JABEX 日本バイオ産業人会議 Japan Association of Bioindustries Executives

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Digest version

Bioeconomy Vision of Japan for 2030

Bioindustry's Social Contribution to Enhance Adaptation to Changing World

- Creation of new key industry and provide solutions on global issues-

April, 2016

Japan Association of Bioindustries Executives

Recent progress of genome editing and synthetic biology is so remarkable and expected to impact relevant industries with incomparable rate. At the same time, biotechnology is expected to contribute to social issues of population, food and water supply, climate change, environmental problems or pandemics expected in our society. In Europe or USA, biotechnology to contribute to society is viewed as "Bioeconomy" activity and policies are made, discussed and taken in to actions. In this report, we would like to forecast 2030's industrial vision of biotechnology originating Japan contributing global issues with development of our economy. We would like to propose this as the national vision and strategy in relation to government, academia and industry's respective measures and cooperation.

Back Ground

Global level issues, National policies

Global issue and international agreement

Global level problem ; 2050 ; 10 bil. Food water shortage

COP21 - CMP11
PARIS 2015

International Agreements

SUSTAINABLE DEVELOPMENT GOALS

"2030 Agenda" (SDGs)

Japan's target for 2030:
GHG emission reduction
-26.0% (vs 2013)

"Paris Agreement"

Biotech initiatives in respective nations

"The Bioeconomy to 2030" (2009, OECD) triggered emergence of "Bioeconomy" as national policies in Europe or US to enhance biotechnology for industrial promotion and problem solving.

USA: National Bioeconomy Blueprint (2012) ;
From White House including medical application
Federal Activities Report on the Bioeconomy (2016)
Utilize one billion dry ton of biomass

EU: Innovation for Sustainable Growth: A Bioeconomy for Europe (2012)
Invest €79 bil over 7 yrs.
Budget allocation at HORIZON2020

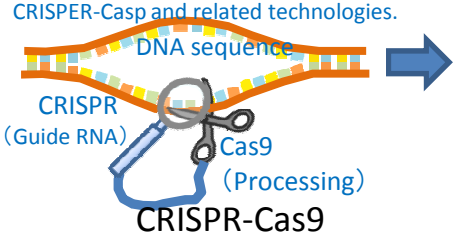
Germany: National Research Strategy Bioeconomy 2030 (2012)
Aiming to lead the world and conducted 1st Global Bioeconomy Summit (2015)
(German Bioeconomy Council)

GLOBAL BIOECONOMY SUMMIT 2015

Rapid technological advancement in biotech

Genome editing

Quantum leap development and IP on CRISPER-Casp and related technologies.



CRISPR-Cas9

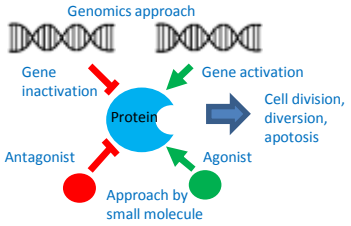
Genome selection

DNA sequence difference (SNP) can have strong correlation to certain gene function. Selection is enabled by using the SNP difference on certain unknown gene with next generation sequencer.
Economic animal or plant breeding is envisaged by Univ. of Tokyo, Livestock Improvement Assoc. and NARO.

Synthetic Biology

US/UK treat in national policy
UK: Created National strategy to 2030 Roadmap in 2012. Target area, technology element, industry and academia involvement are noted.
Most recent plan indicates 2016 to be the year to industrialize the technology.

Chemical Biology



Japan's situation forecast for 2030

Health /Medical

Latter stage elderly: 20 mil. Care cost: Y 20 tril.
Av. Age: 2 years longer, Health expectancy?
Drug/Med. Equip import exceed import?
National Health Service System collapse?

Manufacturing ▪ Environment/Energy

Employs novel tech. genome editing etc.
Switch from fossil to renewable resource
Stable access to biological resource
Contribution to 2030 Agenda
Accomplish "Paris agreement"

Agri・fishery foodstuff

Agri/fish industry worker below 65 yrs: 300 k.
Global worming become evident worldwide
Decline of agri/ fish productivity
FTA (EPA) activate, middle class affected
Gov. subsidy cont. Low food self-sufficiency

（Proposal）A long term vision be shared by industry, academia and government

Bioindustry's social contribution in 2030

40 trillion yen impact by industrial growth with global issue solution

Economical benefit: Market size: 40 tril yen, GDP: 20 tril yen, Employment 80 mil. jobs

