Introduction of some Research of Integrated Research System for Sustainability Science (IR3S)

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Contents

- Integrated Research System for Sustainability Science (IR3S)

- Research Projects
  1. Membrane Technology
  2. Small Wind Turbine

Background Concepts

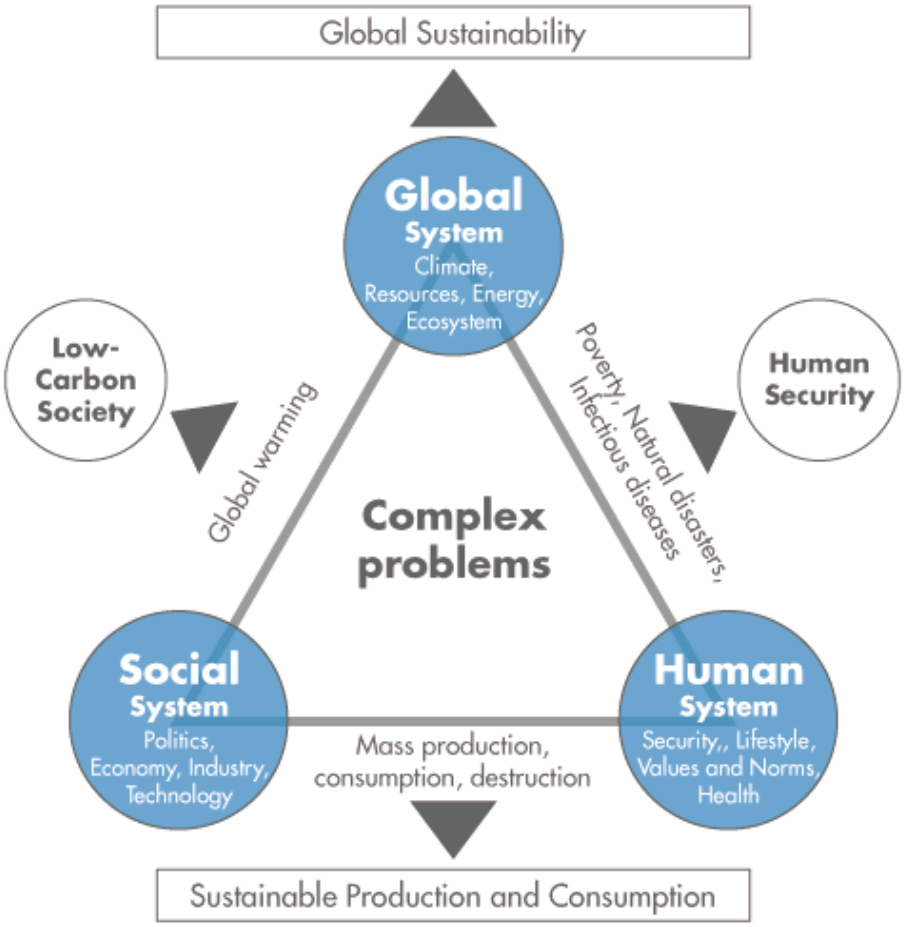
- New type of Issues (Global Warming, Sustainability etc) becomes urgent!
- A single discipline is not sufficient.
- INTEGRATION of Knowledge is critical.
- Explosion of Knowledge !
- Difficult to reach the right knowledge.
- Structuring Knowledge and networking of Knowledge

Objectives & Management Plan

IR3S

- Aims to create a network-type platform for world-class research and education in the field of sustainability science.
- Issue-driven Approach!
- Coordination of disciplines
- Linkage to Society and Outreach
- A New Eduaction Program

Approach



Concept of Sustainability

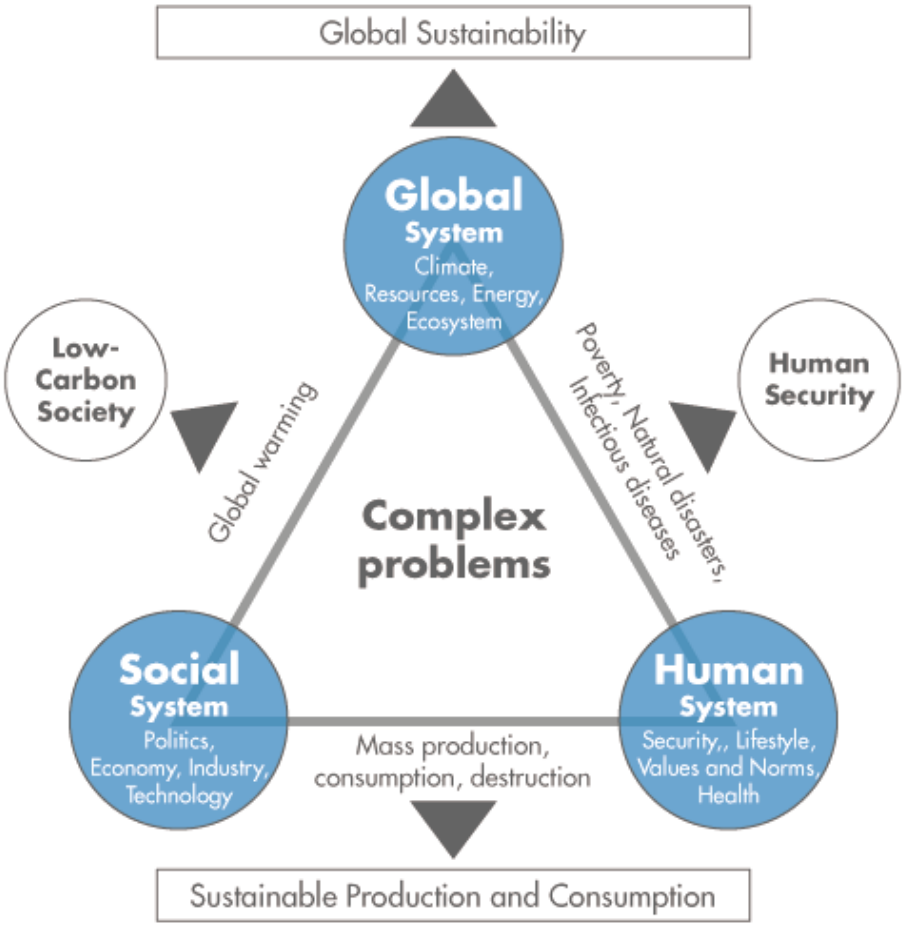
Repairing global, social, and human systems

- Global systems: resources, energy, and ecosystems that support human life;
- Social systems: national economies, governments, industries, and technological structures;
- Human systems: individual lifestyles, health, security and safety, and human values.

