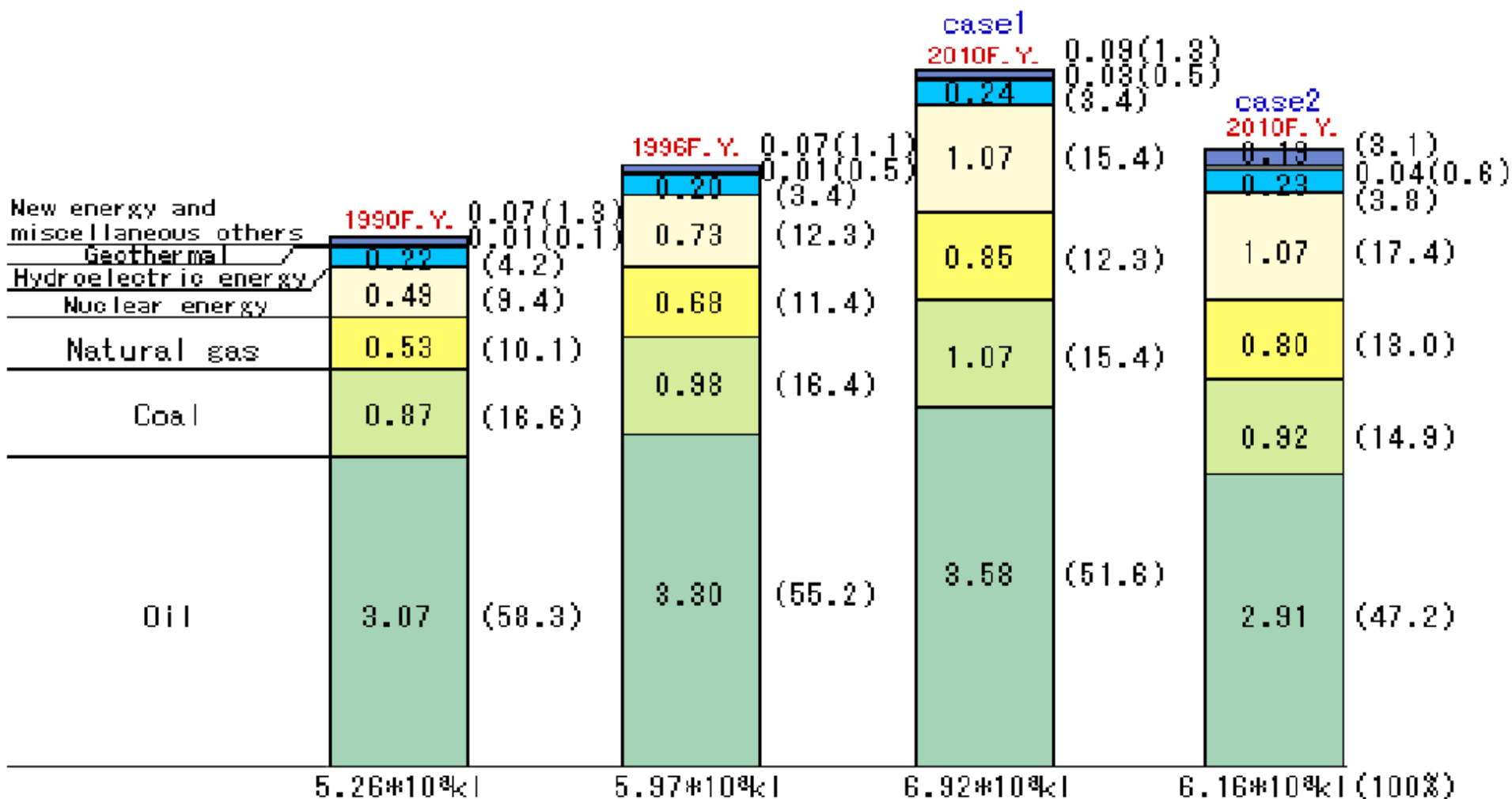


# Long-term Outlook for Energy Supply and Demand. (from HP of NEDO <http://www.nedo.go.jp>)



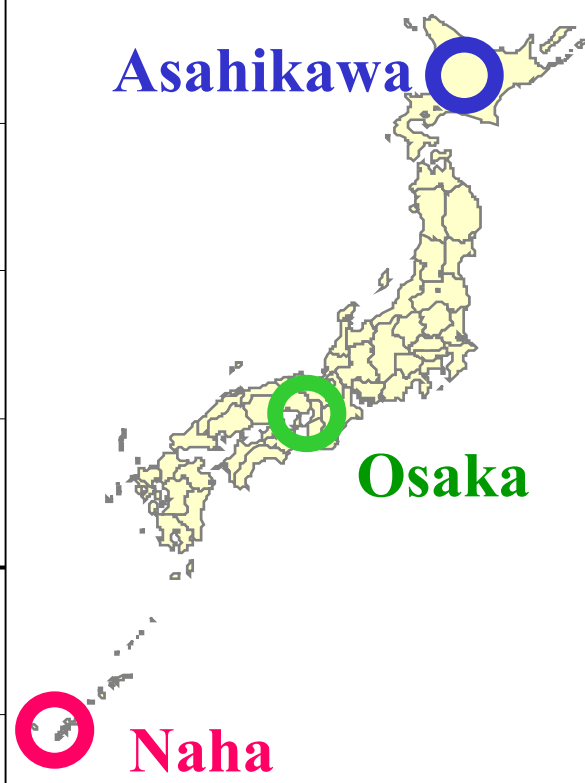
