Thailand:
Research and Innovation of Biotechnology to Develop Thailand's Bio-Economy

Wonnop Visessanguan, Ph.D.
Executive Director
National Center of Genetic Engineering and Biotechnology (BIOTEC)

Talking points

01 Policy driven:
BCG platform and research capability

- Refocus on Focus areas in Agriculture, Food, Biorefinery, Wellness and Health
- Being more digitalized and smarter

02 Key infrastructures and facilities for BCG platform

03 Human resource development platform for EECi-Biopolis and new model on collaboration

Biodiversity & Biotechnology as drivers for BCG economy

BCG MODEL: Aim for Distributive Economic Prosperity

Food & Agriculture | Medical & Wellness | Energy & Biochemical materials | Tourism & Creative Economy

Biodiversity → **Cultural Diversity**

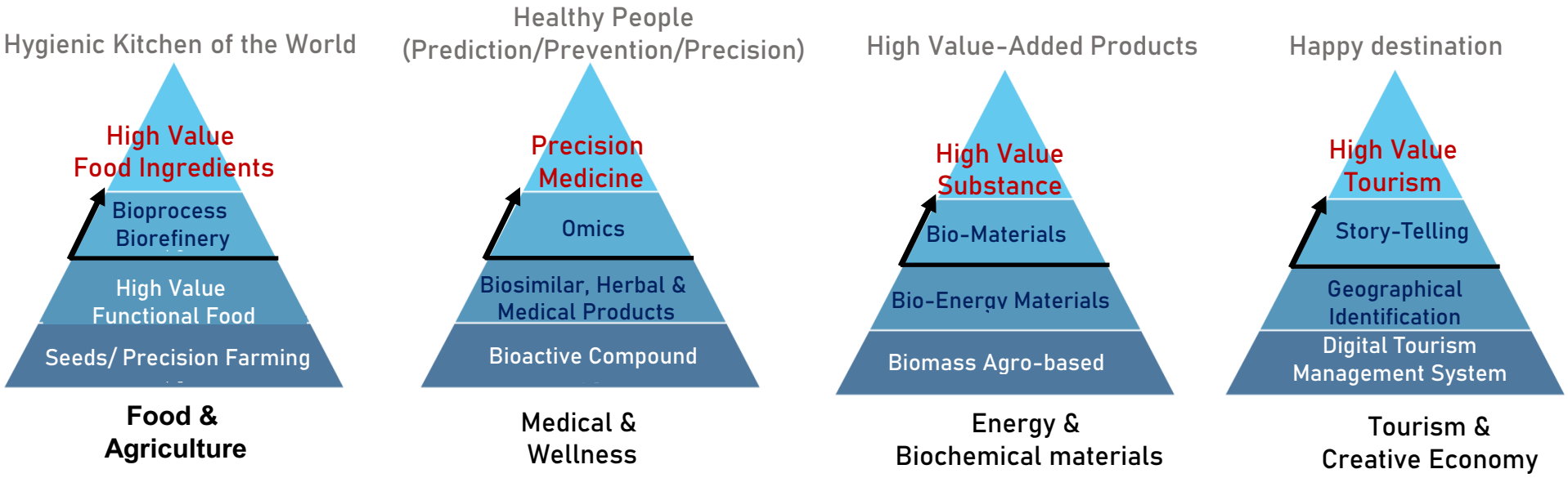
3.4 Trillion Baht (21% GDP) 16.5 Million Employment

