

Boron Neutron Capture Therapy



biofi

anotechnology



Ibaraki Prefectural Government



City of Tsukuba



University of Tsukuba

# **Tsukuba** International Strategic Zone

Promoting life and green innovation by utilizing scientific technologies clustered in Tsukuba

promising

# Tsukuba International Strategic Zone

A center where industry, government and academia collaborate to deliver innovations by using scientific technologies clustered in Tsukuba and to turn the resultant new business and industries into international standards and models that drive the economic growth of Japan and help mitigate global issues

# Initiatives in Tsukuba International Strategic Zone

# 1. Objectives

A new industry-government-academia collaboration system is to be constructed to change Tsukuba by effectively using the preferential legal and tax measures that are available in the zone. The aim is to attain tangible results in five years from the four pioneering projects in order to contribute to the growth and development of Japan in the fields of life and green innovation.

## 2. Construction of a new industry-government-academia collaboration system to change Tsukuba

Establishing an organization for promoting global innovation in Tsukuba to serve as a core of the collaboration system Creating systems for enabling researchers to use leading-edge research facilities of other organizations, producing tangible results, publicizing study resources, and supporting projects on a common platform Creating at least 5 new projects in 5 years

# 3. Four pioneering projects

Development and implementation of next-generation cancer treatment, BNCT Project

Project 2 Living with Personal Care Robots

- Project 3 Practical use of algal biomass energy
- Project 4 Creating a global hub of nanotechnology, TIA-nano

# Area of Strategic Zone

Tokyo 🛶 Tsukuba

Japan

Areas of Strategic Zone

#### Tsukuba-no-sato Industrial Park in Ryugasaki City

- Tokai-mura Hospital, Japan Atomic Energy Agency and Ibaraki Neutron Medical Research Center in Tokai-mura, Naka-gun
- Ibaraki Prefectural University of Health Sciences and its University Hospital in Ami-machi, Inashiki-gun
- \*The area will be flexibly revised based on the progress of projects.

#### Excellent location for global business

As an R&D site with a world-class location, Tsukuba City has many similarities to Silicon Valley in the US, and is ideal for the headquarters of global companies in Asia.

- To central Tokyo by Tsukuba Express Line (45 min) • To Narita International Airport by car (when the Ken-O Expressway opens, 50 min)
- To Ibaraki Airport by car (45 min)

• Entire Tsukuba City (all area)

- Various means of access including Ibaraki Port (Oarai, Hitachinaka and Hitachi ports),
- the Joban Expressway, and the Kita-Kanto Expressway, which are logistics arteries of east Kanto.

# Tsukuba, an International City

Tsukuba has not only produced Nobel laureates, but is also a magnet for research organizations and is now one of the world's foremost science and technology cities. With its many world-class research facilities, Tsukuba is home to a multitude of researchers, students, and residents from foreign countries. As of November 1, 2012, there were 7,167 people from 125 countries living in the city. Tsukuba is creating various programs in response to its international character:

- International exchange fairs
- Classes for international understanding
- Social cooking classes
- Volunteer interpreters
- Foreign language classes

Tsukuba is home to 32 research institutes, of which one-third are national organizations, and more than 20,000 public and private researchers. World-class research facilities include Japan's biggest Super Clean Room for research (Advanced Industrial Science and Technology) and the B-Factory Accelerator (High Energy Accelerator Research Organization), forming the biggest R&D cluster in Japan. More than 200 venture companies have been spawned so far, and have produced inventions such as the tunneling magneto resistance element which is now used in 98% of hard disks (530 million units in 2008) in personal computers and the world's first cyborg-type robot, "Robot Suit HAL®".

# Comfortable living environment for business

A good living environment is essential to succeed in business. Tsukuba City offers excellent facilities for raising children, including top-class education in Japan. Other comprehensive facilities include medical clinics for peace of mind, good public cultural and education facilities, as well as parks and sports facilities. The city is also famous for its fresh agricultural products grown in nature.