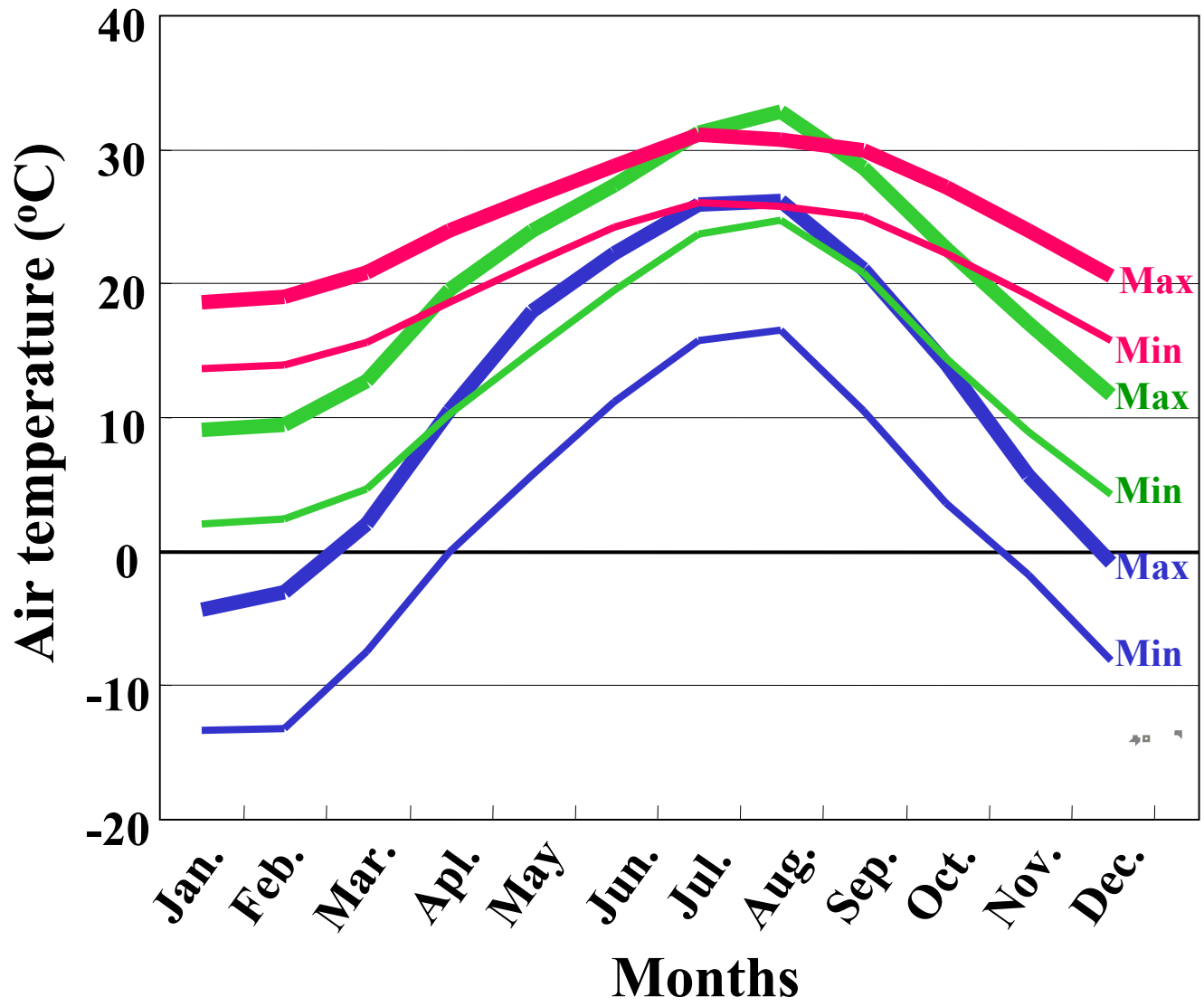
Note: "New energy and miscellaneous others" includes solar energy, oil sand, shale oil, alcohol-based fuels, oil from liquefied coal, pulp waste, firewood and charcoal.