Health・medicine

Better medicine・Healthcare

Domestic problem solving

Convert problems to opportunities
Ex: Aged society, Manufacturing, Agriculture

Manufacturing・Environment・Energy

Maximal sustainable manufacturing, energy and better environment

New key industry creation

Affects multiple area of industry with great speed and impact

Agriculture/Fishery・Foodstuff

Optimal efficient farming・health benefitting food

Provide global solution

Traditional biotechnology industry

Health・Medicine/ Manufacturing/ Agriculture・Fishery・Food

Genome editing, Synthetic biology, Big data

Life Science

Physiology・Brain Science
Bioinformatics
Omics (genomics)
Biology (animal, plant, micorbe)
Genetic resource

Biotechnology

Gene technology
Protein engineering
Bioprocess technology
Environment technology
Bio mimetics

Fusion with others

Nanotechnology (material・chemical engineering)
IOT
Robot（Machinery）
Technology
Outer space・Marine

Social Contribution Vision in 2030: Health & Medical

Key

Healthy longevity achievement by destructive innovation

・Together with latest biotech, fusion of ICT/IoT, nanotech, robot engineering create a main stream health industry to enable healthy longevity society inclusive of elderly and handicapped.
・Become a nation that can provide worldwide solution in health and medical field

Innovation promotion

・Destructive innovation created by original and versatile R&D carried out by industry, academia and government
Drugs (Innovative novel drug target, biomarker led drug discovery), Medical device (persuasion of Japan Biodesign), Novel therapeutic methods (regenerative medicine, gene therapy)
・Prevention/nursing care development/integration
ICT/IoT (Society5.0), Diagnosis technology, healthcare, nursing devices, functional foods, healthcare and nursing care services.

AMED
PMDA

Japan style innovation ecosystem

System development for industrialization of research outcomes
・Academia: MD initiated drug studies, TLO reformation, venture education support
・Industry: Link with academia or venture, B to B connections
・Private support organization: Education tool supply, mentor system, alliance with industry
・Public support organization: Mutual support collaboration, private capital development
・Government: Fund allocation or tax exemption to start ups
⇒Industry and ventures to promote innovation and new business

・Medical/Nursing care efficiency/productivity improvement（utilize IT/AI） ・Promote personalized prevention/treatment
・Verify health/sickness status by integrated medical information（Big data evaluation, omics analysis, diagnostic technology）
・Expedited recovery and elongated healthy life span to enable all people to participate in social activity

Possible problems in 2030

・Latter Stg elderly: 20 mil. Care cost: Y 20 tril.
・Av. life: 2 years longer, Health expectancy?
・Drug/Med. Equip import exceed export?
・National Health Service System collapse?

2030 Agenda Contribution

Health, medical strategic headquarters “peace and decision of the basic policy for health”（2015 Dec）

Universal Health Coverage promotion

Social Contribution Vision in 2030: Manufacturing, Environment, Energy

Key **Shift to sustainable manufacturing and new industry generation**

・Original and competitive biotechnology and bioproduct enables new industry emergence using sustainable source and innovative production method.
・Japan to play a major role in manufacturing, environment and energy segment (COP target achievement)

Innovation promotion

"Sustainable manufacturing" shift with "New industry generation" by cooperation of industry, academia and government
【Important Technology】Share a long term national strategy and make progress
①Ecosystem improvement for the industry ②Originally developed methods ③Integration with manufacturing technology (such as smart cell industry)
※Genome editing, synthetic biology's industrial usage may have IP burdens
【Unique technology development】Crosslink traditional field and emerging area
①Microbe mining and selection ②Plant, insect application for innovative manufacturing (grafting, silkworm) ③Cascade biomass utilization ④Integration with nano technology (feedstock, energy, environment application)

Innovation support style

・Share and cooperate the vision by stakeholders
【Technology development program】
1. Create new genome technology
2. GHG reduction technology
3. Biomass conversion technology

【Ecosystem establishment】
Establish unique manufacturing system
【Genetic resource security】
Safe and sound use of imported gene resource

Possible problems in 2030

・Innovative technology development delay
・Shift of fossil to regenerative resource stagnate
・CBD to prohibit biomass stable access
⇒ Overseas products may have advantage?

2030 Agenda Contribution

From SDGs 2015

Japan's target for 2030:
GHG emission reduction
-26.0% (vs 2013)

Social Contribution Vision in 2030: Agriculture, Fishery, Foodstuff

Key **Industrial farm involvement and food export promotion**

- Industrial farm involvement to create series of new business and employment
- Agricultural reformation contributes to working population decrease, global warming and food supply
- Branded foodstuff export increase with international recognition of taste and soundness

Innovation promotion

With the aid of government action, develop new key industry in the area of agriculture and fishery and promote foodstuff export

【Technology development to increase competitiveness】

Point of focus ①Overcome the workforce decrease and global warming ②Yield and quality improvement ③Brand establishment by health function, quality and traceability ④Align with IOT

Development items ①Agriculture: New breeding technology and cultivation methodology ②Forestry: Handling technology and new biomass production ③Fishery: Fish farm expansion by fish variety, productivity and quantity