Today's global problems arise from the close interaction among these three systems.

Sustainability science first seeks to understand the mechanisms that damage these systems and the linkages among them, then proposes visions and methods for repairing.

Approach



Concept of Sustainability

The novelty of Sustainability science

- Simultaneously understanding and solving problems,.
- Brings together the natural sciences, social sciences, and humanities, and defines and structures problems.
- Disseminates the results of research to society and the individuals to achieve a sustainable society.

Flagship Projects (FP)

IR3S promotes flagship projects as a means of integrating activities by the five partner universities.

- Establishment of conceptual principles for sustainability science

  The process of “Structuring,” which sorts out broad range of information and identifies important issues, will be essential to developing sustainability science as a new discipline.

- Sustainability science research projects

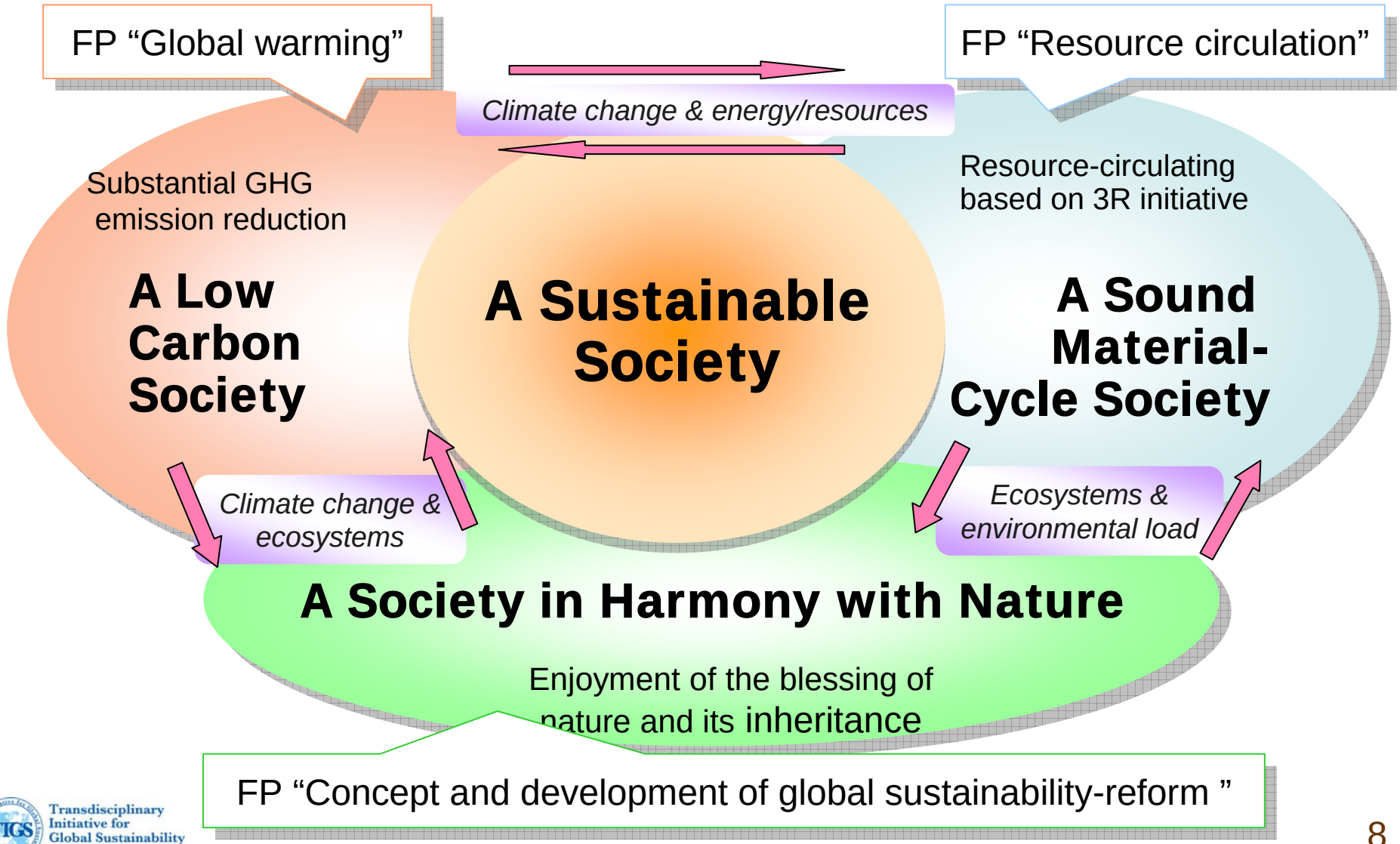
  1. Sustainable Countermeasures for Global Warming
  2. Development of an Resource-Circulating Society
  3. The Conceptual Framework of Global Sustainability: Appropriate Reform of the Socioeconomic System and the Role of Science and Technology