(Unit)

New energy and miscellaneous others...1 million kl  
 Coal...1 million t  
 Geothermal...1 million kl  
 Hydroelectric energy...1x10<sup>9</sup>kWh  
 Natural gas...1 million t  
 Nuclear energy...1x10<sup>9</sup>kWh  
 Oil...1 million kl  
 Rate of conversion into crude oil is 9,250kcal/l

# Outlook for New Energy Supply (from HP of NEDO <http://www.nedo.go.jp>)

....ITEM	.unit	1990	1996	...2010	
				CASE1	CASE2
<b>Photovoltaic</b>	<b>MW</b>	<b>9</b>	<b>57</b>	<b>230</b>	<b>5000</b>
	<b>mill.kL</b>	<b>0.002</b>	<b>0.014</b>	<b>0.060</b>	<b>1.220</b>
<b>Solar thermal energy</b>	<b>mill.kL</b>	<b>1.260</b>	<b>1.040</b>	<b>1.090</b>	<b>4.500</b>
<b>Wind power</b>	<b>MW</b>	<b>3</b>	<b>14</b>	<b>40</b>	<b>300</b>
	<b>mill.kL</b>	<b>0.001</b>	<b>0.006</b>	<b>0.020</b>	<b>0.125</b>
<b>Waste combustion</b>	<b>MW</b>	<b>480</b>	<b>890</b>	<b>2130</b>	<b>5000</b>
	<b>mill.kL</b>	<b>0.440</b>	<b>0.820</b>	<b>2.820</b>	<b>6.620</b>
<b>Heat from solid waste</b>	<b>mill.kL</b>	<b>0.037</b>	<b>0.044</b>	<b>0.120</b>	<b>0.140</b>
<b>Temp. difference energy</b>	<b>mill.kL</b>	<b>0.018</b>	<b>0.033</b>	<b>0.090</b>	<b>0.058</b>
<b>Heat from liquid waste</b>	<b>mill.kL</b>	<b>5.030</b>	<b>4.900</b>	<b>5.170</b>	<b>5.920</b>
<b>Total</b> <b>(Primary power supply)</b>	<b>mill.kL</b>	<b>6.79</b>	<b>6.85</b> <b>(1.1%)</b>	<b>9.40</b> <b>(1.3%)</b>	<b>19.10</b> <b>(3.1%)</b>