5 Years

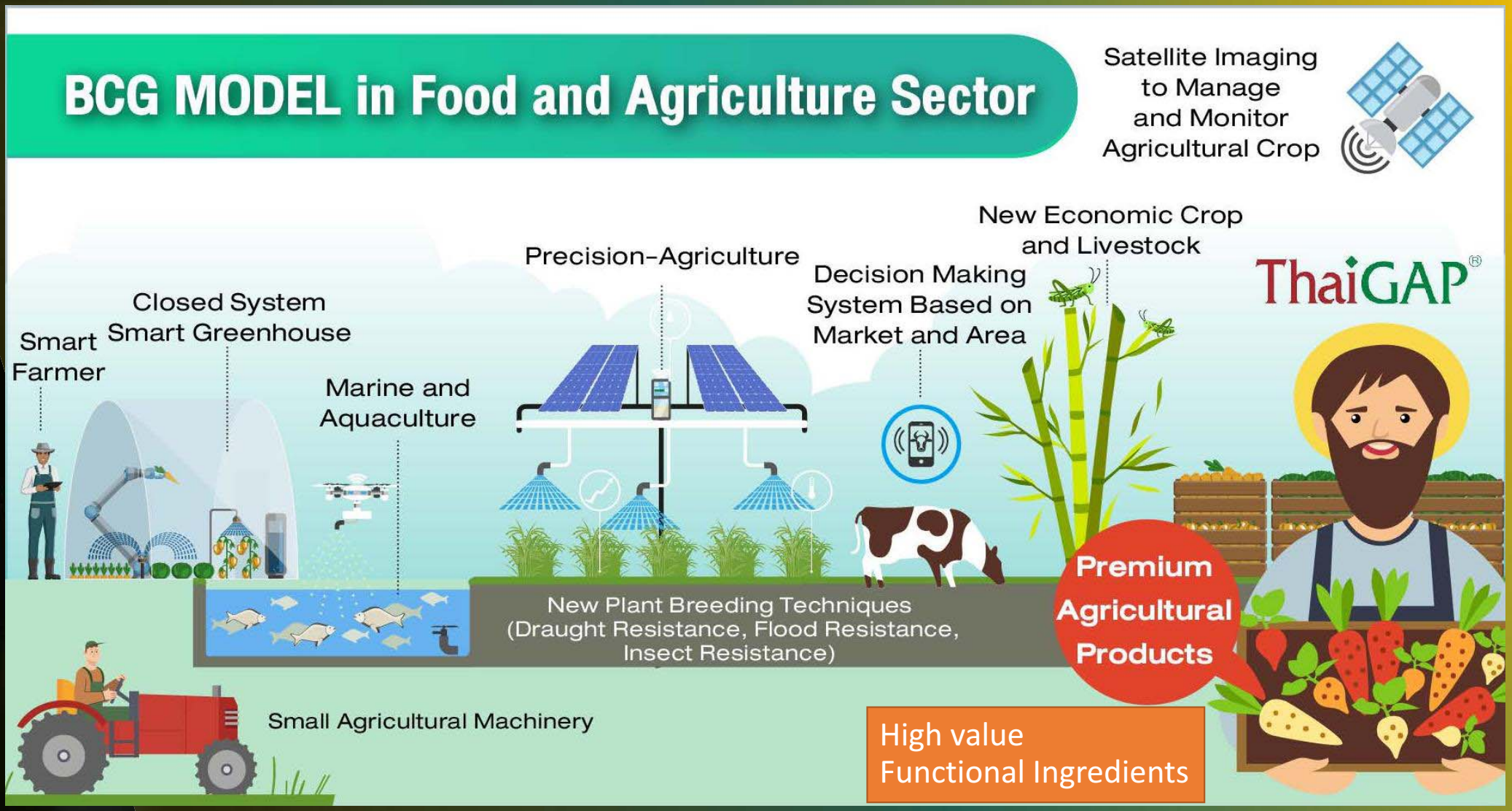
4.4 Trillion Baht (24% GDP) 20 Million Employment