- Sustainability science education programs

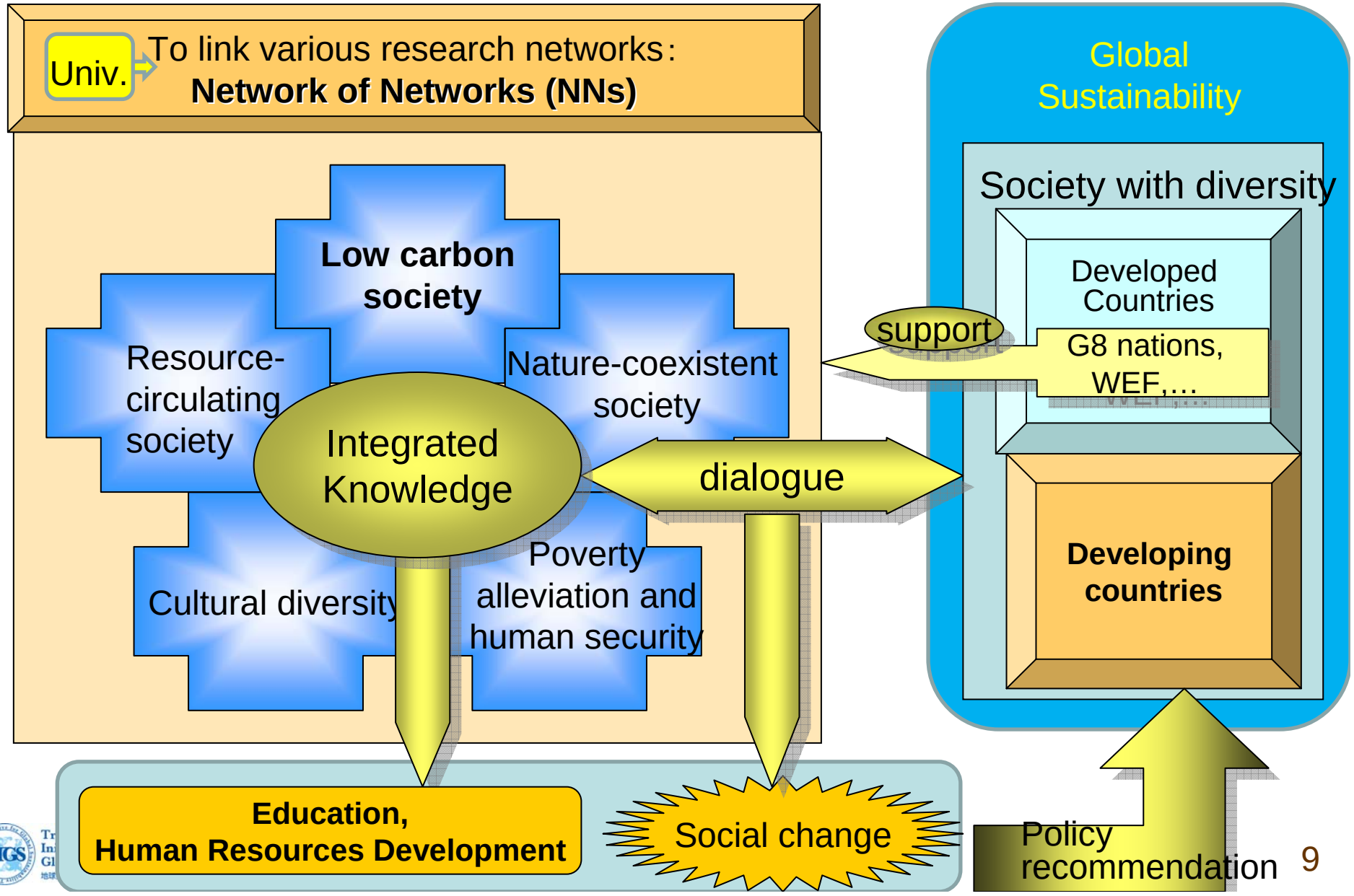
  English-based master’s program that aims to develop international experts with the capacity to understand diversity, internationality and interdisciplinarity.

Transdisciplinary Initiative for Global Sustainability

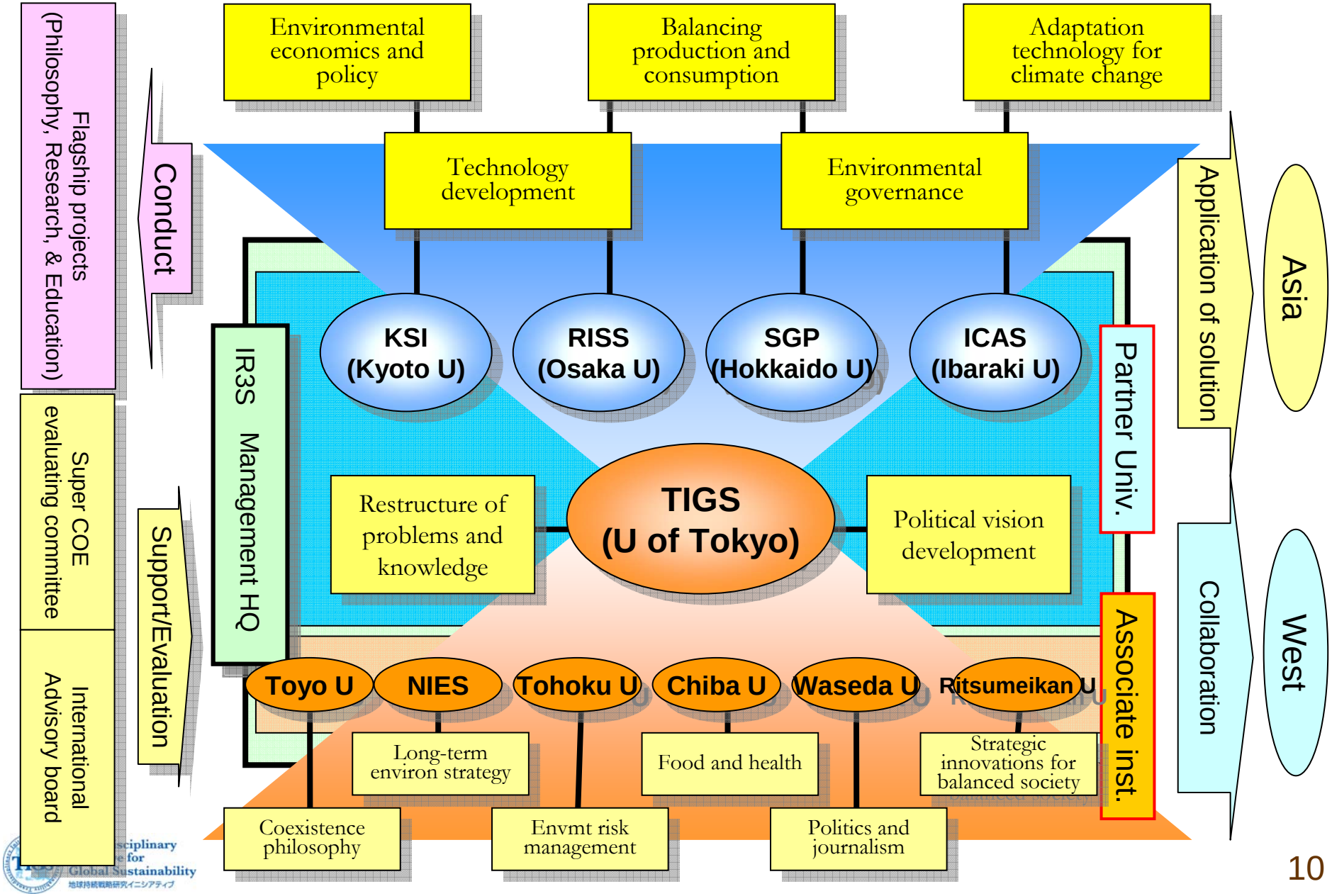
Toward the establishment of Sustainability Society