#### Housing for Foreign Researchers

Hitachi Port area

Hitachinaka Port area

Tokai-mura

Oarai Port area

achi ICI

Ami-mach

Ryugasaki City

Tsukuba Science City has housing for foreign researchers working at research institutes and universities, and their families. Such facilities also provide support for general daily life in Tsukuba, such as assistance with joining a school, advice on shopping, etc., and Japanese language classes and cultural exchange events.



iva House - International Residence for Research

#### **Tsukuba Science Tours**

Through the Tsukuba Science Tours, visitors can see the latest science and technology at public research institutes in Tsukuba Science City. For those interested in visiting research institutes, the Tsukuba Science Tour Office provides information on where to visit and can suggest tour routes. Many people join a Tsukuba Science Tour, whether for sightseeing, school trip, or just something to do after a convention.

Tsukuba Science Tour Office (The Science and Technology Promotion Foundation of Ibaraki ww.i-step.org/tou

#### Tsukuba International School

Tsukuba International Schoo is an IB World School in Tsukuba established in 1992 tis.ac.it







Park

#### Tsukuba International Congress Center

Tsukuba International Congress Center (TICC) was built to encourage research exchanges, revitalize the regional economy, and hold conventions. Some 2.8 million people have visited it since it opened in June

In addition to the large hall with capacity for 1,258 people, there are also two medium-sized halls and conference rooms that can handle meetings for up to 2,500 people using video-conferencing. The latest equipment includes a 400-inch Hi-Vision Projector, a six-language simultaneous interpretation system, and a satellite teleconferencing system.

Among all international convention facilities in Japan (excluding universities, etc.), TICC held the second-most international conventions (48) in 2008. (Statistics from Japan National Tourism Organization) www.epochal.or.in

# BNC Boron Neutron Capture Therapy

Boron Neutron Capture Therapy (BNCT) is an attractive, next-generation method for treating refractory cancer.

By utilizing reactions between boron atoms and neutrons, BNCT destroys cancer cells selectively. It is effective also against invisibly small cancer cells and tumors that are difficult to remove surgically.



#### Main institutes involved:

mization, Japan Atomic Energy Agency, Hokkaido University, University of Tsukuba, High Energy Accelerator Research Or Japan Chemical Analysis Center, related enterprises, Prefectural Government of Ibaraki

# Development and implementation of next-generation cancer treatment, **BNCT**

The University of Tsukuba has conducted clinical studies on BNCT since the 1980s using nuclear reactors. Comprehensive researches have also been carried out to develop accelerator-based therapeutic devices that can be installed in hospitals, including peripheral equipment and control systems.

## Studies

- Development of reasonably-priced therapeutic devices that can be installed in hospitals (2010–)
- Construction of Ibaraki Neutron Medical Reserach Center as a center for joint studies (2011–2012)
- Animal experiments (2013)
- Clinical studies (2014–)
- Obtaining accrediataion for advanced medical care (2015)

# **Principles of BNCT**





ntaining drug that accumulate only in cancer cells is administered

# Schematic diagram of a therapeutic device

Accelerated proton beams from the linear accelerator react with beryllium in the neutron generator and emit ne The low-energy neutrons are irradiated at the malignation



Linear accelerator







Before BNCT Cancer grew aggressively, rupturing the skin and emerging outside

Project

Life Innovation



After BNCT The tumor disappeared almost entirely High quality of life (QOL) was achieved

boron atoms emits alpha particles and lithiun



Both alpha particles and lithium ion only as far as the diameter of one cell (10 µm) enabling cell-level therapy



# lerso aif RO The Personal Care Robot performs a variety of actions that contribute

to improve quality of life of its operator and surrounding people. Application fields include various daily, social and work related activities such as eating meals, cleaning, communication and locomotion.

©Prof. Sankai University of Tsukuba / CYBERDYNE Inc. Robot Suit HAL®

# Living with Personal Care Robots

We aim to launch certification scheme promptly by establishing safety verification system of personal care robots, to accelerate empirical studies of them, and thus to enhance international competitiveness of robot industry in Japan. We believe that those attempts lead to create society where young and elderly people live actively.