INNOVATION

PRODUCTIVITY

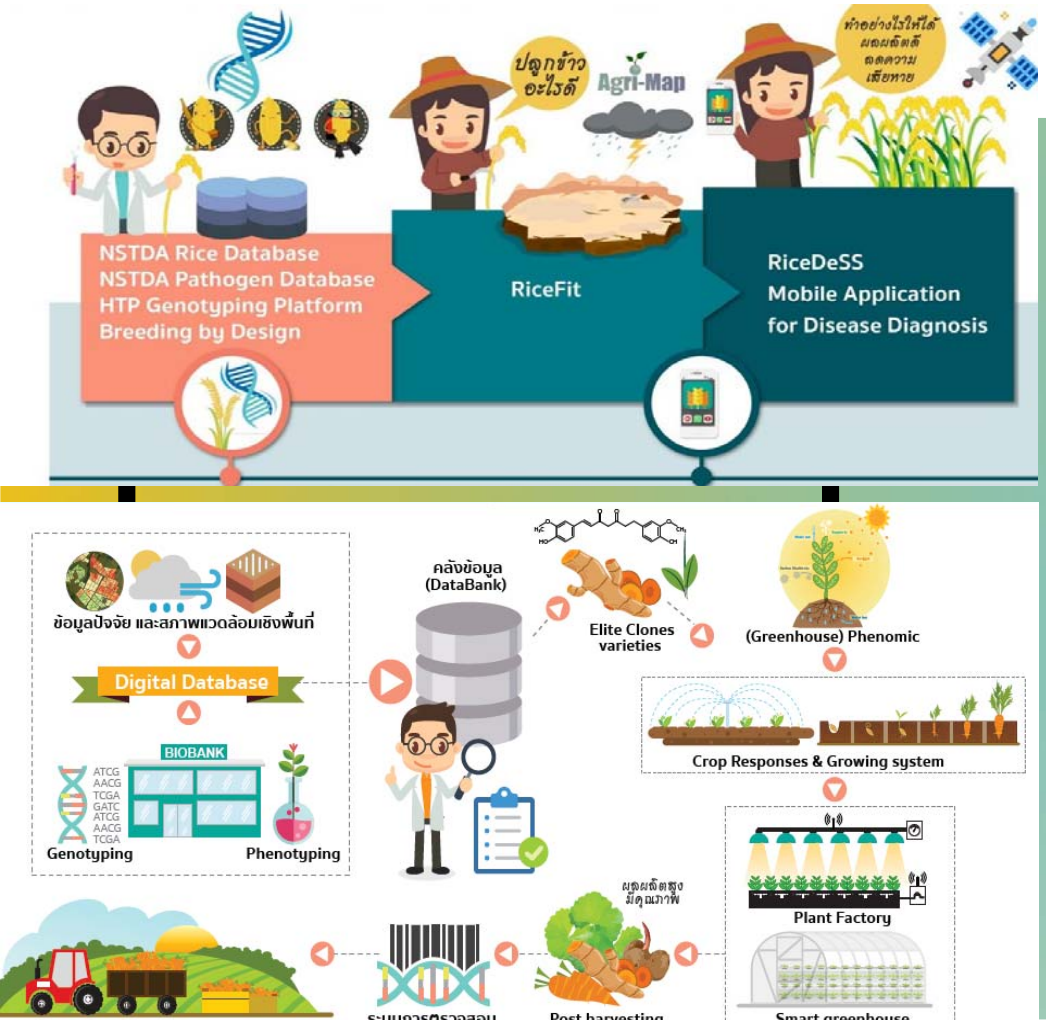


BCG Digital Platform



Source: Ministry of Higher Education, Science, Research and Innovation

Innovative and Smart Agriculture



Plants

(Rice, Medicinal Plants, Seeds, Ornamental Plants)
Genomic Innovation
Breeding by design
Modern cultivation management

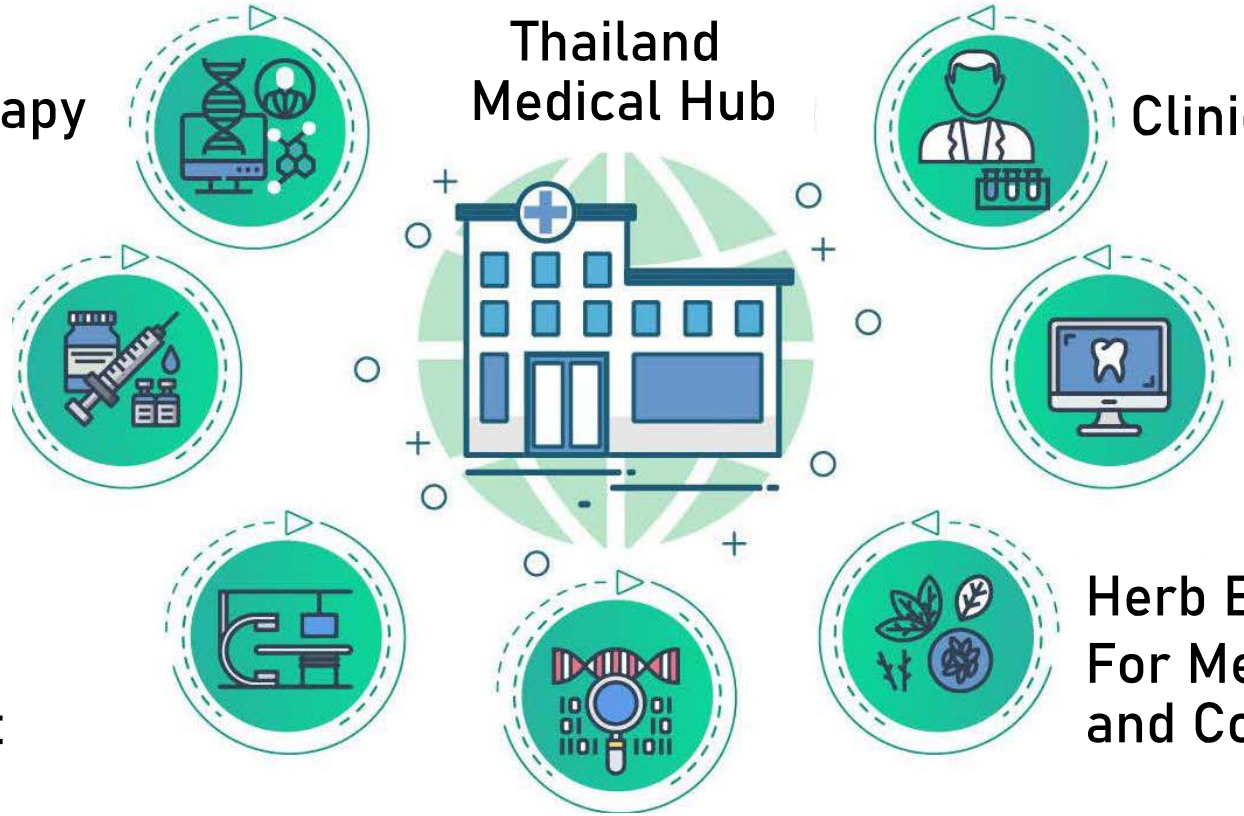
Animal

(Porcine, Bovine, Poultry)
Production and modern farm management

Aquaculture

(Shrimp, Fish)
Genetic selection of aquatic species
Culture of aquatic species
Sustainable culture system management