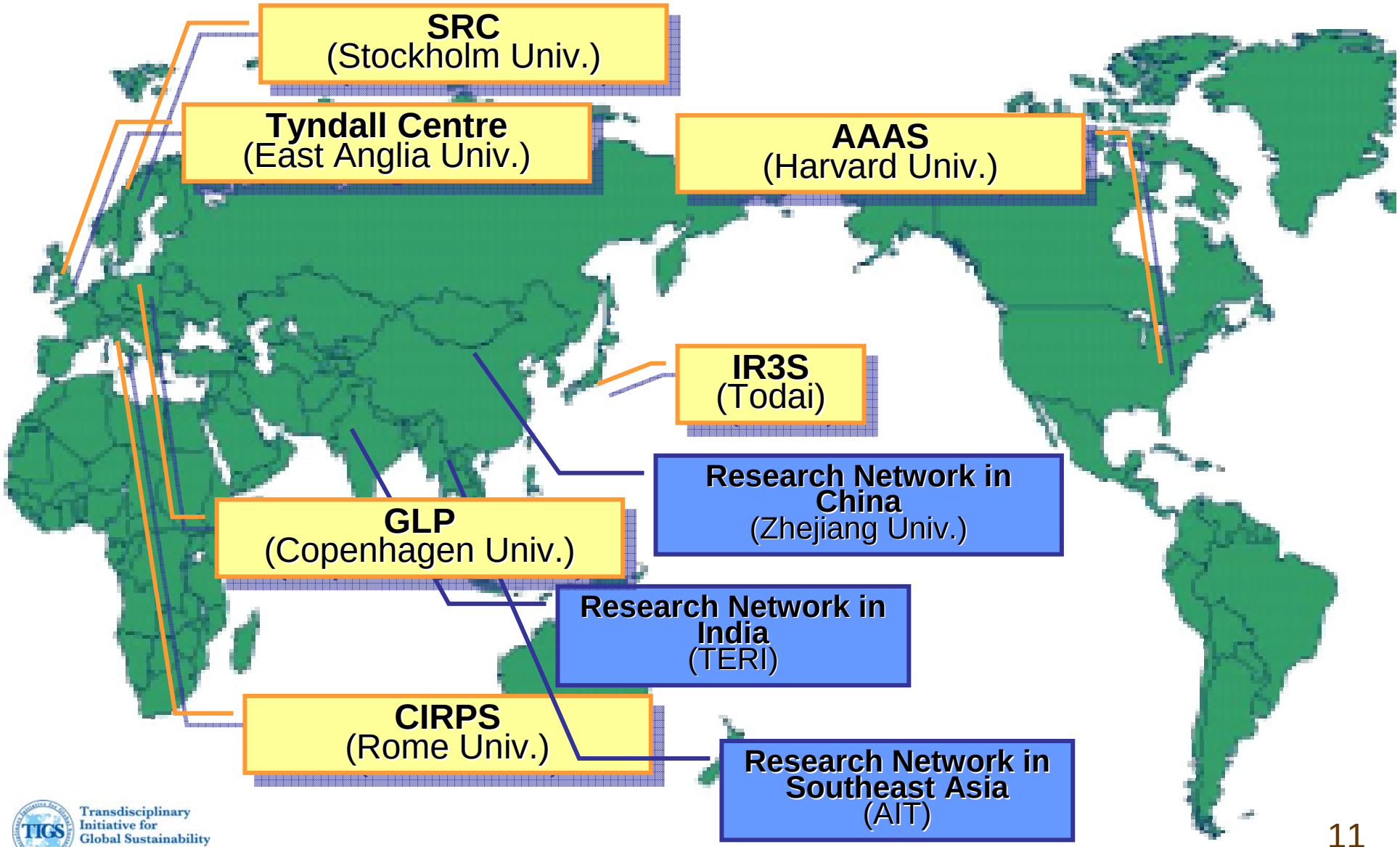
Knowledge Innovation for Global Sustainability



Integrated Research System for Sustainability Science (IR3S)

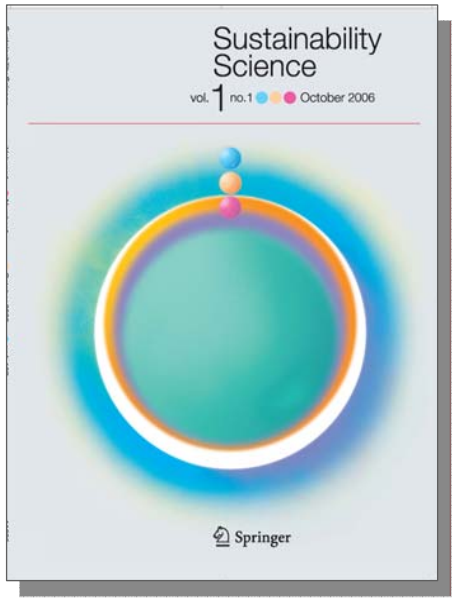


Establishing strategy for global sustainability in the 21st century through collaboration amongst international research networks



Transdisciplinary Initiative for Global Sustainability

Journal “Sustainability Science”



Please visit IR3S website for more info.
http://www.ir3s.u-tokyo.ac.jp/journal.html