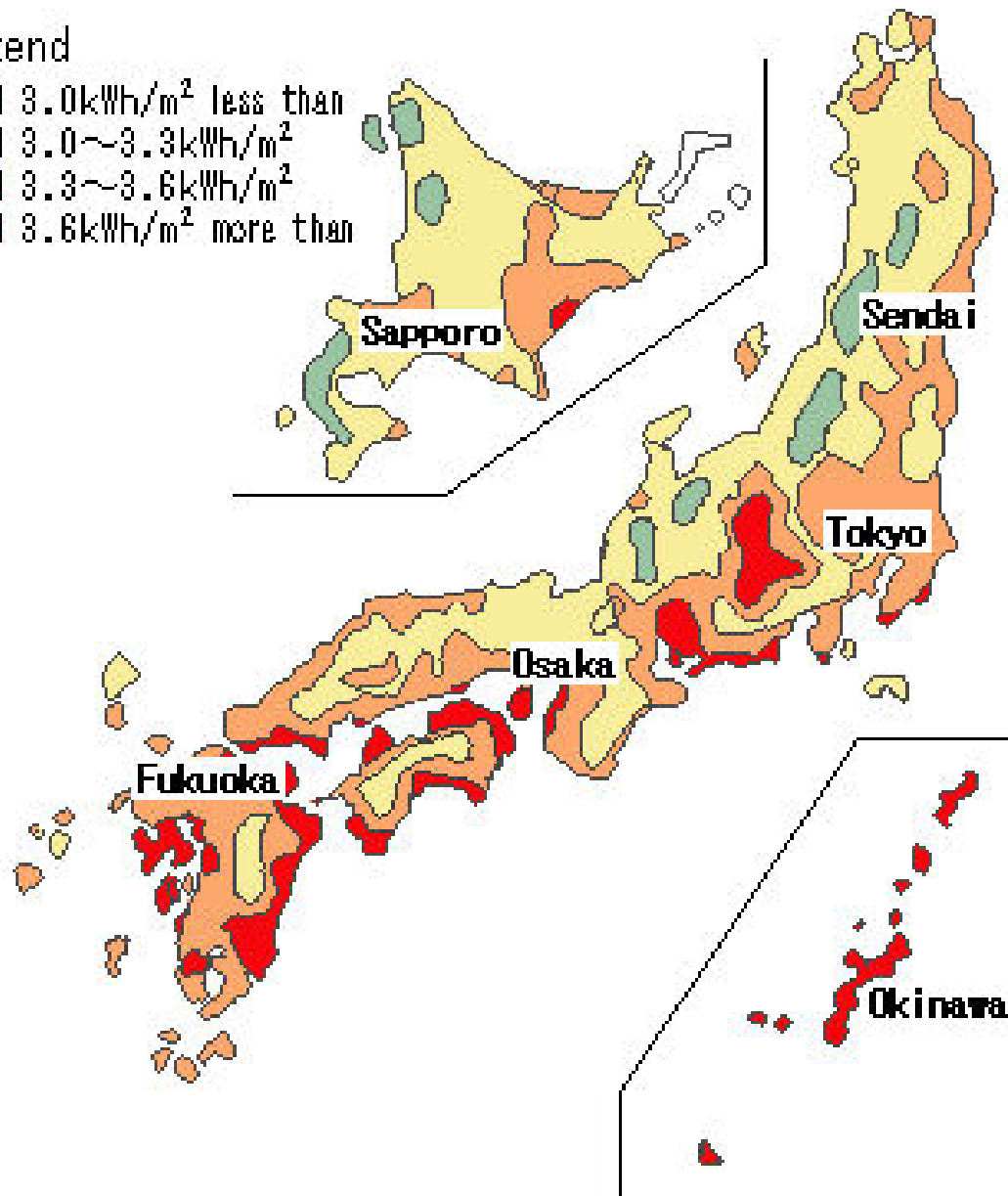


# Irradiance map in Japan (daily average 1961-1990)

(from HP of NEDO <http://www.nedo.go.jp>)

## Legend

- 3.0kWh/m<sup>2</sup> less than
- 3.0~3.3kWh/m<sup>2</sup>
- 3.3~3.6kWh/m<sup>2</sup>
- 3.6kWh/m<sup>2</sup> more than



# **Current technologies for conserving and recycling energy in plant growth facilities in Japan**

- Energy efficient lighting systems**
- Utilization of cheap off-peak electricity**
- Spacing systems for efficient use of plant culture space**
- Air conditioners with inverter fan systems**
- Combined systems with feedback and feedforward control systems**
- Co-generation system**
- Control of solar shading with shading screens or reflection glass for cooling**
- Efficient ventilation systems for cooling**
- Solar panel systems for heating with hot water**
- Use of heat from waste combustion for heating**
- Highly airtight and thermal insulation structure for reducing heat loss, etc.**



(Koito Industries Ltd.)