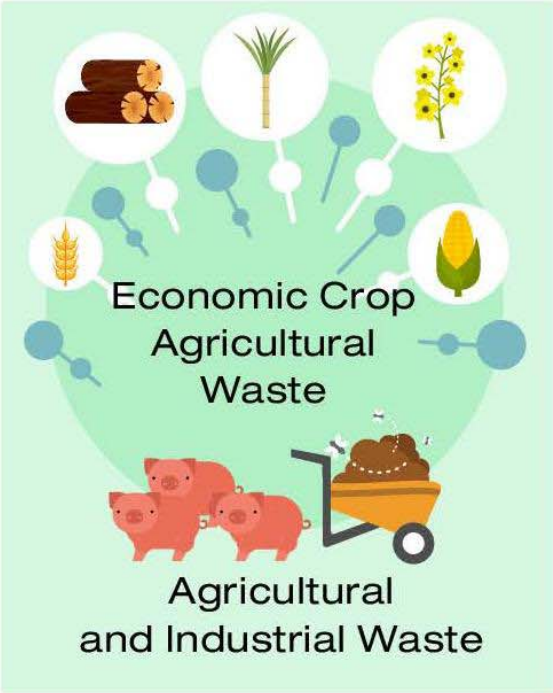
BCG MODEL in Medical and Wellness Sector



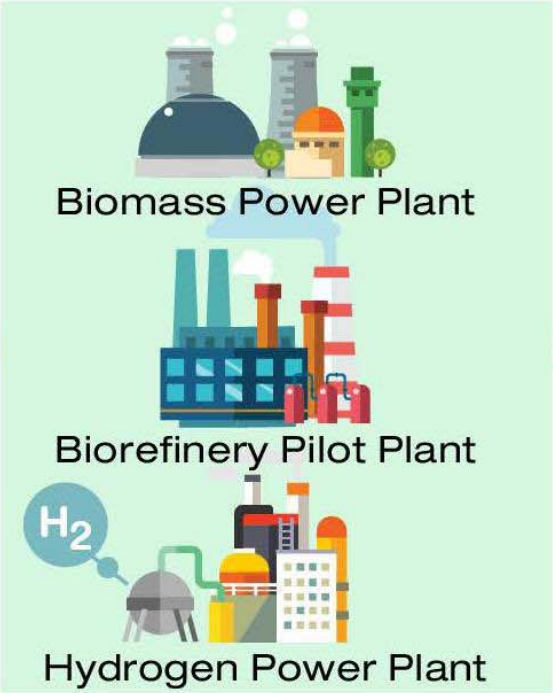
Source: Ministry of Higher Education, Science, Research and Innovation