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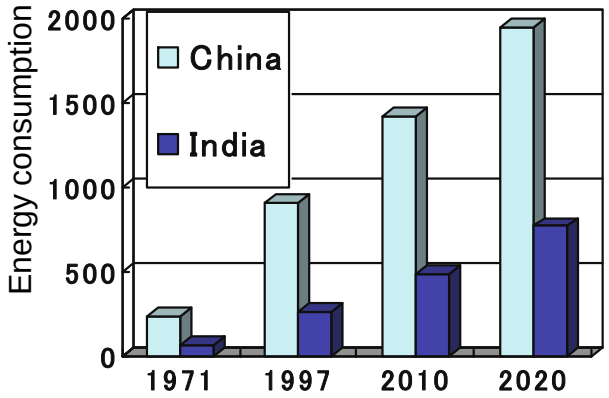
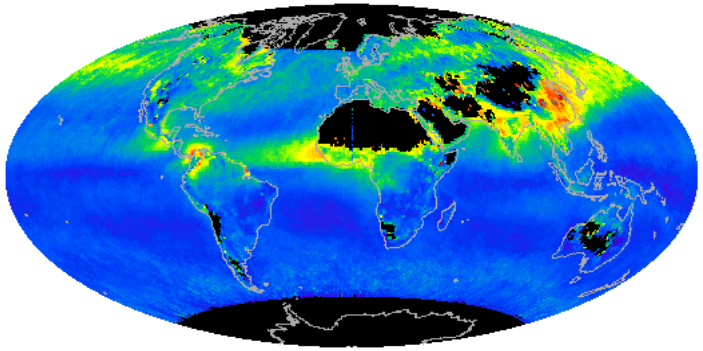
Our Strategy of Technology Development for Sustainable Society

Asia: a key to global sustainability

Booming of energy demand



Asia: a key to global sustainability



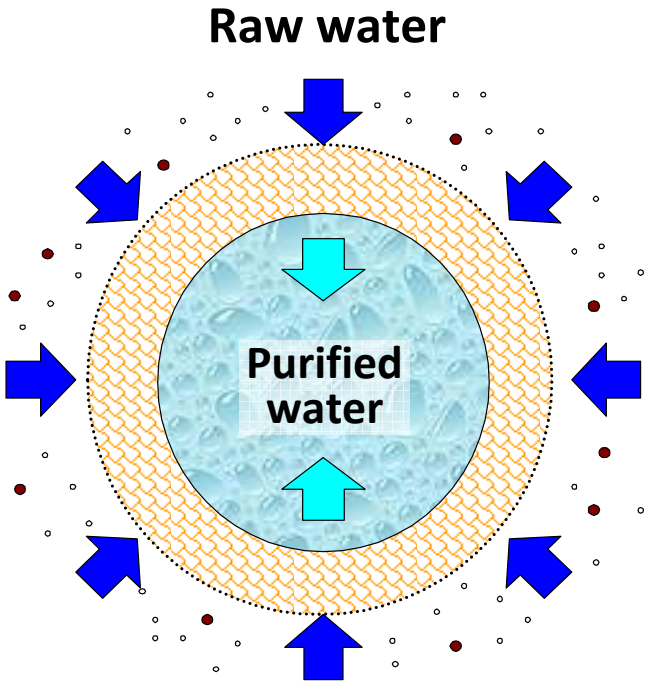
- Poverty Issue
- Not a high-tech.,
- Less expensive technology is importantfor low-income society!

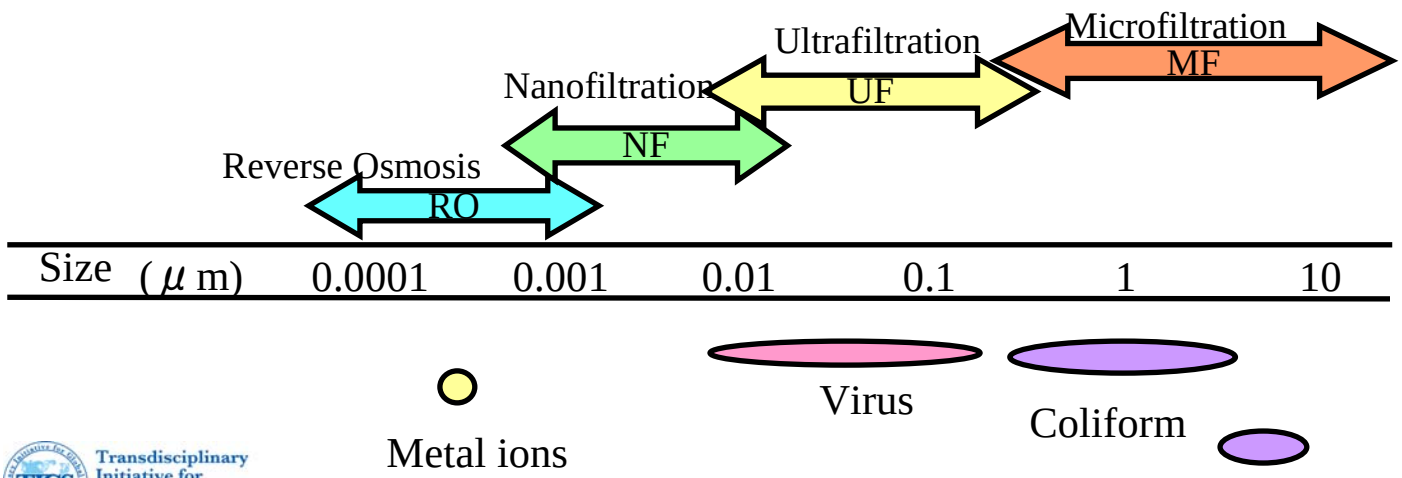
Two examples of technologies developed by UT

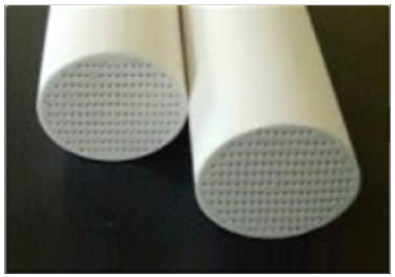
- **Membrane technology**
- **Small Wind Turbine**
- **Not expensive**
- **Maintenance-free**
- **Not a large system, but Distributed System**

Membrane technology:
a dream technology for water/wastewater treatment

- Filter dirty water to make clean water
- Remove pathogens and various pollutants almost completely
- Treated water is reusable