【Technology element for brand value increase】

Element: Safety and soundness assurance, taste profile evaluation, processing and shipment technology

Innovation support style

【Ecosystem establishment for industry farm involvement 】

Establish systems in agriculture, forestry, fishery area and develop regional foodstuff with traditional technology improvement

【Communication promotion】

Science communication of biotechnology application in agriculture, forestry, fishery and foodstuff

(Only biotechnology can solve food needs)

Possible problems in 2030

- Workforce below 65 yrs: 300 thousand
- Global worming become evident worldwide
- Decline of agri/ fish productivity
- FTA（EPA） activate, middle class affected
- Gov. subsidy cont. Low food self-sufficiency

Regional revitali-zation

TPP

2030 Agenda Contribution

From SDGs 2015

Provide solution for food demand

Key Technology Development for Bioindustry Promotion

Key **Needs industry, academia government collaboration**

Science and Technology Basic Plan, Total Strategy for Science Technology and Innovation

Health・Medical Strategy

Aggressive actions in agriculture, forestry, fishery

Action towards key technology

Key technology needs to have nationalistic strategy

Common technology to catch up — Collective action to pursue

Genome editing・synthetic biology — **Society 5.0 (super smart society)**

【Industry, academia, government collaboration】
1) Global technology trend grasp and share
2) Impact evaluation on society and industry
3) Action plans for respective organizations

Key technology in respective field

Health・medical strategy
Genome, IT application, personalized treatment, regenerative medicine, device

Manufacturing strategy
Breeding, selection, modification for variety of production (smart cells, plants, insects)

Agri/forest/fish foods strategy
New breed production, health benefit, processing, preservation, taste, safety technologies

Technological area expected to link and develop with biotechnology

Genome editing・synthetic biology
Rapid progress with monopoly cause big impact to entire biotechnology

Big data・IOT: System establishment needed
Health data, genome fof all source, IOT infrastructure

Biology・Biomass utilization
Differentiation induction: Regeneration・plant multiplication
Microbiome: Drug・food
Brain science: Link with robot, medicine, manuifacturing
Plant technology: Biomass, agriculture

Chemical, material, analytical science
Chemical biology: Regeneration・plant differentiation
Integrated information of organic material research: Manufacturing
New principle・Accurate analysis: All bio field

Robotics・control engineering
Bio⇒Robot: Sensor, actuator technology
Robot⇒Bio: Heavy workload reduction, nano machine

Omics
Medical: Epidemiological genetic analysis
Manufacturing: Resource value and productivity increase

Nanotechnology
Molecular imaging: Diagnosis, analysis
DDS: Medical, Soil control
3D Cell structuring: Medical, manufacturing
Nano device, nano machine: Medical

Outer space・deep sea
Foodstuff, oxygen supplying plant

Posthuman (h+)
Need to discuss its objective of being in several level

Actions Needed for Bioindustry Promotion

Common understanding of the vision and ecosystem installment

Key National Vision Sharing on Biotech

・Innovation by biotechnology to generate new business and provide global scale solution. Such vision to be made and shared among stakeholders

【The vision characteristics】

・Long term (aim 2030) to have social contribution
(Applicable area is broad hence divide in to 3 sections
1. Health/Medical, 2. Manufacturing, environment or energy with biotech 3. Agriculture, forestry, fishery and foodstuff.

・Actions, roles to be specified to achieve the vision
(Below to specify the roles of industry, academia, government)
1. Action towards key technology, 2. Innovation ecosystem establishment, 3. Action towards international trend, 4. Human resourcing and scientific communication

※Several industrialized nations have their national bioeconomy, biotechnology initiatives and perusing.

Key Innovation ecosystem establishment

・Ecosystem of innovation by industry, academia and government

【Government role】
・ Key industry technology development・Legislation reform
・Encourage ecosystem to function
【Regional governing body's role】
・Regional cluster formation and support
【R&D Corporation・Administrative Institution・Public Labs role】
・Provide support to bioventure or industry research with other organization
【Academia role】
Link research at project start and completion to industry. Educate and provide human resource
【Industry role】
・Fortify mid-long term R&D
【Financial institution, investor role】
・Active investment to bioventures

Timely action for international trend change

≪Trend grasp and opinion dispatch≫①International agreement/standardization on biodiversity and bioeconomy ②Retain fair environment in R&D and business conduct by grasping technological trends in genome editing and synthetic biology.
≪International pledge and new market≫Participate in 2030 and contribute to reduce GHG and partnering with Asian nations

Human resource and communication promotion

≪Human resource≫Generate talents with future views
①Multiple interest such as biotech and information
②Entrepreneurship, willing to take risk
③Expand the width of biobusiness
≪Communication≫Justify the role of biotechnology in the society for overcoming of global issues and promotion of industry by appropriate communication conduct to media and public