BCG MODEL in Energy, Material and Biochemical Sector

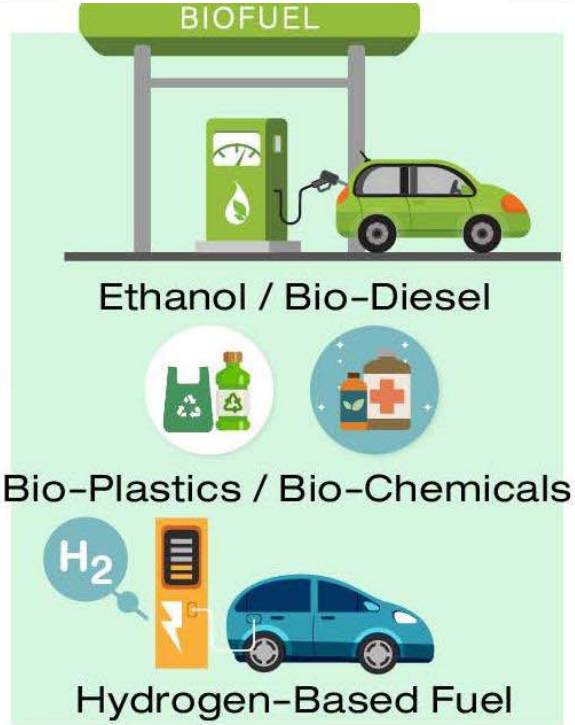
Agricultural Product and Waste



Investment Promotion



Industrial Development



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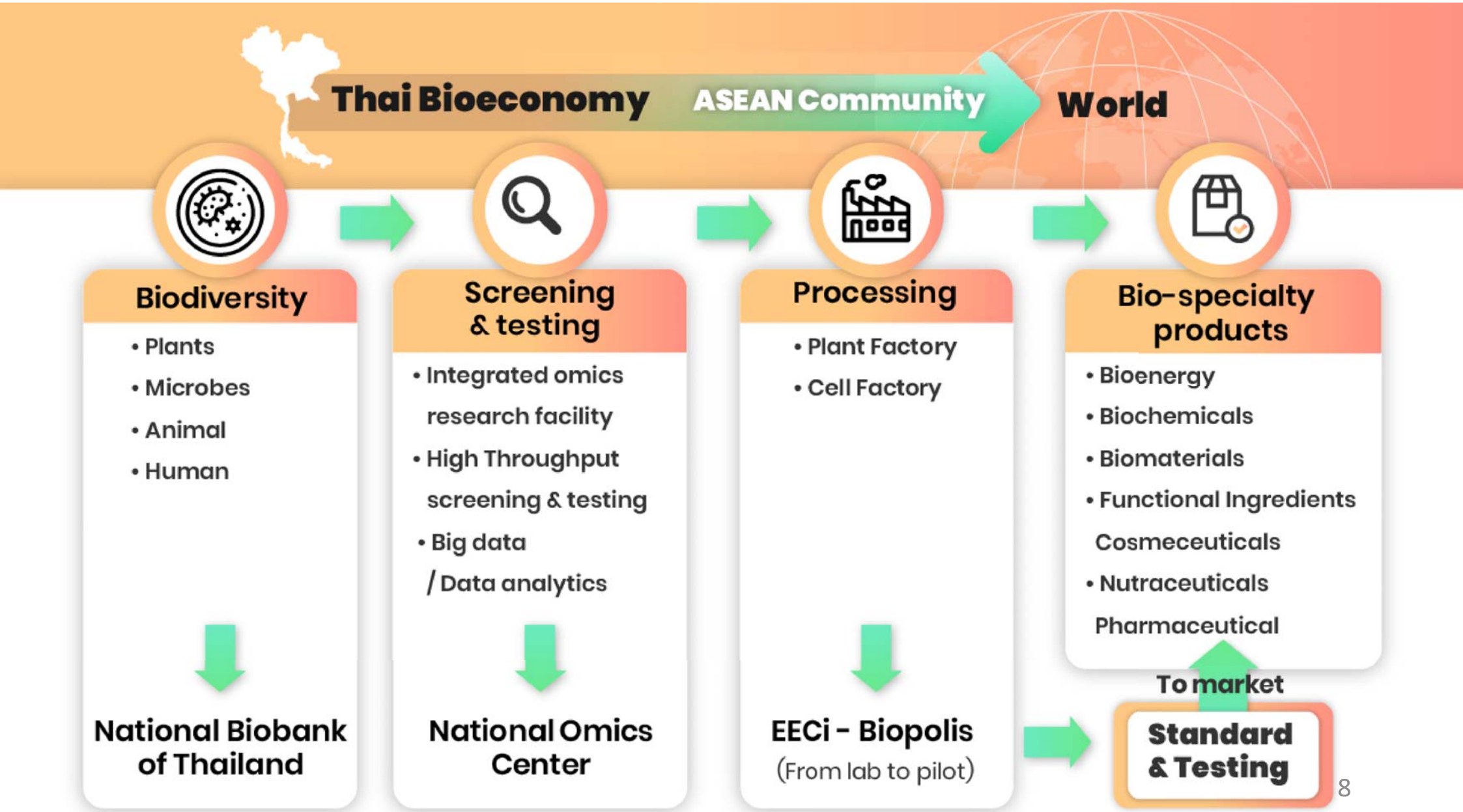
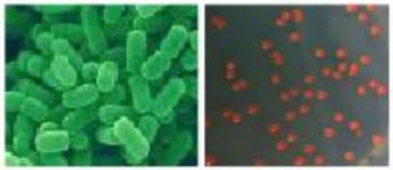

Thai Bioeconomy
ASEAN Community
World
Biodiversity
• Plants
• Microbes
• Animal
• Human
National Biobank of Thailand
Screening & testing
• Integrated omics research facility
• High Throughput screening & testing
• Big data / Data analytics
National Omics Center
Processing
• Plant Factory
• Cell Factory
EECi - Biopolis
(From lab to pilot)
Bio-specialty products
• Bioenergy
• Biochemicals
• Biomaterials
• Functional Ingredients Cosmeceuticals
• Nutraceuticals Pharmaceutical
To market
Standard & Testing

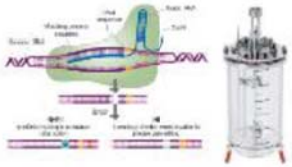
Biodiversity and Biotechnological Resource Research

Technology Platform

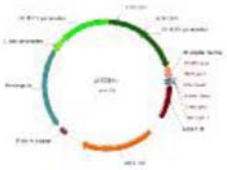
Host cell improvement



Bioprocessing Technology



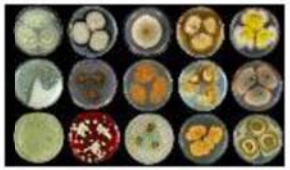
Expression system



Microbial bioinformatics

Biodiversity research

Novel species



Microbial diversity

Ecology

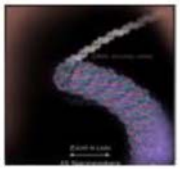
Microbial utilization

Bioscience and Biotechnology Infrastructure

National Biobank of Thailand

BIOTEC Bangkok Herbarium

National Omics Center



Access and Benefit Sharing (ABS)