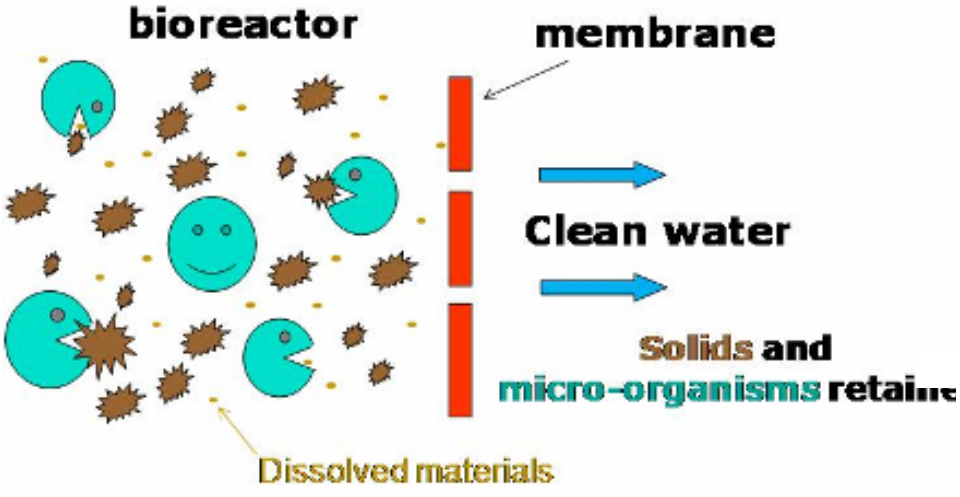


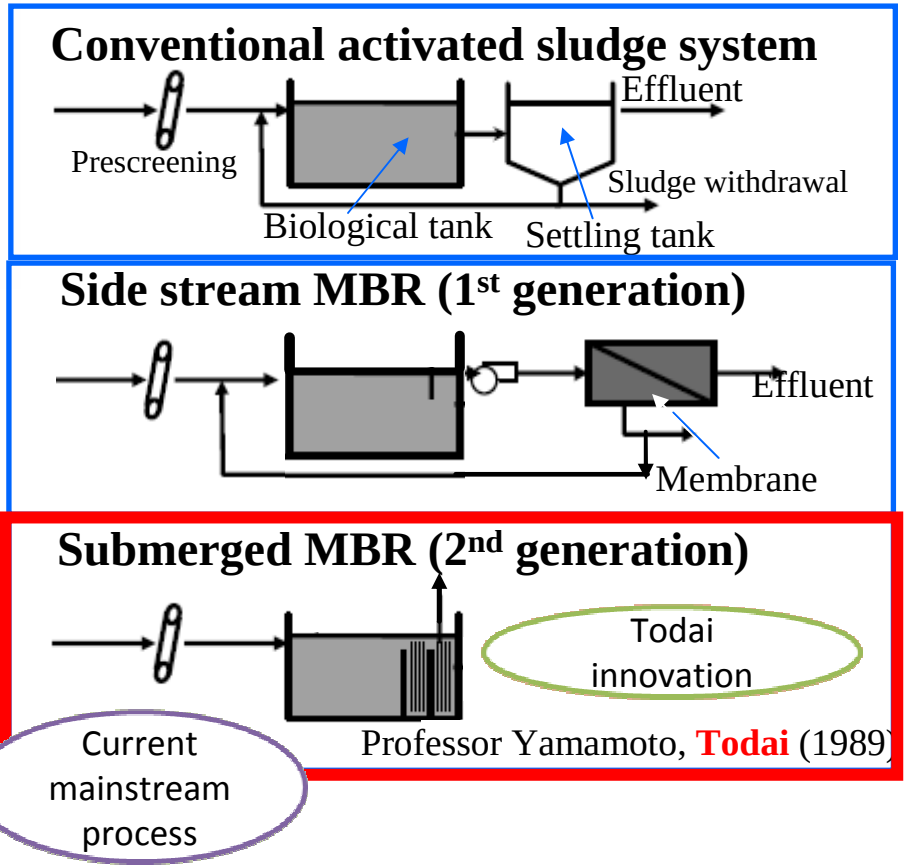




Ceramic membrane for drinking water

Membrane technology for wastewater treatment: Membrane bioreactor (MBR)



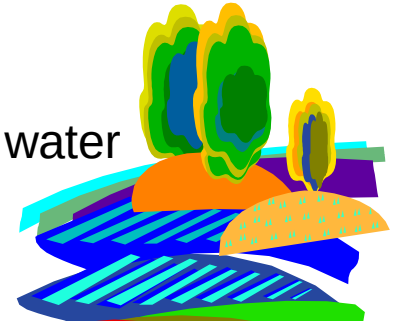


- Principle:
- Microorganisms consume organic pollutants
- Filtered effluent is very clean

- Membrane for MBR does not need to use high-quality membrane
- Any country which can produce polyethylene textile can manufacture membrane module for MBR

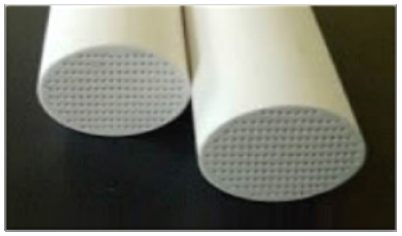
Application of membrane technology for water purification in rural area: removal of pathogens

Surface water



Groundwater

Contaminated surface/groundwater



Ceramic membrane for drinking water
(photo provided by Metawater Co.)

Coarse ceramic membrane for safe drinking water economically and reduce significant amount of pathogen

Ceramic membrane lasts for more than 10 years: extremely durable
Old ceramic membrane is easy to dispose (just crash, it turn to soil again)
Japan has advantages for manufacturing ceramic membrane

Small Wind Turbine

1. Feature of Wind Turbine (WT)

Solar Energy	proportion by Area
Wind Turbine	proportion by the cube of the wind velocity
Micro Gas Turbine	need fossil fuel

→ With same technology, wind turbine can get high power when it is used under the condition of enough wind velocity.

