-energy)*

	Units	Years		
		2010	2015	2010
<b>INTEGRAL INDICATORS</b>				
Volume of consumption of biotechnology products	Billion rubles	120	400	1000
Volume of production of biotechnology products	Billion rubles	24	200	800
Share of imports in consumption	%	80	60	40
Share of exports in production	%	Less than 1	20	25
By sectors:				
.....				
<b>Agricultural Biotechnologies</b>				
Plant varieties created with use of biotech methods	% of import replacement	0	5	20
Increase of Use of Biotech Control in Plant Breeding	% to 2010		300	500
Share of Wastes of Agricultural Production Processed by Methods of Biotechnology	%	1	30	70
<b>Veterinary Biotechnology</b>				
Increase of Use of Biotech Veterinary Pharmaceuticals	% to 2010		14	70
Vaccines, diagnostic sets, pharmaceuticals	% of import replacement	70	80	100
<b>Food Industry Biotechnology</b>				
Ferments	% of import replacement	5	10	20
Food Proteins	% of import replacement	10	30	70
Share of Wastes of Food Industry Processed by Methods of Biotechnology	%	1	10	20
.....				

<b>Bio-energy</b>				
Motor fuel and its components	%	0	3	10
Production of heat	Billion rubles	8	60	200
Production of electric energy	Billion rubles	0.1	18	54
Cleaning of contaminated surface and ground waters and soils by means of biodegradable products	%	0	30	90
Energy recycling of wastes of poultry, crop production, livestock, forestry and food production industries, including production of alcohol and beer	%	3	30	90
Production of solid bio-fuel	Million tons	3	6	18
<b>Forest biotechnology</b>				
Area of plantations with fast-growing forest	1,000 hectares	-	20	100
Increase of use of bio-agents in forest industry	% compared to 2010	-	200	300
<b>Marine Biotechnologies</b>				
Volume of production of special feeds	1,000 tons	70	250	500
Share of value-added marine bio-recourses of Russian origin in the world market	%	0.4	0.75	0.94

#### APPENDIX #4. ESTIMATED FINANCING OF THE PROGRAM

	Estimated financing by segments, billion rubles, in current prices										Share, %	
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		2011-2020
Biopharmaceuticals*	10	9	7	6	8	8	10	10	16	22	106	9.0
Biomedicine	0	5	10	15	20	20	20	20	20	20	150	12.7
Agricultural and Food Biotechnology	1	5	16	18	18	20	24	28	30	40	200	17.0
Industrial biotechnology	1	10	14	20	21	24	24	26	28	32	210	17.8
Bio-energy	14	22	26	28	31	31	35	50	60	70	367	32.2
Environmental (ecological) biotechnology	0	2	2	3	3	3	4	4	4	5	30	2.6
Forest biotechnology	1	3	3	3	4	5	5	6	7	8	45	3.8
Marine	1	3	5	7	7	7	8	10	10	12	70	5.9

biotechnology												
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Note: \* financing of biopharmaceuticals will consist of budget and non-budget funds, and from the state owned institutes of development, including from funds envisaged by the Federal Target Program “Development of pharmaceutical and medical industries of the Russian Federation until 2020 and for the future”:

**APPENDIX 5. PLAN OF PRIORITY MEASURES FOR IMPLEMENTATION OF THE PROGRAM**

*This plan determines in general what ministries and agencies shall develop concrete plans of actions in order to begin implementing the Program, what resolutions, orders, regulations shall be prepared by these agencies in the time period 2012-2014.*