Convention on Biological Diversity

NSTDA Biochemicals Roadmap

Renewable feedstock	Converter	Process	Products	2B target process & products
Sugar Molasses Cassava starch Palm oil	Non-GMO Microbes: Fungi/Yeast/ Bacteria	Fermentation • Aerobic/Anaerobic • SmF/SSF	Bio-specialties High Bio-pharma Specialty chemicals Enzymes Functional additives Value Commodity chemicals Liquid biofuels Energy Low Conventional biorefinery	Specialty chem Enzymes Cell platform Agrobiochemicals HMF/FDCA Activated C Lignin-based C Bioethanol Biogas
Lignocellulosic	Recombinant & Cell factory	Enzymatic conversion CBP biocatalyst		
Wastes: Organics MSW Industrial	Chemo-Catalysts	Anaerobic digestion Organic synthesis Chemical process Thermocatalysis Thermal processing Supercritical process		

Healthcare and pharma

Food & Feed

Agriculture

Green industrial process

Renewable Energy & Chemical industry

Biodiversity→ Discovery → Conservation →Sustainable utilization

Biodiversity Research

Novel Species

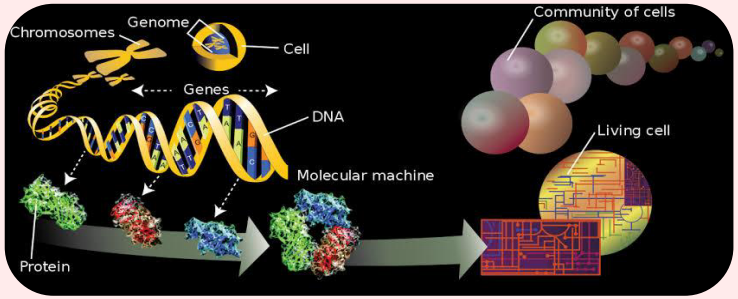
Taxonomy

Microbial Diversity

Ecology

National S&T Infrastructure

National Omics Center



National Biobank of Thailand

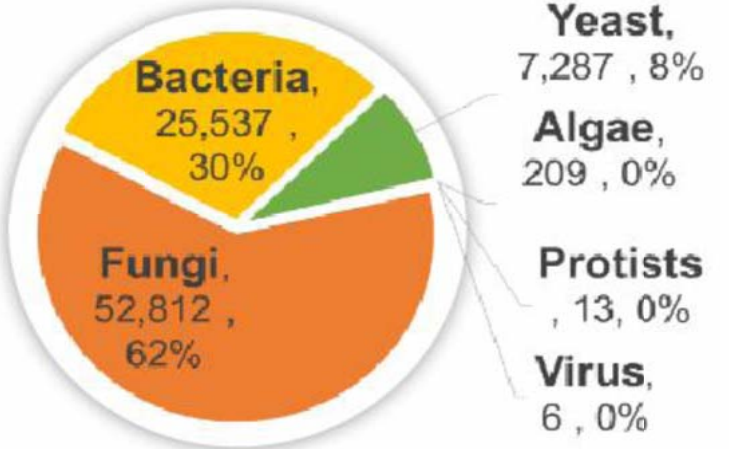
Thailand Bioresource Research Center (TBRC)

https://www.tbrcnetwork.org/

collection

85,864

Microbial strains
(bacteria/ fungi/ yeasts/ protists/ algae/ virus)



National Biobank of Thailand

NBT FOR LONG-TERM CONSERVATION AND UTILIZATION OF THAI BIORESOURCES

GENOMICS THAILAND
2,300 SAMPLES
HUMAN GENOME
Precision medicine

- PLANT
- MICROBE
- ECOLOGY
- HUMAN GENOME

DIGITAL BANK

SEED BANK
430 SAMPLES
- CROP VARIETIES
- HERBS
- WILD CROP SPECIES
- INDIGINOUS SPECIES

NBI
National Biobank of Thailand

BASIC SCREENING FOR INDUSTRIAL APPLICATIONS
- ENZYME
- FATTY ACIDS

2,300 SAMPLES
MICROBE BANK

TISSUE BANK
160 SAMPLES • HERBS

200 PLANT SAMPLES
GENOMIC DNA BANK
9,000 MICROBE SAMPLES

HERBARIUM
150 SAMPLES
FUNGARIUM
2,400 SAMPLES

ISO/TC 276 Biotechnology
BIOBANKING STANDARDS

ONLINE DATABASE
ANALYTIC PLATFORM

CORE TECHNOLOGY	• CRYOPRESERVATION (SEED/ TISSUE) • ADVANCED TAXONOMY (MALDI-TOF MS) • ECOLOGICAL MODELLING • BIOINFORMATICS AND DATA SCIENCE
DATA TECHNOLOGY	• GENOTYPE/ PHENOTYPE ANALYSIS • POPULATION ANALYSIS • METAGENOMICS OF MICROBIOME
INFRA-STRUCTURE	• HPC; HIGH PERFORMANCE COMPUTING • AUTOMATED SAMPLE STORAGE -20C/ -80C • BIOTYPER/ MALDI-TOF MS • SEED GERMINATION SCANALYZER