### Milestones

- Empirical studies of personal care robots (2009–)
- Turning safety standards into international standards (2013)
- Operation of test facilities related to safety certification of robots (2014-)
- Full-scale market introduction (2015)

# Establishment of safety verification systems for personal care robots





The Robot Safety Center is currently developing international safety standards and methods for testing and assessing the afety of robots in order to ascertain the safety

In an anechoic chamber sealed off from radio waves, strong radio waves are irradiated to robots to observe changes in their movements, and electromagnetic noise emitted from robots i

# Empirical studies of personal care robots





Empirical studies on caregiver burden reduction and user

Empirical studies on functional training effects and user safety. Empirical studies on mobility assistance and user safety





Durability tests are conducted to check the durability of physical assistant robots

# Algalo o Biomass

# The most promising feedstocks for biofuels

Several species of algae can efficiently produce oil. For example, the potential hydrocarbon-oil production o microalga, Botryococcus braunii is estimated to be 118 t per 1 ha per year, which is much greater than 0.2 t for maize and 6.1 t for palm.

Aurantiochytrium has only one third of hydrocarbon content of Btryococcus braunii, but grows 36 times faster and thus produces 12 times more hydrocarbon than Botryococcus braunii. These biofuels will improve the low oil self-sufficiency of Japan and help mitigate global warming.

# Practical use of algal biomass energy

To enable algae fuel to replace fossil fuel, outdoor mass production of algae is being tested on abandoned farmland. The aim is to establish the technology by 2015, help resolve global energy issues, and boost the algae industry.

## Studies

- Preparing for demonstration experiments to establish technologies for outdoor mass production of algae (2012)
- Construction of an outdoor test plant (in 2012)
- Use of official vehicle of Tsukuba City fueled with algae-derived crude oil (2013–2015)
- Production of crude oil from algae in the test plant (2013–2015)

# Development of mass production technologies









institutes involved University of Tsukuba,

ted enterprises, Tsukuba City, ctural Government of Iba





yococcus (right)



# A-nano Tsukuba Innovation Arena for Nanotechnology

Nanotechnology is a common basic technology in the fields of manufacturing and medicine, medical care and life sciences. TIA-nano (Tsukuba Innovation Arena for Nanotechnology) is a global open innovation hub set up by integrally utilizing the world-class nanotechnology research resources that have been accumulated in the Tsukuba area. Led by the National Institute of Advanced Industrial Science and Technology (AIST), National Institute for Materials Science (NIMS), University of Tsukuba and High Energy Accelerator Research Organization (KEK) with a support of the Japan Business Federation (Keidanren) and related ministries and agencies, TIA-nano aims to enhance the competitiveness of Japanese industries and to create new industries for the next generation.



NanoGEEN/WPI-MANA Building, NIMS (completed in March 2012) hosts world-leading research on material science for energy and ent and of nanotechnology by scientists from univeres in and outside Japan as well as engineers from private

#### Main institutes involved:

National Institute of Advanced Industrial Science and Technology (AIST), National Institute for Materials Science (NIMS), University of Tsukuba and High Energy Accelerator Research Organization (KEK)

# Creating a global hub of nanotechnology

From "Tsukuba" towards future industries Project **4** An internationally competitive open innovation hub has been created in Tsukuba taking advantage of the state-of-the-art research resources on nanotechnology that had been accumulated there. By integrally propelling collaborative research and development among industry, academia, and government, and human resources development, TIA-nano aims creation of new industries and regeneration of Japanese industries.