Small Wind Turbine

2. Why small?

Distributed Energy System vs. Energy GRID System

- Characteristics of Energy GRID
  - Efficient and Stability
  - Expensive
- Characteristics of Distributed Energy System
  - Suitable for developing countries
  - Relatively inexpensive
  - Inefficient

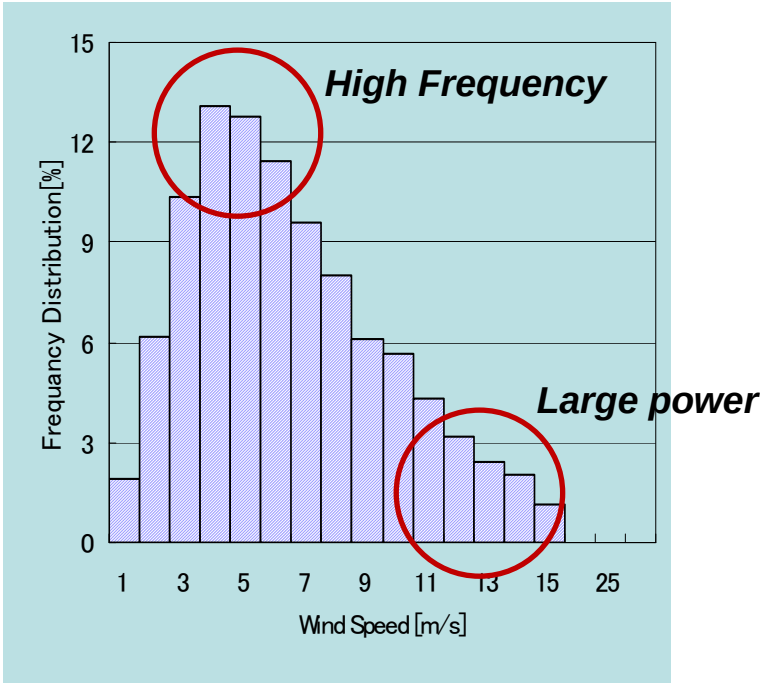
Issues

- High performances
- Acceptability : Safe, Easy to build (maintenance), Low pollutions

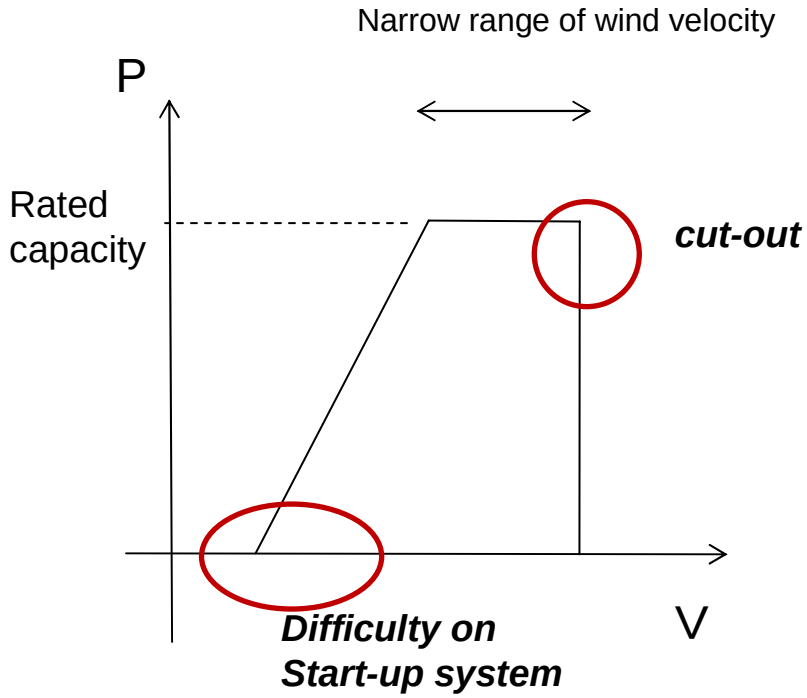
Feature compared to Large WT

- High performance under wide wind speed range
- A broad range of needs with wide application possibilities
  - Low/Middle wind velocity
  - Less constrain by landscape
  - Low noise
  - Stand-alone use in remote places
  - Simple construction

Issues for high performed WT



Frequency distribution of wind speed



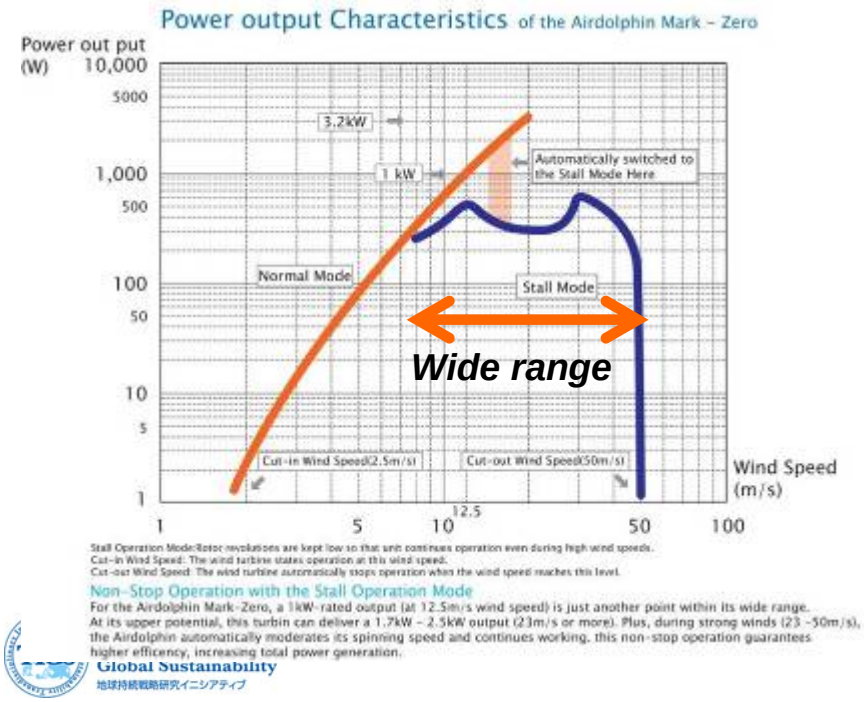
General Power Curve

Wide wind speed range

High Performance 1kW Small Horizontal-axis Wind Turbine：“Air Dolphin”

Wide wind speed range

- Without reliable brake system, no high operation mode above 30m/s up to 50 m/s is possible.
- Thanks to the rigid carbon blades, the rotor has no cut-out speed, which means Airdolphin may work under storms.