PLATFORMS

THAI BIORESOURCES CATALOGUE

ECOSYSTEMS

PRECISION MEDICINE IN THAILAND

BCG MODEL

Bioeconomy Circular economy Green economy

- FOOD AND AGRICULTURE
- ENERGY AND MATERIAL
- TOURISM
- HEALTH & MEDICAL

Enzymes : High-throughput (HTP) enzyme screening platform

TBRC/Biobank

Crude extract library

>80,000 strains
1st in ASEAN
6th in world

HTP screening for target products

10^4–10^5 samples/month*

Conventional: 10^2 samples/month

Directed evolution

Rational design

Genome & Enzyme engineering

HTP Formulation

Bioprocess development

HTP micro-scale bioprocess optimization

BioLector II

Bioprocessing facility (Module VI)

Pre-pilot bioprocess

- SmF 300 L
- SSF 500 kg

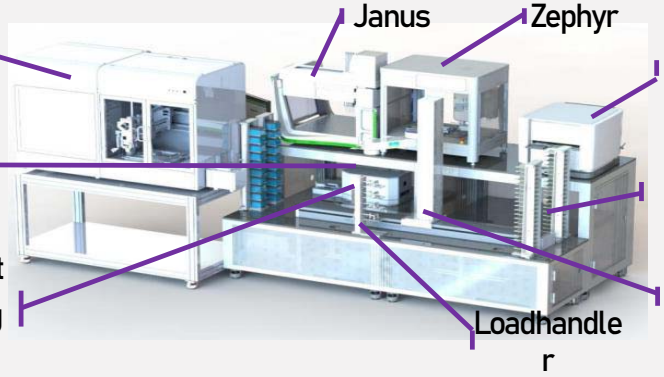
+ Downstream processing units GMM/non-GMM

Up-scaling

EECi Biopolis

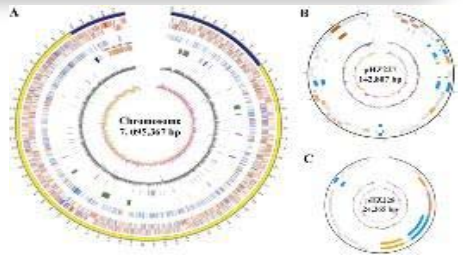
High-throughput screening platform

The 1st Microbial Product Screening Platform in Thailand

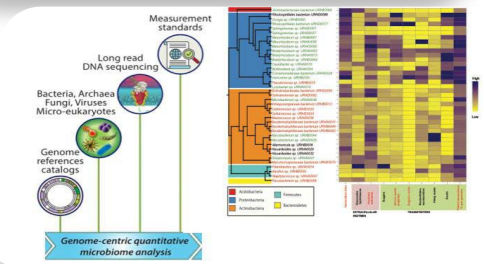


Technology Platform

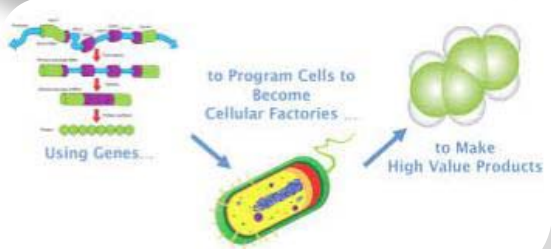
Expressing System



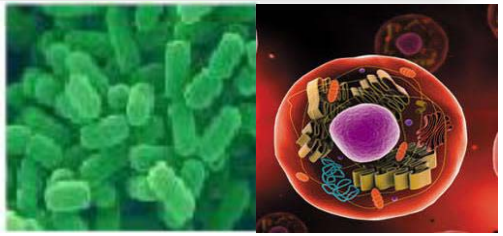
Microbial Bioinformatics



Synthetic Biology



Host Cell Improvement



Bioprocess Technology

Infrastructures for EECi BIOPOLIS

Phenomics Greenhouse

To do research on phenomics for trait improvement

Plant Factory

Closed system, Controlled environment for high-value plant production

Biorefinery Pilot Plant

GMP facility for scale-up production of functional ingredients, an application testbed for nutraceutical, cosmeceutical and pharmaceutical industries

Non-GMP facility for pilot production for market testing ex. pretreatment, fermentation, extraction, downstream process.

HRD Platform in Biotechnology for Bioeconomy

National programs

- University joint research program: Agriculture/ Food / Biorefinery /Bioenergy
- University consortium program: Bioprocess & Chemical engineering
- Post Undergraduate Intensive Training Program: Engineering (in collaboration with private sectors)

International programs

- Visiting professor program: Synthetic biology/ Bioinformatics/ Bioprocess engineering
- Top Notch Researcher program: Bioprocess engineering
- HRD Program for Neighboring Countries [Operated since 2001, targeting at ASEAN + Nepal + Bhutan + Pacific Islands}

KINGEN BIOTECH

To be ASEAN's No.1 R&D-based biotechnology company with manufacturing capabilities

Kingen Holdings Stakeholders

Genexine

Innovative immunotherapeutic and next generation novel long-acting biologics

NBF NATIONAL BIOPHARMACEUTICAL FACILITY

Thailand's #1 cGMP capacity and CMC expertise

BGIC BIO GENETECH INTERNATIONAL CO., LTD.