**Glass**

**Solar reflecting film**

**Glass**



# **New technologies for conserving and recycling energy in plant growth facilities in the near future**

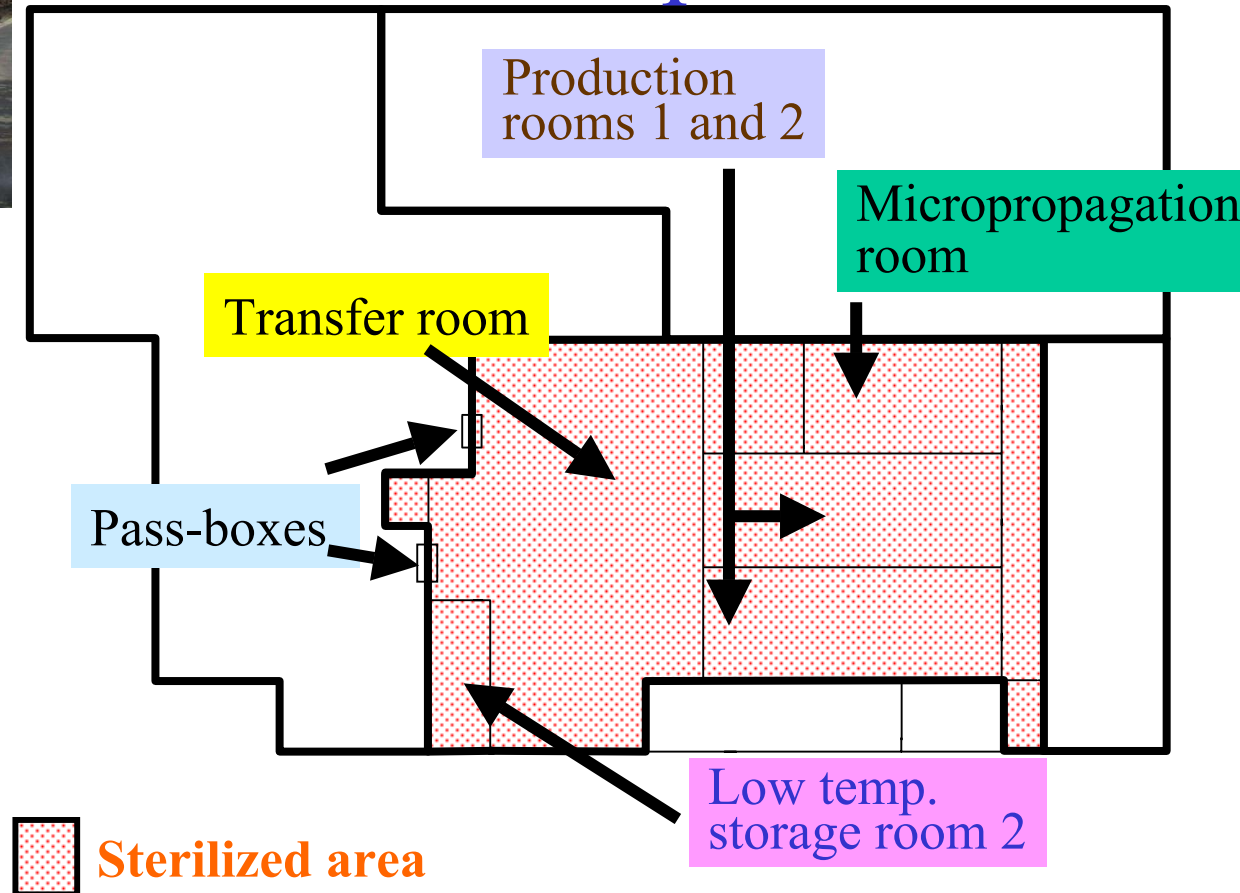
- Co-generation system with absorption chilling system**
- Solar cell systems and other electric generation systems**
- Use of ice-melting heat for cooling. The ice is made with discount electricity in the nighttime**
- Use of newly developed autonomous response type dimming glass known as thermo-tropic glass for shading**

# Closed Transplant Production System at Chiba University

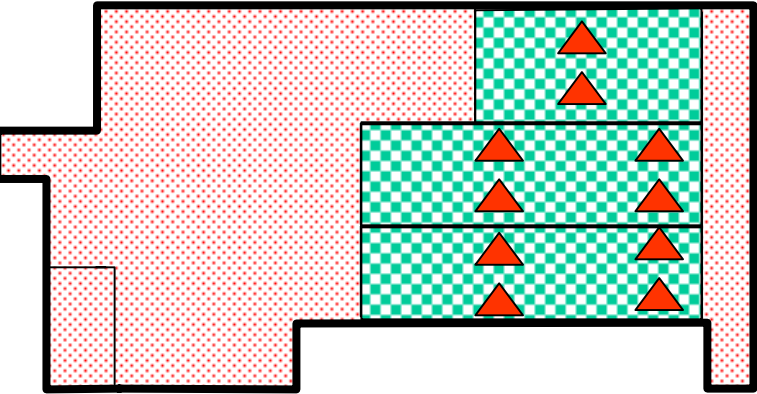
(by C. Chun and T. Kozai)



## Floor plan







10 multi-layered “basic modules” in micro-propagation room and production rooms

7 layers each module

(Chun and Kozai, 2000)



# Fluorescent lamps

The least expensive light source

Enough PPF for transplant production

High efficiency of “electrical energy to PPF”