#### Activities

- Nanotechnology research with commercial goals (A number of research-projects; development of advanced power electronics etc., 2000-)
- Establishment of methods for assessing the safety of nanomaterials, information collection and distribution (2000-)
- R&D by open innovation models where multiple enterprises participate (a membership R&D organization "TIA Nano-Green" and an industry-funding-based open innovation consortia "TPEC" founded in 2012.)
- Installation of facilities and equipment for nanotechnology research for shared use and promotion of their use (2000-)
- Cultivation of next-generation leaders in nanotechnology fields (Foundation of the TIA Graduate School Consortium in 2011/education and training of young researchers in projects mentioned above, 2011-)

# Nanotechnology R&D for green innovation





From SiC (siliconcarbide) substrates to completed devices and systems, power devices (such as semiconductors for power developed to dramatically reduce power consumption. control) are being systematically developed and tested

LSI (large-scale integration) is being actively researched and

# World-leading infrastructures for advanced studies and joint use



Super Clean Room (SCR) with a spacious area of 4,500 m<sup>2</sup> in In April 2012, KEK joined TIA-nano as a core institute. The AIST Tsukuba West is equipped exclusively for producing and processing nanomaterials and has the state-of-the-art facilities light technologies for characterization and analysis of materi for characterization, enabling technological development which is difficult to achieve in the existing semiconductor





Green Innovatio

We have successfully developed technologies for mass-production of carbon nanotubes (CNT), which is a new material that will sustain green innovation. Further research on its application is now under way

light technologies for characterization and analysis of material

TIA Collaboration Center (tentative name), which is scheduled to be completed in March 2013, will be directly connected to SCR. It will serve as a center of research and educational activities for TIA-nano projects and human resources development, which will be conducted in cooperation with member companies

# National Support Systems



#### (1) Preferential legal measures

- Preferential legal measures are prescribed in advance concerning the relaxation of regulations on industrial land use (special measures of the Building Standards Act) and on green land areas in factory sites (special measures of the Factory Location Act and the Act on Formation and Development of Regional Industrial Clusters through Promotion of Establishment of New Business Facilities, etc.).
- Preferential measures to promote projects in the comprehensive special zones are successively added by national and local councils, which discuss the matter together and then revise the law, government ordinance, ministerial ordinance or notification based on the regulations.

#### (2) Financial support measures

Budgets of related ministries and agencies will be preferentially utilized, and flexibly topped up from the reserve fund for promoting comprehensive special zones.

#### (3) Preferential tax measures (International Strategic Zone)

The following measures are selectively applied:

- An investment tax credit or special depreciation is available upon acquisition of machines, buildings, etc. to be used for business in a comprehensive special zone.
  - Investment tax credit: 15% of the acquisition cost (8% for buildings)
  - Special depreciation: 50% of the acquisition cost (25% for buildings)
- A tax deduction of 20% exemption on income is available for enterprises that exclusively conduct business in a comprehensive special zone, based on the preferential legal measures.

#### (4) Financing support

• An interest subsidy (not exceeding 0.7%, for 5 years) is available on loans made by a government-designated financial institution for conducting business in a comprehensive special zone.

# Local Support Systems

## 0

#### Exemption from prefectural taxes for business establishments in Ibaraki Prefecture

Business establishments that set up a new office (factory, plant, etc.) in Ibaraki Prefecture and additionally hired at least five employees by March 2015 may be exempted from prefectural taxes.

- The enterprise tax on corporations may be exempted for three years depending on the percentage of employees additionally hired for opening the new office (factory, plant, etc.).
- The real estate acquisition tax may be exempted for buildings and land (the part on which the building is built) related to the opening of the new office (factory, plant, etc.).

#### Tax exemption for bodies engaged in one or more strategic zone projects

- 1) Corporate bodies that engage in projects in the international strategic zone and receive the national preferential tax measures by March 2016 may be exempted from real estate tax and city planning tax.
  - Exemption from real estate tax and city planning tax related to the corresponding building, machinery, equipment and land for up to 3 years
- 2) A deduction for real estate tax and city planning tax is available to those who provide land for verification experiments by March 2016.

#### Tsukuba City Subsidy for stimulating industries

A subsidy equivalent to the real estate tax of the office is available to those who open a new office (factory, plant, etc.) in the city by March 2015.

• A subsidy equivalent to the real estate tax on the land, building and depreciable assets of the new office (factory, plant, etc.) is available depending on the number of employees additionally hired for opening the new office (factory, plant, etc.).

#### For more information, please contact:



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