Business expertise in South East Asia and execution capacity

Source: http://www.nbf.kmutt.ac.th/

Conclusions

01 Thailand has already been prepared for new economy.

02 BCG model is now fully activated and put in action by Thai government and key stakeholders to shape up a country after disruption by COVID-19.

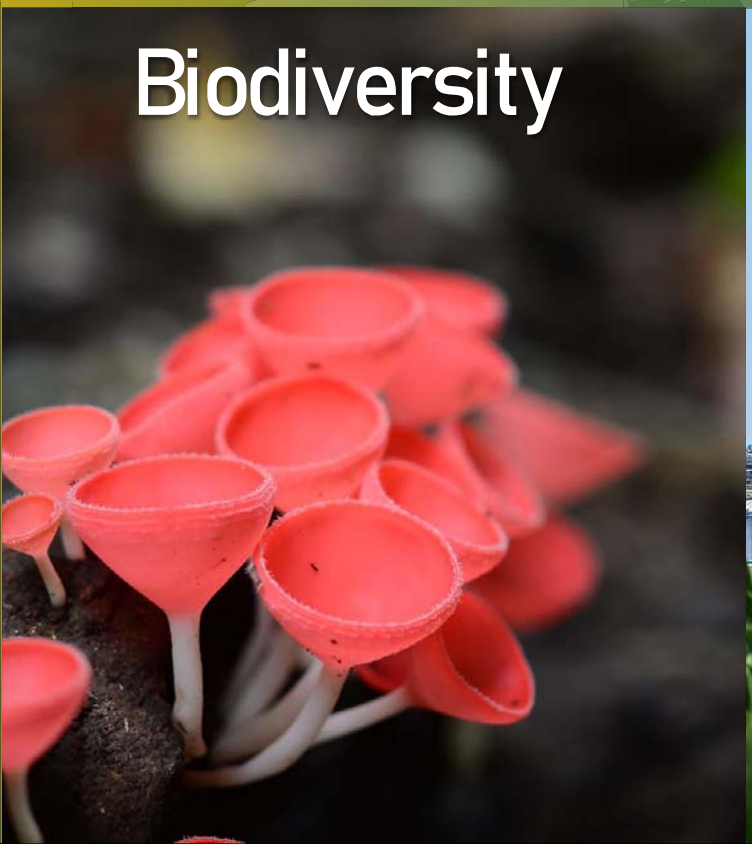
03 International partners and global network are considered as key enablers.

04 With more experiences on new mechanisms and business models, we will move forward at higher speed.

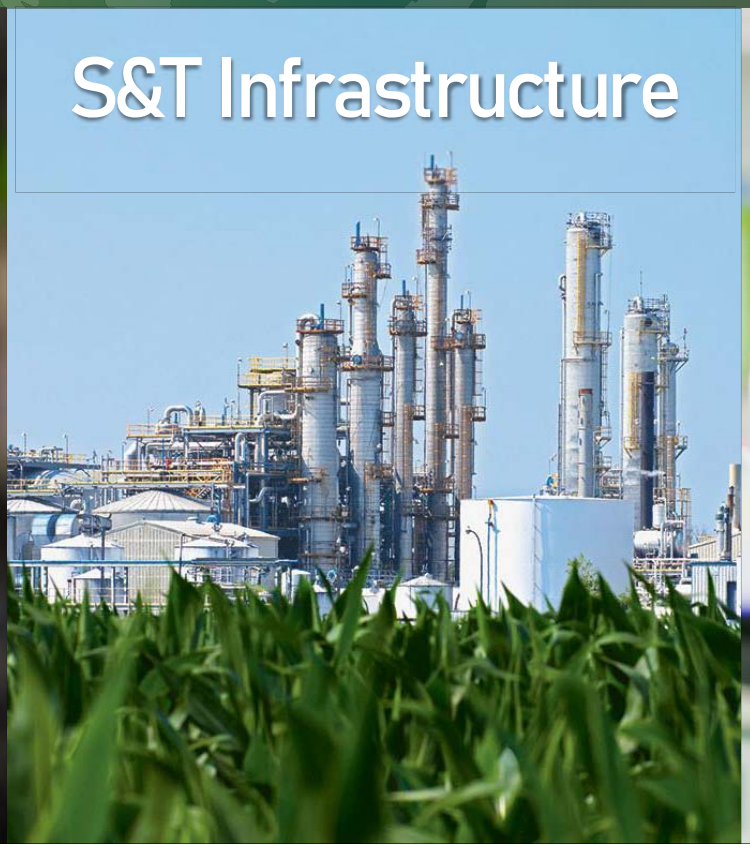
THAILAND

Southeast Asia's prime destination for biotechnology development

Biodiversity



S&T Infrastructure



Human Capital