- Light and strong **full-carbon** blades to attain high response
- Multi-stagger design to achieve **high start-up** at low wind speed region

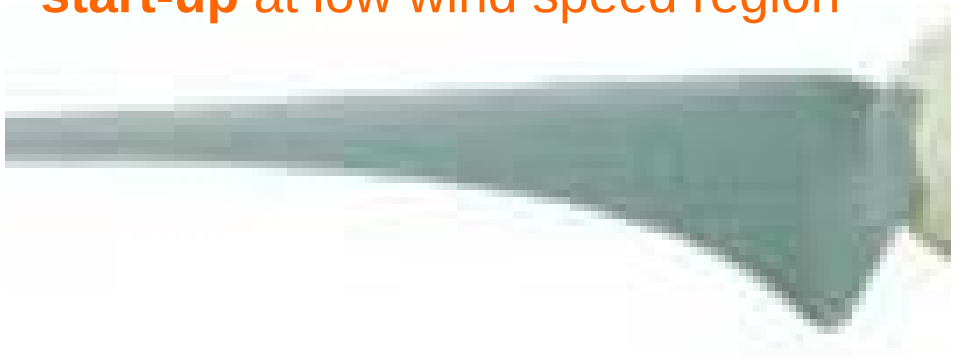
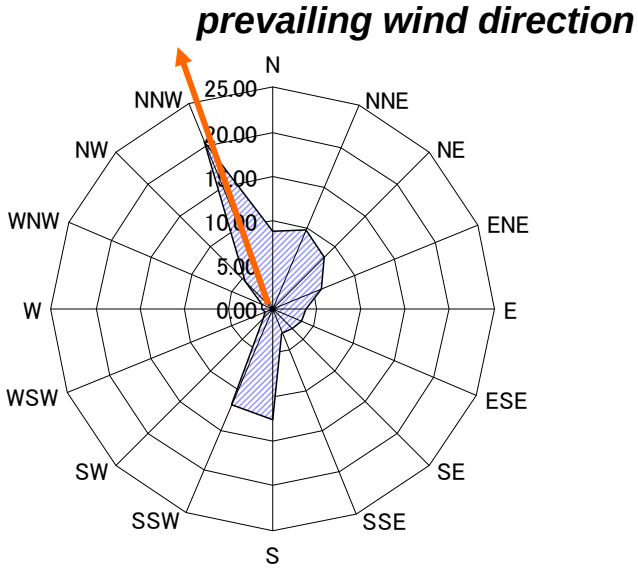


Fig. Power Generating Capability of the Airdolphin Mark-Zero

（Pic by Zephyr Co.）

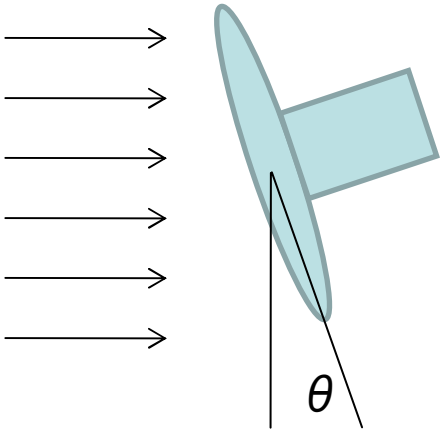
Issues for high performed WT

Reduce Yow Error

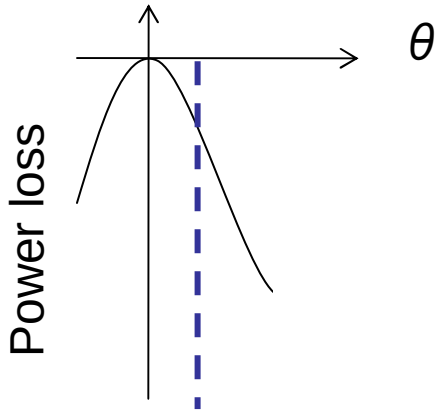


wind rose

Fluctuation of wind direction makes Yow error



Yaw error



If yow error angle is 30 degree, then 50% power loss occurs.

swing rudder system for yaw control

- The tail wing is hinged free to swing flexible under random wind direction change.

High Performance 1kW Small Horizontal-axis Wind Turbine : “Air Dolphin”

Acceptable:
- Safe
- Low Pollution
- Maintenance Free

An Innovation for Low Noise :
“Silent Disrupter Blade“ inspired by the wings of owe

Robust Body with No Screw:
inspired by traditional japanese crafts

（Photo by Zephyr Co.）

Experimental studies

Truck Tests
A data acquisition system on the vehicle collects all the operational data of the wind turbine.

Round Robin Testing

Demo. sites:
Spain, China, Bulgaria, Scotland, Italy, Japan

In the city

Compared to Large WT

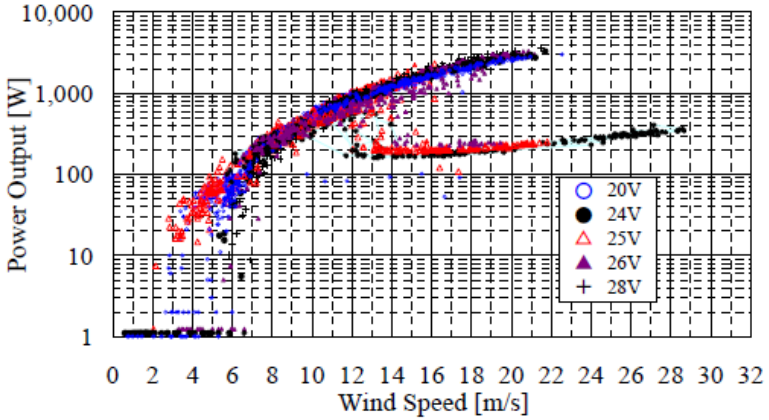


Fig. Power Performance of Airdolphin by track test

mountainous areas

General Households

Matsumiya, et. al. “The Dynamic Wind Power Captureability of a High Performance SHWT：Zephyr's "Airdolphin“”, Global Windpower 2006 in Adelaide, Australia

These technologies can and will be ....

- Applied to developing countries
- Co-Benefit
- ODA
- Easy-maintenance
- Distributed System, not a large system

Thank you