Small amount of thermal radiation

Small size

No spectrum problem





## **Plant factory system** *by Mitsubishi Electric Co. and Morihisa Eng. Co.*

**Floor area: 400 m<sup>2</sup>**

**Each culture bed: 1.8 x 4.5 m<sup>2</sup>**

**Layout of the beds: 8 shelves x 9**

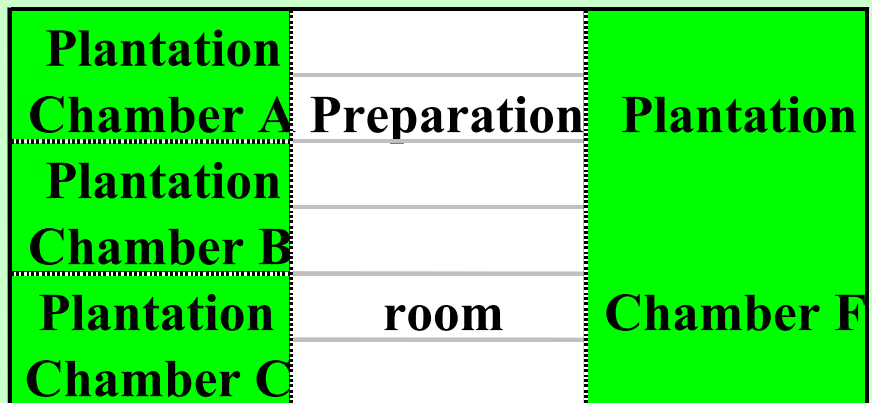
**Yield: 1,500 plants/day**

# Closed Ecology Experiment Facilities

**Institute for Environmental Sciences**

**(by Y. TAKO and K. NITTA)**

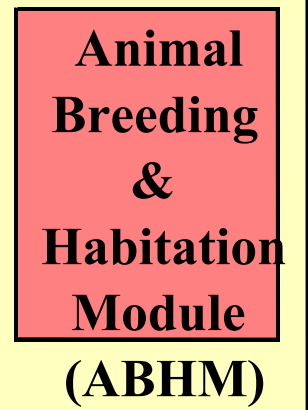




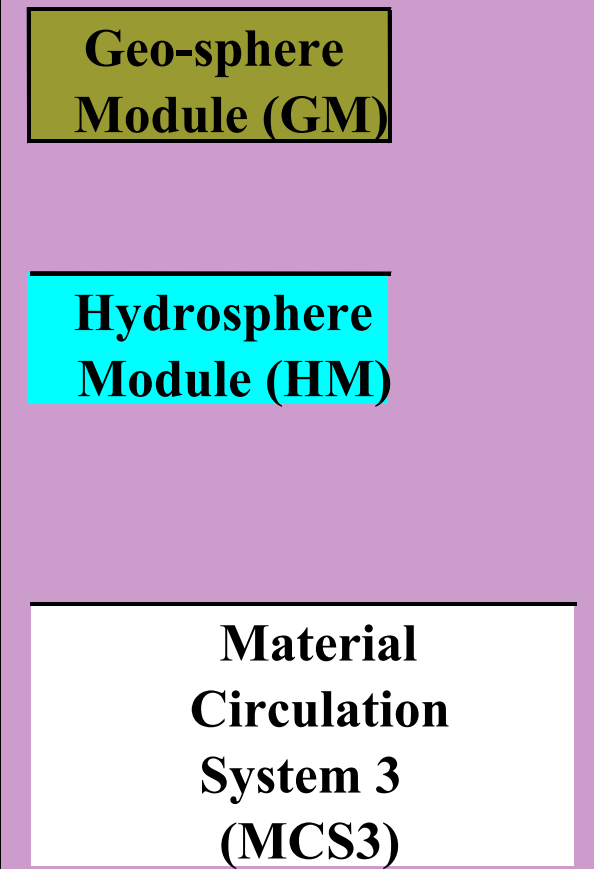
**Plantation Module (PM) with artificial lighting**

**PM with natural lighting**

**Material Circulation System 1 (MCS1)**



**Material Circulation System 2 (MCS2)**



**Closed Plantation Experiment Facilities (CPEF)**

**Closed Animal Breeding & Habitation Facilities (CABHF)**

**Closed Geo-Hydrosphere Experiment Facilities (CGHEF)**

**Configuration of the Closed Ecology Experiment Facilities (CEEF).**

(Tako, 2001)

# Biological and physicochemical systems in CEEF



**Plantation system**



**Material Circulation System**